Report on the strategic assessment of the relevant impacts of the Valga Municipality special plan, including environmental impacts

FIRST STAGE REPORT

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Title	**First stage report on the strategic assessment of the relevant impacts of the special plan for Valga Municipality, including environmental impacts**
	Strategic assessment of the relevant impacts of the Valga Municipality Special Plan, including environmental impacts
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Summary of the report

The strategic planning document subject to this strategic environmental assessment (hereinafter *SEA*) is the Valga Municipality special plan for finding a suitable location for a wind farm planned for the territory of Valga Municipality. This is the preliminary selection stage[(1) of] the special plan.

The preparation of the Valga Municipality special plan and strategic environmental assessment was initiated by Valga Municipal Council Resolution No. 81 of 25 October 2023, 'Initiation of a local government special plan and strategic environmental assessment'. The reason for initiating the special plan was the applications submitted by Sunly Wind OÜ (registry code 14937897) and Eurowind Energy OÜ (registry code 16584180) to initiate a special plan for the local government in Valga Municipality in order to find the most suitable location for the construction of a wind farm and the infrastructure necessary for its operation. Sunly Wind OÜ submitted a corresponding application on 31 August 2023 for an area of 7,400 ha, and Eurowind Energy OÜ submitted a corresponding application on 9 October 2023 for an area of 2,800 ha. The purpose of drawing up the EP is to select the most suitable locations in the planning area for the construction of the wind farm and the infrastructure necessary for its operation, and then to determine the building rights for the selected locations and to resolve other relevant tasks specified in § 126(1) of the Planning Act (hereinafter *PlanS)*.

Based on Valga Municipal Council Decision No. 96 of 31 January 2024, Municipal Council Decision No. 81 of 25 October 2023 was amended. Pursuant to Decision No. 96, Eurowind Energy OÜ submitted an application to the Valga Municipal Government on 29 November 2023, withdrawing the application for the initiation of a local government EP and SEA for the planning of a wind farm and proposing that on 24 October 2023 to terminate the preliminary agreement (No. 8-1.10/136) concluded with the Valga Municipal Government on 24 October 2023 for the commissioning of a local government special plan and the assessment of its impact, including the costs of a strategic environmental assessment. Valga Municipal Government considered the agreement between the parties to be terminated on the basis of an agreement between the parties. By decision No. 96 of the Valga Municipal Council, the entire planning area was reduced by 2,800 ha. The preparation of the local government's special plan and SEA will continue in the planning area, which covers approximately 7,400 ha and in which Sunly Wind OÜ is interested in preparing a plan.

The purpose of preparing the EP is to select the most suitable locations in the planning area for the construction of wind farms and the infrastructure necessary for their operation, and then to determine the building rights for the selected locations and to resolve other relevant tasks specified in § 126(1) of the Planning Act. The EP will be prepared with a degree of accuracy that will allow for the further planning of the wind farm with design conditions after its adoption.

The special planning area covers the northern part of Valga Municipality. The special planning area covers the following villages: Mustumetsa, Killinge, Kiviküla, Uniküla, Õruste, Tõlliste and Sooru. The area of the special planning area is approximately 7400 ha.

The maximum permitted height and number of wind turbines [2](hereinafter referred to as *wind turbines*) in the wind farm area will be determined during the preliminary selection of the location, based on the size of the suitable location and the effective placement of the wind turbines. The maximum height limit for wind turbines will be determined in cooperation with the Ministry of Defence.

The need to establish a wind farm arises from Estonia's climate and energy policy, the framework for which is set out in the document Climate Policy Fundamentals until 2050 ([3]) . Estonia's long-term goal is to balance greenhouse gas emissions and sequestration by 2050 at the latest, i.e. to reduce net greenhouse gas emissions to zero by that time. In the shorter term, Estonia has set a target that Estonia

[1] According to the Planning Act, the preliminary selection of a location involves choosing the most suitable location or area for the planned construction by considering various possible locations.

[2] According to the Electricity Market Act, an electric wind turbine is any production device that converts wind kinetic energy into electrical energy. In this plan and the SEA, it is assumed that the electric wind turbine is a three-bladed horizontal axis turbine as described in section 2.4.1.

[3]https://kliimaministeerium.ee/kliimapoliitika-pohialused-aastani-2050

could produce as much renewable electricity in 2030 as our total annual consumption[4]. In terms of onshore wind energy, such targets mean that by 2030, new wind farms with a capacity of at least 1GW must be built onshore[5]. It is possible that the need will be greater([6] .

The special plan being prepared is in line with Estonia's climate and energy policy objectives, including the Estonian Energy Sector Development Plan 2030+ and the Estonian Climate Change Adaptation Development Plan until 2030.

During the preparation of the SEA programme, a preliminary simplified map analysis of the Valga municipality special plan territory was carried out. The map analysis ruled out areas that were clearly unsuitable for wind farm locations. All areas protected under the Nature Conservation Act (protected areas, conservation areas, permanent habitats, including planned protected areas) and residential and public buildings within a 1000 m buffer zone based on data from the Estonian Topographic Database[7] (hereinafter *ETAK*) data, residential and public buildings within a 1000 m buffer zone.

The map analysis and preliminary opinions revealed that there are **potentially four areas** within the special plan territory that have no direct exclusionary factors for the further selection of the location of the object covered by the special plan and that have sufficient territory. A strategic environmental assessment was carried out for these areas.

The SEA revealed that, primarily for bird conservation reasons, area 1 (TU1) as a whole is unsuitable for use as a wind farm. Considering the natural values present in area TU1 and the possible combined effects with other potentially suitable areas on the connectivity of capercaillie habitats, the SEA report provides guidance not to select area TU1 as a location. In the case of areas 2 (TU2) and 3 (TU3), areas directly excluded from wind farm development for bird protection reasons were not zoned. In the case of Area 4 (TU4), the initial impact assessment zoned the potential feeding water body of the black stork, together with a buffer zone, as an area excluded from wind farm development for bird protection reasons. No wind turbines were planned for the excluded area 4 in the initial draft solution. In the parts of the SEA report that were assessed as unsuitable for the construction of a wind farm, either abandon further development activities or proceed only if a study of the habitat use of the relevant species confirms that it would be possible to establish a wind farm in the area without damaging the conservation objectives of the permanent habitat or protected area of the relevant species. In addition to the KSH report, the most representative wetlands, areas with habitat types in good condition under the Habitats Directive, valuable forest habitats, habitats of protected plant species, feeding waters important for bats, and forest communities. As the potentially suitable areas overlap with green network areas, the SEA report made recommendations for the functioning of the green network in order to maintain its coherence. A wind turbine location solution was drawn up for areas suitable for siting. The initial wind turbine layout plan was drawn up for 27 wind turbines, but the number of wind turbines was reduced to 23 based on feedback from the visual impact assessment workshop held in Tsirguliina on 25 July 2024 (see section 4.7.1). The draft plan for 23 wind turbines was assessed in the SEA report in all environmental aspects to be assessed, and measures were presented to be taken into account in the implementation of the plan to ensure the mitigation of significant adverse effects.

Based on the feedback received during the cooperation and opinion submission stage of the draft solution and SEA report, both the SEA report and the plan were supplemented. The most important aspect of the SEA report was the recommendation to further reduce the number of wind turbines to 18 as a mitigating measure to ensure connectivity between capercaillie habitats. The measure was developed in cooperation with bird experts and the Environmental Board. In the planning solution, it was decided to significantly reduce the size of the preliminary selection area 4 and, in connection with this, the number of wind turbines that could be planned there in order to ensure connectivity between capercaillie habitats.

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[4] Energy Economy Organisation Act § 32[1] https://www.riigiteataja.ee/akt/110102024005?leiaKehtiv

[5] State Chancellery. 2022. Audit on accelerating the development of renewable energy.

[6] ENMAK 2035 draft working version 13 November 2024 as of provides for the need for 2850 MW of onshore wind farms.

[7] https://geoportaal.maaamet.ee/est/Ruumiandmed/Eesti-topograafia-andmekogu/Laadi-ETAK-andmed-alla-p609.html

In order to assess the social and human health aspects of wind turbines, wind turbine noise modelling (see section 4.6.1), shadow modelling (see section 4.6.2) and a visibility analysis with visualisations (see section 4.7) were carried out. The assessment was carried out for a planning solution that took into account measures arising from the natural environment (i.e. a solution with 18 wind turbines([8]). Based on the modelling, recommendations were made in the planning solution to ensure a living environment that is as free from disturbance as possible.

Considering the accuracy of the special plan and its SEA, the SEA also determined the need for further studies necessary for the design of the wind farm, which may reveal the need for additional measures for the construction and operation of the wind farm.

[8] The initial assessment was carried out for a solution with 23 wind turbines, but in August 2025, the assessments concerning human health, well-being and property and visual impact in August 2025, based on a planning solution with 18 wind turbines.

1 General

1.1 Objective of the proposed activity

The strategic planning document that is the subject of this strategic environmental assessment is **the preliminary selection decision for the location of the Valga municipality wind farm special plan**. This is the preliminary selection stage[9] of the special plan.

The SEA is an assessment organised with the participation of the public and relevant authorities to identify the significant environmental impact associated with the implementation of the strategic planning document, to identify alternative options and to find measures to mitigate adverse effects. The results of the assessment are taken into account in the preparation of the strategic planning document and a report is prepared in accordance with the requirements. **The purpose of the SEA** is to take environmental considerations into account in the preparation and adoption of the strategic planning document in accordance with the Environmental Impact Assessment and Environmental Management System Act (hereinafter referred to *as the KeHJS)*, to ensure a high level of environmental protection and to promote sustainable development. This SEA report is a strategic environmental assessment of the preliminary selection of the location for the special plan**,** i.e. **the first stage of the SEA.** As the plan specifies the basic solution for the wind farm, the impacts have been assessed with a degree of accuracy corresponding to the level of detail of the plan.

Pursuant to § 95(1) of the Planning Act (hereinafter *PlanS*), a special plan shall be prepared by the local government (hereinafter *LG*) for the construction of a building with a significant spatial impact if the location of the building with a significant spatial impact is not specified in the comprehensive plan. According to Regulation No. 102 of the Government of the Republic of 1 October 2015
"List of buildings with a significant spatial impact", a wind farm consisting of wind turbines with a height of more than 30 metres is considered a building with a significant spatial impact.

The purpose of establishing wind farms (hereinafter *referred to as wind farms*) (planned activity) is to generate electricity from wind and feed it into the main grid. The need to establish wind farms stems from the agreement between the Member States of the European Union on long-term climate goals, whereby each country, including Estonia, has committed itself to moving towards a cleaner and carbon-neutral future. Estonia has set a target that, in order to meet its climate goals and ensure energy security, it will produce as much renewable electricity in 2030 as our total annual consumption([10]. To achieve this, new wind farms with a capacity of at least 1 GW must be built on land([11].

1.2 Parties

The parties involved in the preparation of the special plan and SEA are as follows:

- The initiator and establisher of the special plan and SEA is the Valga Municipal Council, and the compiler and organiser of the special plan is the Valga Municipal Government (Valga County, Valga Municipality, Valga City, Puiestee tn 8, 68203);
- The consultant for the preparation of the special plan is AB Artes Terrae OÜ (Tartu County, Tartu City, Tartu City, Küütri tn 14, 51007; e-mail:heiki@artes.ee ; tel: +372 509 1874; contact person: Heiki Kalberg);
- The SEA is being prepared by LEMMA OÜ (Harju County, Tallinn, Kristiine District, Värvi tn 5, 10621; e-mail:info@lemma.ee ; tel: +372 505 9914).

The SEA working group consists of:

[9] According to the Planning Act, the preliminary selection of a location involves choosing the most suitable location or area for the planned construction by considering various possible locations.

[10] Energy Economy Organisation Act § 32[1] https://www.riigiteataja.ee/akt/110102024005?leiaKehtiv

[11] State Chancellery. 2022. Audit on accelerating the development of renewable energy.

- Piret Toonpere – SEA lead expert/EIA expert (KMH0153) – socio-economic impacts, shadowing, noise, visualisations, Natura assessment, comparison of alternatives; the lead expert has the right to manage the SEA in accordance with § 34(4) of the KeHJS;
- Heli Aun – environmental consultant – compilation of environmental description, deposits, impacts on the natural environment, issues related to hydrogeological conditions and cartography;
- Andrus Veskioja – environmental consultant – impact on climate change;
- Mihkel Vaarik – environmental consultant – impact on soil, water regime and aquatic environment;
- Astrid Koplimäe – environmental consultant – visual impacts, including fieldwork necessary for the preparation of photomontages;
- Laura Elina Tuovinen (participated in the working group until 08.2024) – environmental consultant – impact on the natural environment, including green networks and protected areas; compilation of WindPro models;
- Helen Opp (participating in the working group since 08.2024) – environmental consultant – compilation of WindPro models.

The impact on birds and bats, including the necessary analyses and fieldwork, was carried out by the Loodusekspert OÜ working group led by Ants Tulli. The relevant areas were integrated into the SEA report and, where necessary, updated by the SEA lead expert.

The vegetation inventory of the possible construction areas according to the preliminary draft of the wind farm and their immediate vicinity was carried out by a working group from Midges OÜ led by Liisi Peets. The relevant areas were integrated into the SEA report by the SEA lead expert.

In 2025, in addition to the planning solution and SEA, Meelis Leivitsa prepared an expert opinion on the impact of the Valga wind farm on the local capercaillie population. The expert opinion was used to supplement the SEA report, including the development of mitigation measures based on reducing the number of wind turbines. The planning solution was amended on the basis of these measures (the number of wind turbines was reduced).

In addition, expert opinions, studies and other relevant works previously compiled on the region were used in the preparation of the SEA report. The final reports of the Valga-Tõrva studies on birdlife, forest habitats, bog habitats, plant species and bats (the so-called KAUR Repower study) conducted to identify priority areas for wind energy development in the country were also used. The Valga-Tõrva study area for priority wind energy development areas overlapped with area TU1 and partially with area TU3 assessed in this SEA report.

In addition, the assessment of the impact of wind turbines was based on scientific literature and studies conducted on wind farms elsewhere in the world.

1.3 Overview of the organisation of the SEA and public participation

The preparation of the Valga Municipality special plan and strategic environmental assessment was initiated by Valga Municipal Council Decision No. 81 of 25 October 2023, 'Initiation of a local government special plan and strategic environmental assessment'. The reason for initiating the special plan was the applications submitted by Sunly Wind OÜ (registry code 14937897) and Eurowind Energy OÜ (registry code 16584180) to initiate a special plan for the local government in Valga Municipality in order to find the most suitable location for the construction of a wind farm and the infrastructure necessary for its operation. Sunly Wind OÜ submitted a corresponding application on 31 August 2023 for an area of 7,400 ha, and Eurowind Energy OÜ submitted a corresponding application on 9 October 2023 for an area of 2,800 ha. The purpose of drawing up the EP is to select the most suitable locations in the planning area for the construction of the wind farm and the infrastructure necessary for its operation, and then to determine the building rights for the selected locations and to resolve other relevant tasks specified in § 126(1) of the Planning Act (hereinafter *PlanS)*.

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The maximum permitted height and number of wind turbines in the wind farm area will be determined during the preliminary selection of the location, based on the size of the suitable location and the effective placement of the wind turbines. The maximum permitted height of the wind turbines will be determined in cooperation with the Ministry of Defence.

In accordance with the special plan and the technical specifications of the public procurement organised for the preparation of the SEA location selection stage, a suitable location for the wind farm will be sought through the special plan. After the procurement procedure, the starting points for the special plans and the SEA programme began to be prepared.

On 11 April 2024, Valga Municipal Government announced on its website the preliminary selection criteria for the location of the special plan for wind farms in Valga Municipality and the impact assessment, including the disclosure of the strategic environmental assessment programme and public discussion. The disclosure took place between 30 April 2024 and 29 May 2024, during which time written opinions on the document were also expected.

The preliminary selection criteria and impact assessment for the Valga Municipality wind farm special plan, including the public disclosure of the strategic environmental assessment programme, took place between 30 April 2024–29 May 2024 at the Valga Municipal Government, Valga Central Library, Õru Library, Tsirguliina Library, Sooru Library and Hummuli Library during their opening hours and on the website https://www.valga.ee/tuulepargi-eriplaneering. Discussions following the public display of the special plan took place on 27.06.2024 at the Valga War Museum and Tsirguliina Community Centre, where the special plan process, the content of the disclosed document and the opinions received during the disclosure were presented and questions from those present were answered. A total of 11 letters were received during the public display period.

In addition to the involvement required by law, the developer and the municipality have held a series of additional information events with the aim of ensuring that people are better informed and have the opportunity to participate:

- 16 August 2023 – Preliminary presentation of the Sunly wind farm at the Õru Cultural Centre and Hummuli Community Centre
- 24 October 2023 – Sunly community evening at Õru Cultural Centre
- 31 January 2024 – Energy cooperative workshop: 'Will the wind farm bring us our own, cheaper electricity?' Tsirguliina community centre
- 16 May 2024 – Valga Municipal Government wind farm special planning information day at Tsirguliina Community Centre
- 28 June 2024 – Sunly study trip to Saarde wind farm and Pikkori battery and solar park
- 24 July 2024 – Tetra Tech landscape architect Kerttu Ots' fieldwork in Uniküla and introduction to the wind farm at the Väike-Make, Kalda, Jaanimäe and Une-Mati farms
- 25 July 2024 – Workshop on assessing the visual impact of the wind farm at Tsirguliina community centre
- 2 December 2024 – Information day presenting special planning materials at Tsirguliina community centre
- 27 March 2025 – Meeting with residents of Õruste village as part of the Valga municipality wind farm EP
- 5, 7, 8 and 13 May 2025 – consultation days in Sooru, Tsirguliina, Õru and Hummuli.

In addition to the municipality's website, the public was kept informed via the wind farm's website, newsletter and the Lõuna-Eesti Postimees newspaper. A website has also been created for the project: https://herrotuulepark.ee/

Based on the opinions of the relevant authorities, the public display and the results of the public discussions, the initial planning principles and the intention to develop a strategic environmental assessment were adjusted. Information on whether opinions and proposals were taken into account or not was compiled in a table, which was published on the local government's website and sent to the person or institution that sent the letter for review.

From 25 November 2024 to 5 January 2025, the draft special plan materials were coordinated and opinions were collected in accordance with section 105(1) of the Planning Act. During this process, the opinions of the persons involved were collected and approvals were requested from government agencies. A total of 32 letters of opinion were submitted by the deadline, including a joint appeal from the residents of Õruste village with 22 signatures and an opinion submitted via the Rahvaalgatus.ee portal with 409 signatures. The municipal government reviewed the opinions submitted and formed its own position on them. The Valga Municipal Council and members of its relevant committees were also involved in forming the opinion so that local issues and important spatial decisions could be resolved in a balanced manner.

Of the authorities, the Environmental Board, which submitted the plan, the SEA and its supplementary proposals, did not approve the planning solution. Based on the proposals, additional cooperation took place with the Environmental Board and bird experts, the materials were supplemented and will be resubmitted for approval. Based on the need to ensure the connectivity of capercaillie habitats, the number of wind turbines was reduced from 23 to 18 as a mitigation measure. Additional measures to protect bat habitats were also added. Once all the necessary approvals from the authorities have been obtained, the planning solution will be put on public display.

Everything related to the special plan, including the proposals received, the municipality's positions on them, and the additional considerations raised in public discussions and the municipality's positions on them, is publicly available on the Valga Municipality website at https://www.valga.ee/tuulepargi-eriplaneering. The following procedural diagram is presented in Figure 1 for the preparation of the special plan.

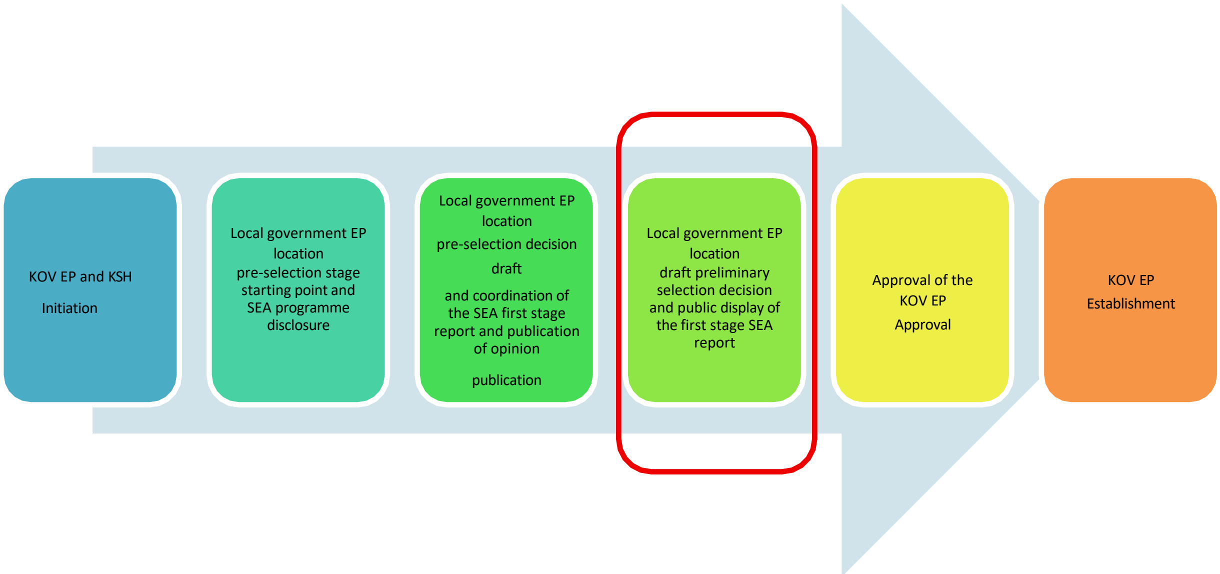

Figure 1. Procedure for local government special planning and SEA. The current stage of the procedure is highlighted in red. The diagram is based on the version of the Planning Act that entered into force on 18 July 2025.

The chapter will be updated on an ongoing basis in accordance with the progress of the SEA procedure.

1.4 Methodology

The strategic environmental assessment was carried out on the basis of the Environmental Impact Assessment and Environmental Management System Act (KeHJS) and the Planning Act (PlanS). The SEA report was prepared in accordance with the requirements of the relevant legislation in force in Estonia and the European Union. The SEA report was prepared in accordance with the requirements set out in KeHJS § 40 , taking into account , among other things the objectives of the strategic

planning document. Pursuant to KeHJS § 40 lg 3 p-le 2, when preparing the SEA report,
take into account the content and level of establishment of the strategic planning document.

Similar to the special plan itself, the SEA report for special plans is also prepared in two stages in accordance with the Planning Act. Together with the preliminary selection of the location of the special plan, an SEA Stage I report is prepared, which deals with the identification and comparison of suitable locations based on environmental impacts. The SEA Stage I report also sets out the conditions that need to be taken into account and identifies and determines the need for additional studies for the object at the selected location. A SEA report will be prepared together with the detailed solution of the special plan, which will assess the impacts of specific wind farm solutions and identify mitigation measures. Both the planning solution and the SEA preparation process are public and involve the public.

When preparing a special plan for a wind farm, the local government may decide not to prepare a detailed solution and establish the location of the plan on the basis of a preliminary selection decision, if there are no factors that would preclude the further planning of the wind farm with design conditions and the preliminary location selection decision sets out the conditions on which the design conditions are based. In preparing this special plan, the local government has provided guidelines for areas where it is possible to refrain from preparing a detailed solution in order to reduce the administrative burden. Therefore, in places where there is certainty that there are no exclusionary factors (including certainty that there will be no significant adverse impact on Natura areas), conditions for issuing design conditions will be set when selecting locations, including the approximate locations of wind turbines, service roads and connection lines. In the case of this plan, no detailed planning solution (and the accompanying SEA) is envisaged for any of the location options.

Neither PlanS nor KeHJS provide guidance on how to resolve the preparation of an SEA report in such a situation. The SEA report on the location selection should, in essence, address the suitability of the location and the impacts resulting from the location selection, rather than being an assessment of the impacts of the detailed solution for the wind farm. The Environmental Board (hereinafter *KeA)* has expressed the view that if a detailed solution is not adopted, the SEA Stage I report should be more accurate, including more detailed baseline studies. This SEA report is based on an approach that provides recommendations for the preventive exclusion of known and potential high-value natural communities from the location selection areas. The baseline studies for the SEA have also been carried out with a higher degree of accuracy than would be necessary for assessing the suitability of the site selection. Nature studies that could significantly change the wind farm solution are not left to the design stage, but such baseline studies have been carried out during the SEA at the site selection stage.

The SEA report was prepared on the basis of relevant methodological guidelines, the most important of which were:

- Peterson, K., Kutsar, R., Metspalu, P., Vahtrus, S. and Kalle, H. 2017. Strategic Environmental Impact Assessment assessment.
- Põder, T. 2017. Environmental Impact Assessment Handbook.
- Kutsar, R.; Eschbaum, K. and Aunapuu, A. 2019. Guidelines for conducting Natura assessments in the implementation of Article 6(3) of the Habitats Directive in Estonia.
- European Commission. Commission Communication Assessment of plans and projects in relation to Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of Directive 92/43/EEC. ET Brussels, 28.9.2021 C(2021) 6913 final.

In addition, the environmental impact assessment takes into account the expertise of the lead expert and the working group on environmental impact assessment, as well as information presented in specialist scientific literature. References to literature sources are provided in footnotes when relevant claims are made. If the assessment of the impacts has been carried out through additional studies or using computational assessment, the methodology for assessing the impacts in the relevant impact area is described in the corresponding assessment in section 4.

According to the KeHJS, the first stage report of the strategic environmental assessment must contain the source data for the preparation of the strategic environmental assessment report for the local government's special plan. This report takes the approach that the need for additional assessment and studies provided for in the design conditions is presented in the report. The relevant source data (impact assessments and studies to be carried out during the further design of the wind farm) are presented at the end of each impact assessment in Chapter 4 on a coloured background.

1.5 Source materials

The following source materials were used in the preparation of the SEA:

- Valga Municipal Council Decision No. 81 of 25 October 2023 "Initiation of a special local government plan and environmental impact assessment";
- Valga Municipal Council Decision No. 96 of 31 January 2024 'Amendment to Valga Municipal Council Decision No. 81 of 25 October 2023 'Initiation of a special local government plan and strategic environmental assessment'';
- AB Artes Terrae OÜ and LEMMA OÜ. 2024. Starting points for the preliminary selection of the location of the Valga Municipality wind farm special plan and impact assessment, including the strategic environmental assessment programme.

1.6 Overview of difficulties encountered in preparing the SEA report

The SEA Stage I report for this special plan was prepared during a period when the methodology for the basic research necessary for the assessment and the assessment methods used in the assessment were being refined in several areas of assessment. As a result, there was a need to refine and update the assessments during the preparation of the SEA. In order to ensure the quality of the assessment, it was decided to update the assessments presented in the SEA report when updating the relevant methodologies used in the assessment.

During the preparation of the SEA report, it also became apparent that there was a need for additional research (i.e. in addition to the studies provided for in the SEA programme)
The above aspects resulted in additional time being spent on the assessment.

The above aspects caused additional time expenditure in conducting the assessment.

However, no significant difficulties that would affect the assessment results presented in the report were identified during the SEA. When updating the relevant assessment methodologies, the corresponding estimates in the SEA report were also updated. With regard to the natural environment assessments, the SEA report was prepared in cooperation with species experts and the Environmental Board in order to find the best solutions.

2 Planned activities and alternatives considered

2.1 Planned activity

In accordance with Valga Municipal Council Decision No. 81 of 25 October 2023 and Decision No. 96 of 31 January2024 and the technical specifications of the public procurement**, the most suitable locations in the planning area for the construction of a wind farm and the infrastructure necessary for its operation will be sought through a special plan, and then the building rights for the selected locations will be determined and other relevant tasks specified in § 126(1) of the Planning Act.** The maximum permitted height and number of wind turbines in the wind farm area will be determined during the preliminary selection of locations, based on the size of the suitable location, the effective placement of the wind turbines, the locations of objects causing restrictions, and the height restrictions specified by the Ministry of Defence.

When selecting the location of wind turbines, restrictions and limitations arising from legislation, recommendations made by authorities (including guidelines for planning renewable energy production), local interests and values, and reasoned statements by the persons involved are taken into account.

The connection to the 110 kV or 330 kV transmission network will be resolved in the EPs. Existing substations or direct connection to the 110 kV/330 kV power line are preferred for connecting the wind farm to the electricity network. **The connection is planned to be made with an underground cable line.** The approximate location and length of the cable lines between the wind farm and the electricity grid connection point have been determined during the preliminary selection of the location.

2.2 Location alternatives

In accordance with the order to initiate a special plan, a special plan will be drawn up for the northern part of Valga municipality with a total area of 7400 ha. The special plan area covers the following villages: Mustumetsa, Killinge, Kiviküla, Uniküla, Õruste, Tõlliste and Sooru. (Figure 2)

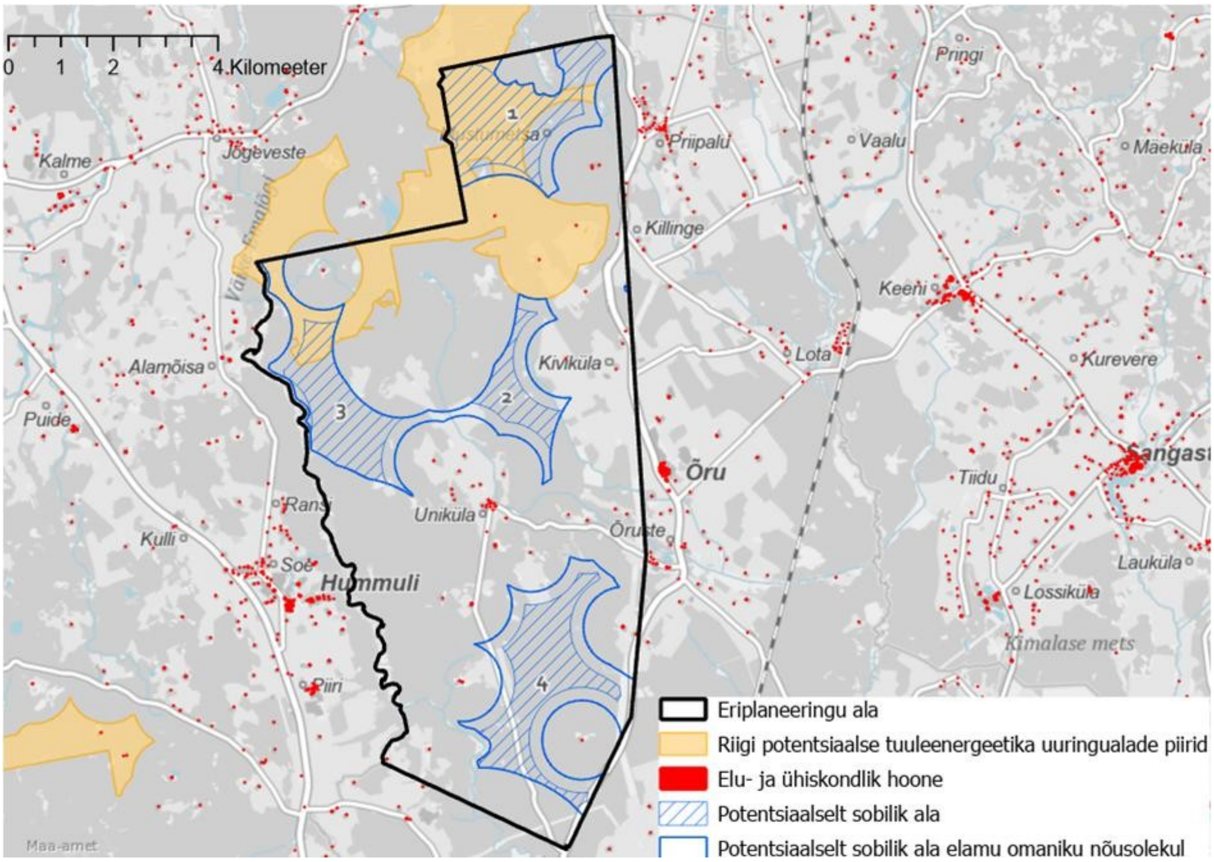

Figure 2. Areas potentially suitable for wind farms, as identified by initial map analysis. The figure also shows the location of the study area in the region, which is being conducted by the Environmental Agency to identify potential priority areas for wind energy development.

During the preparation of the SEA programme, a simplified
.

The following exclusion criteria were used to identify potentially suitable areas:

- areas closer than 1000 m to existing residential buildings were excluded (a reduction of the distance to 750 m may be considered when compiling the plan if the landowner gives their written consent during the EP procedure and compliance with the noise limit is guaranteed). In addition, areas within 2000 m of densely populated areas were initially excluded. Based on the feedback received when the initial positions were made public, it was decided to use the 2000 m buffer for noise-sensitive areas located in densely populated areas([12]) . Such distances ensure compliance with noise standards in most cases and meet the distance criteria recommended by state authorities([13]) . With regard to residential buildings, the initial analysis was based on the location of ETAK residential and public buildings and the boundaries of densely populated areas and noise-sensitive areas within densely populated areas, as specified in the working version of the Valga municipality comprehensive plan.

Protected areas, conservation areas, permanent habitats, including areas of planned protected objects, where construction is generally not possible under the current protection regime, were excluded.

- Permanent habitats established for the protection of plant growth sites were excluded with a 100 m buffer zone to prevent adverse effects on growth sites. The selection of criteria was based on the recommendation of the Environmental Board[14].
- Permanent habitats of capercaillies with a 1 km buffer zone were excluded to prevent significant direct adverse effects on permanent habitats of bird species in protection category II. The criterion was selected based on the recommendation of the Environmental Board.

was excluded from all permanent habitats of Category I protected bird species and protected areas
.

During the planning process, the local government has specified that the 1000 m distance criterion also applies to known residential buildings under construction/legalisation and to land parcels designated for residential use. In the case of land parcels designated for residential use, it is possible to plan wind turbines closer than 1000 m if the landowner expresses that they do not wish to build a residential building on the land parcel in question.

The map analysis and preliminary opinions revealed that there are **potentially four areas** within the special plan territory that have no direct factors precluding the further selection of the location of the object covered by the special plan and that have sufficient territory. The description of the areas and the objects located in the potential impact area is presented in the SEA programme and will not be repeated here. The SEA report also presents relevant information on the current environmental status in the assessment of the impact of the respective impact area.

Table 1. Potentially suitable areas in the special planning areas of Valga Municipality.

Designation	Settlements located in the area	Area, ha
1	Mustumetsa village and Kiviküla	443
2	Uniküla and Kiviküla	128
3	Uniküla and Tõlliste villages	302
4	Õruste village, Tõlliste village and Sooru village	401

[12] Valga Municipal Government Order No. 157 of 13 June 2024.
[(]Letter No. 17-7/2019/2142 of the Ministry of Economic Affairs and Communications dated 13 March 2019 on the inclusion of renewable energy in the comprehensive plans of local governments (registered in the Valga Municipal Government document register on 13 March 2021 under No. 9-1.3/1124).
[14] The impact of onshore wind farms on wildlife and the recommendations of the Environmental Board for their planning in local government comprehensive plans (28 June 2021).

2.3 Alternatives for wind turbine height

This SEA takes into account the maximum possible wind turbine height over a five-year period, which is estimated to be up to 270 m. The height of wind turbines is particularly important in terms of visual impact and shadowing. At the time of writing this SEA report, the tallest models in series production from leading wind turbine manufacturers are known to have a tip height of approximately 270 m. In accordance with the impact assessment methodology, the assessment is based on the worst-case scenario, i.e. the maximum wind turbine parameters that can be expected in the near future are used. Based on this, the construction of a wind farm consisting of wind turbines with a rotor height of up to 180 m and a tip height of up to 270 m is assessed.

2.4 Wind turbine layout, technical solution and alternatives

The preliminary selection stage of the special plan does not generally determine the location of the wind turbines or the internal infrastructure of the wind farm associated with them. However, if it is desired to establish a special plan after the preliminary selection stage, i.e. to refrain from preparing a detailed solution, it is necessary to determine the basic locations of the wind turbines. If a detailed solution is not prepared, the land use and construction conditions for the wind farm, including the maximum height, number and general location of the wind turbines, shall be determined during the preliminary selection stage of the local government's special plan.

In addition to identifying areas suitable for initial location selection, this special plan also includes a basic solution for the wind farm in the location selection area, including the approximate layout of the wind turbines. The location of the wind turbines, including their number, has been determined taking into account the location of natural values mapped during the SEA (areas of higher natural value have been avoided). The wind turbine layout solution has also been developed in cooperation with the interested party, taking into account the productivity of the wind farm([15]. In addition, the visual impact has also been taken into account in developing the wind turbine layout solution (see 4.7 for more details).

At the preliminary selection stage of the wind farm location, the technical solution for the wind turbines is not known. However, in order to assess the impacts appropriately, it is necessary to have an idea of the technical solution for the wind farm, primarily in order to assess the land requirements and the associated impacts. Therefore, the following subsections provide a basic description of the components of the wind farm, which has been used as a basis for assessing the impacts. The specific technical solution will be determined during the design of the wind farm. **The following is approximate descriptive data.**

2.4.1 Wind turbines and their layout

Wind farms today mainly use three-bladed horizontal axis wind turbines. The

SEA report assumes that such wind turbines will be used in the wind farm.

Wind turbines are usually painted in natural colours (white, grey) with a matte finish. To ensure flight safety, the nacelles of wind turbines are equipped with red warning lights.

The maximum capacity of mass-produced onshore wind turbines is currently almost 7 MW [16]. To date, the capacity of wind turbines has been steadily increasing in line with technological developments. When assessing environmental impacts, the capacity of wind turbines is not a factor that directly determines their impact on the environment. However, capacity does determine the energy yield of wind turbines, and in order to achieve renewable energy targets, it is appropriate to install wind turbines with the highest possible yield, which reduces the number of turbines required.

Wind turbines generate energy at wind speeds ranging from 3 to 25 m/s.

[15] The yield forecasts are based on a separate special plan and SEA carried out by the interested party, and their detailed results are not presented in the SEA report. The SEA is based on the information provided by the interested party to the SEA compiler regarding yield.

[16] https://www.vestas.com/en/products/enventus-platform/v162-6-8-mw

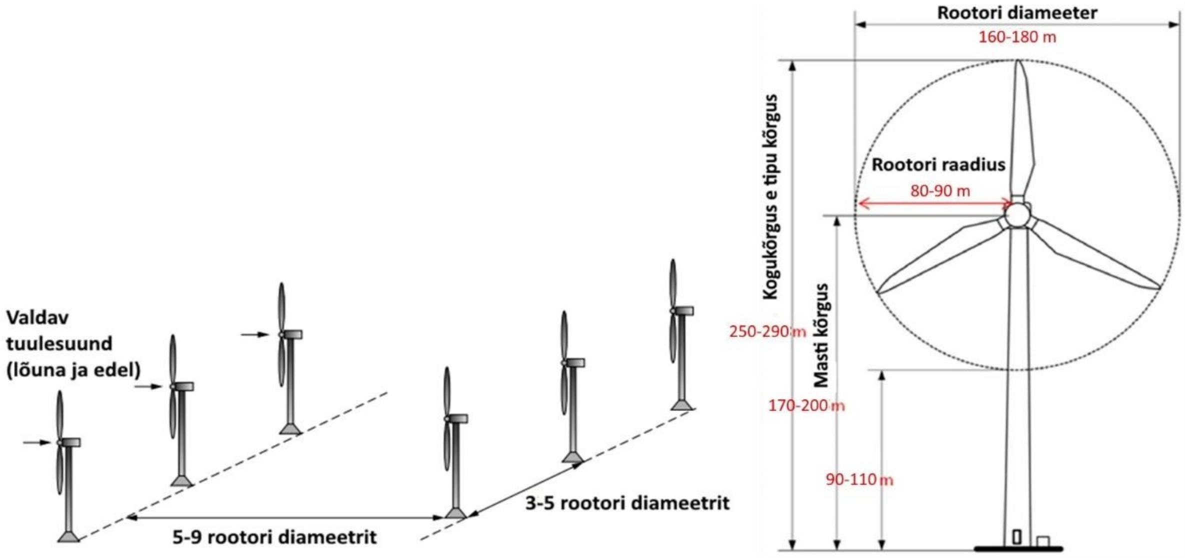

Figure 3. Wind turbine dimensions and typical wind turbine placement in a wind farm. This is an illustrative illustration.

Wind turbines are placed in a wind farm in the prevailing wind direction at a distance of approximately 5–9 rotor diameters from each other (approximately 800 m for a 160 m rotor) and in other wind directions at a distance of approximately 3–5 rotor diameters (approximately 480 m for a 160 m rotor). The actual distance required depends on the wind turbine model and wind conditions in the area.

In this special plan, it is recommended that, where possible (in the absence of exclusions), the procedure permitted by the Planning Act be used for areas suitable for wind farms, whereby the selection of the location is followed by the issuance of design conditions. Based on this, in addition to excluding areas unsuitable for wind farms due to natural environment restrictions, the special plan also includes basic solutions for wind turbines and roads.

2.4.2 Foundation

The type of wind turbine foundation is not specified in the special plan. The type of wind turbine foundation and technical solution will be selected according to the engineering geological properties of the soil when preparing the construction project. For onshore wind turbines, the most common type of foundation is a gravity foundation – a reinforced concrete foundation that holds the wind turbine upright by means of gravity. A gravity foundation is also the type of foundation that requires the most land.

The foundations of modern wind turbines are generally up to 25 m in diameter, which makes the construction area of the foundation approximately 490 m^2. As the dimensions of wind turbines increase, the diameter of the foundation can also be expected to increase. With a diameter of 30 m, the foundation construction area is 706 m([2]. The depth of the foundation also depends on the geological conditions. The depth can range from a p p r o x i m a t e l y 2 to 6 m. The volume of soil excavated for the construction of a single wind turbine is 1000–2000 m([3]. Some of the excavated soil is used to cover the foundation.

When constructing wind turbines in marshy areas and on soil with low bearing capacity, pile foundations or a combination of piles/anchors and gravity foundations are often used instead of gravity foundations. When using piles, the amount of excavated material and concrete used is significantly smaller, while the piles can be constructed to a depth of 10–20 m.

Figure 4. Types of wind turbine foundations [17] . From left: gravity foundation, single pile foundation or monopile foundation, slab foundation combined with piles, slab foundation combined with anchors.

2.4.3 Assembly sites

An assembly site is established for the erection of each wind turbine, where a crane and other necessary equipment can be set up for the construction period. The assembly site can also be used to store wind turbine components prior to erection. Each wind turbine manufacturer has standard assembly site solutions developed for each wind turbine model, which are modified as necessary depending on the specific characteristics of the location. The assembly site is built directly next to the wind turbine to allow the crane to lift the wind turbine components into place. The site must be level and have sufficient load-bearing capacity. The site is not usually dismantled after the construction work is completed, as it may also be needed for wind turbine maintenance work.

The taller the wind turbine to be erected, the larger the assembly site, as the dimensions of the components to be erected and the size of the crane used increase. The technical drawings for the Vestas V150 specify an assembly site of 77×35 m or 2695 m^2[18] . For a wind turbine with a rotor diameter of 180 m, the assembly area can be estimated at approximately 70×150 m, or approximately 10,000 m^2. The shape of the assembly area depends on the technical requirements of the specific wind turbine manufacturer (Figure 5 shows an example of an assembly area).

[17] Annan, D. 2019. Getting Your Wind Farm On The Right Footing. https://www.golder.com/insights/getting-your-wind-farm-on-the-right-footing/
[18] Vestas. 2017. Hardstand V150 max 166m HH.

Figure 5. Possible wind turbine foundation area with assembly sites. Source: Land Board Kaldaerofoto – Tootsi/Sopi wind farm.

2.4.4 Roads

Access roads must be built for all wind turbines to enable their construction (including the transport of wind turbine components) and subsequent maintenance. Roads must be kept accessible all year round for operational wind farms. The roads to be built must have sufficient load-bearing capacity and be sufficiently wide. The width of the road surface in a wind farm is usually around 5 m and the width of the road corridor around 10 m. In the case of road bends and slopes, the transport requirements of particularly large components must be taken into account.

Where roads intersect with ditches or larger bodies of water, culverts/bridges must be designed. To ensure the durability of the roads, it may be necessary to design storm water ditches adjacent to the roads.

2.4.5 Internal electrical connections in the wind farm

The wind turbines are connected to the wind farm substation by underground cables. The underground cables are laid in a trench up to a few metres wide and approximately 1 m deep.

2.4.6 Wind farm substation and connection to the grid

A substation is often required to connect the wind farm to the grid. Wind farms located close to each other can be connected to the grid via a single substation. The size of the substation depends on the capacity of the wind farm. Based on the example of the Jäneda substation, the land requirement for a 110 kV substation is 50×70 m, or approximately 3500 $^{m^2}$(Figure 6). Based on the example of the Sopi substation, the land requirement for a 330 kV substation is 120×120 m, or 14,400 $^{m^2}$(Figure 7). The substation territory is generally a hard-surfaced area, which is usually enclosed by a fence.

In certain cases, the substation may be planned for the wind farm area when establishing a wind farm, and in certain cases for the connection point of an existing high-voltage line. It is also possible that there is no need to build a substation and, for example, an existing substation will be expanded.

In the case of this plan, there are no plans to build a substation in the wind farm location area. A substation may be built at the connection point to the high-voltage line, but the exact solution is not specified in the plan. The explanatory note and drawing concerning the location of the EP describe four alternative connection options, which may be specified in further design work.

Figure 6. Illustration of a 110 kV substation – Jäneda substation. Source: Land Board Aerial photo.

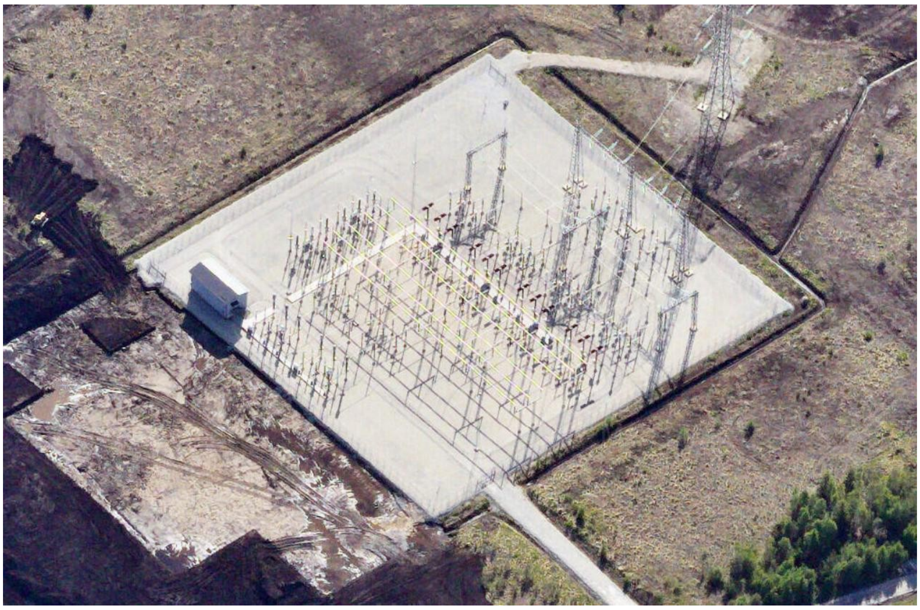

Figure 7. Illustration of the 330 kV substation – Sopi substation. Source: Land Board Kaldaerofoto.

As the connection conditions for the wind farm will be determined on the basis of the technical conditions issued by the network operator and the connection agreement after the plan has been adopted, the connection point of the wind farm is not known at the time of preparing the special plan. In the course of preparing the special plan for Valga Municipality, taking into account the recommendations for measures presented in the impact assessment, the planning of overhead power lines has been abandoned. **Electrical connections to the main grid are planned with underground cables, and the plan specifies their possible approximate corridors, which may be specified in more detail during the design phase.**

3 Links to relevant strategic development documents

An analysis of links to relevant strategic development documents is presented in the SEA programme. The analysis will not be repeated in full here. A summary of national strategic documents on climate and energy policy is provided.

The need to establish a wind farm stems from Estonia's climate and energy policy, the framework for which is set out in
" 's climate policy framework until 2050". 08.02.2023. a Riigikogu updated
The "Climate Policy Guidelines until 2050" stipulate that Estonia's long-term goal is to balance greenhouse gas emissions and sequestration by 2050 at the latest, i.e. to reduce net greenhouse gas emissions to zero by that time. On 12 May 2021, the Riigikogu approved the long-term development strategy "Estonia 2035", which agreed on Estonia's national climate neutrality target for 2050. The "Estonia 2035" action plan sets a target of 8 million tonnes of CO_2 equivalent for net greenhouse gas emissions by 2035.

Document "Climate Policy Fundamentals until 2050 [19] ". Updated by the Riigikogu on 08.02.2023
The "Climate Policy Guidelines until 2050" stipulate that Estonia's long-term goal is to balance greenhouse gas emissions and sequestration by 2050 at the latest, i.e. to reduce net greenhouse gas emissions to zero by that time. On 12 May 2021, the Riigikogu approved the long-term development strategy "Estonia 2035", which agreed on Estonia's national climate neutrality target for 2050. The "Estonia 2035" action plan sets a target of 8 million tonnes of CO_2 equivalent for net greenhouse gas emissions by 2035.

In the shorter term, Estonia has set a target of producing as much renewable electricity in 2030 as our total annual consumption[20]. To achieve this, new wind farms with a capacity of at least 1 GW must be built on land[21] . The Energy Economy Organisation Act, which entered into force on 1 November 2022, stipulates that by 2030, renewable energy will account for at least 65% of the country's total final energy consumption. Renewable energy will account for at least 100% of total final electricity consumption.

The special plan being prepared is in line with Estonia's climate and energy policy objectives, including the Estonian Energy Sector Development Plan 2030+ and the Estonian Climate Change Adaptation Development Plan until 2030.

The need to prepare a special plan arises from the fact that the comprehensive plans and county plans in force in the territory of Valga Municipality have not designated areas for the development of wind turbines in the special plan area, but there is interest in establishing a wind farm in the area, and both national and local renewable energy targets provide for an increase in the share of renewable energy.

The Valga county plan does not designate any preferred areas for the establishment of wind farms, but section 4.2.5 of the explanatory memorandum to the Valga county plan sets out the principles for the development of renewable energy. The county plan stipulates that Valga County is not a nationally important area for the development of wind energy. However, this does not preclude the establishment of wind farms([22]).

Due to the increased demand for renewable energy, technological developments and expected changes in national defence restrictions, the planning of wind farms in Valga County has become a topical issue.

The county plan does not specify specific areas for the development of renewable energy in the county; development will take place taking into account development interest and the availability of resources, and subject to the following conditions. The Valga County Plan sets the following conditions for the planning of wind turbines and wind farms:

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[19] https://kliimaministeerium.ee/kliimapoliitika-pohialused-aastani-2050

[20] https://valitsus.ee/valitsuse-eesmargid-ja-tegevused/rohepoliitika/taastuvenergia-arendamine

[21] State Chancellery. 2022. Audit on accelerating the development of renewable energy.

[22] Letter from the Ministry of Economic Affairs and Communications dated 07.07.2025 No. 9-1.3/2267-3

- All plans and design conditions for wind turbines and wind farms of any height, or, in the absence of an obligation to issue them, draft building permits or construction notices, must be coordinated with the Ministry of Defence. In order to ensure national defence interests, cooperation with the Ministry of Defence must begin at the initial stage of planning a wind generator or wind farm.
- When planning wind turbines, the minimum distance of the wind turbine from the state road must be equal to the total height of the wind turbine (mast and blade height), and the planning of wind turbines must be based on measures to mitigate the risk of accidents.
- When designing wind turbines, the minimum distance of the wind turbine from the boundary of the railway protection zone must be equal to the total height of the wind turbine (mast and blade height), and the design of wind turbines must be based on measures to mitigate the risk of accidents.
- When planning wind farms, attention must be paid to avoiding noise pollution and, if necessary, developing mitigation measures. When planning new wind farms, the aim should be to ensure compliance with the strictest equivalent industrial noise level standard set out in legislation, i.e. 50 dB during the day and 40 dB at night for Category II residential areas.
- When planning wind turbines and wind farms as dominant features in the landscape, the preservation of landscape values must be taken into account.

The conditions for the development of wind farms set out in the county plan shall be followed when drawing up the special plan. When drawing up the special plan, the need to amend or clarify the county plan shall be decided in cooperation with the authorities responsible for the area. As a result of the planning cooperation phase, it has been concluded that there is no need to amend the county plan.

4 Wind turbines and wind farms infrastructure infrastructure The SEA programme has carried out a preliminary mapping of impacts and identified significant impact areas.

The SEA programme has carried out a preliminary mapping of the impacts and identified the significant impact areas. **Areas of impact that were identified as insignificant during the preparation of the programme are not addressed** in **the SEA report.** In addition, the SEA process assesses relevant social and cultural impacts, including impacts on human health, **in accordance with the scope of assessment specified in the SEA programme.** In the case of this SEA, the assessment of impacts pursuant to § 40(4) of the KeHJS and § 4(2) of the PlanS has therefore been combined within the scope of assessment specified in the SEA programme.

The description of the environmental conditions of the special planning area, in particular the potentially suitable areas, is presented in the same chapter as the impact assessments. At the end of each subchapter, a description of the environmental measures and the additional assessment required for the preparation of the construction project is provided.

Based on the nature of the special plan, the impact assessment has been carried out with the degree of accuracy that is possible and appropriate at the location selection stage of the special plan. According to PlanS, the task of the first stage of the special plan is to find the most suitable location for the planned object from among the potentially suitable locations. According to the initial task of this special plan, all suitable locations must be found. Neither the initial task nor the SEA programme stipulates the need to rank the potential suitable areas.

According to PlanS, it is possible that the selection of a location will be followed by the preparation of a detailed solution and its SEA report or, alternatively, the issuance of design conditions (if necessary, together with the submission of an application for a building permit and the performance of an EIA). A solution is possible if, during the preliminary selection of the location, it becomes clear that there are areas in the special planning areas where there are no factors precluding the further development of the wind farm, including the conviction that there will be no adverse impact on Natura areas. The decision on the preliminary selection of the location, including the decision on the design conditions or the selection of a detailed solution, can be made by the council, based, among other things, on the results of the SEA and the opinions of the relevant authorities. **In this case, the SEA report assumes that the detailed solution will be abandoned and that, once the location has been selected, it will be possible to continue with the design conditions procedure.** Both the location selection and the developed wind farm solution have therefore been assessed.

4.1 Impacts on the natural environment

4.1.1 Natura assessment

Natura 2000 is a Europe-wide network of protected areas, the aim of which is to ensure the protection of rare or endangered birds, animals and plants and their habitats and growing sites, or, if necessary, to restore the favourable status of species and habitats that are endangered across Europe. The purpose and content of the Natura 2000 network is set out in the European Union's Habitats Directive (92/43/EEC), adopted in 1992. The same directive also established the bird areas selected under the Birds Directive (2009/147/EC), which entered into force in 1979, as part of the Natura network. A Natura assessment is an assessment of the impact that the implementation of a planned activity is likely to have on Natura 2000 network sites.

The Natura 2000 assessment is based on relevant guidelines [23,24] .

In the case of plans and more generalised planning (such as the location selection stage of special plans), the Natura assessment is carried out with the necessary level of detail, based on the level of detail of the strategic planning document, which must allow for the identification of sensitive/threatened areas and conflicts/risks that need to be addressed in further planning stages

[23] Kutsar, R.; Eschbaum, K. and Aunapuu, A. 2019. Guidelines for conducting a Natura assessment in the implementation of Article 6(3) of the Habitats Directive in Estonia. Commissioned by: Environmental Board.

[24] European Commission. Commission Communication on the assessment of plans and projects in relation to Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of Directive 92/43/EEC. ET Brussels, 28.9.2021 C(2021) 6913 final.

take into account. If, following the preliminary selection of the location for the special plan, it is desired to design a wind farm with design conditions, this is subject to the exclusion of any impact on Natura areas.

The map analysis carried out when compiling the starting points for the special plan excluded Natura areas whose conservation objective is not birds or bats with a 100 m buffer zone, and Natura areas whose conservation objective is bats with a 600 m buffer zone. A 600 m buffer zone was applied to the bird area. This approach has avoided any direct adverse impact on Natura areas.

4.1.1.1 Natura preliminary assessment

A preliminary Natura assessment was carried out during the preparation of the SEA programme. This is repeated here for information purposes.

The special planning area overlaps with two Natura 2000 nature conservation areas: the Sauniku nature conservation area (EE0080408) in the northern part and the Õru nature conservation area (EE0080428) in the eastern part, which is also the Õru conservation area (KLO2000105). To the north and northwest of the special planning area, approximately 2.9 km away, is the Kada Lake nature reserve (EE0080429) and approximately 1.9 km away is the Soontaga-Sauniku nature reserve (EE0080410). The Prange nature reserve (EE0080407) is located approximately 4.6 km to the northeast. The Otepää urban area (EE0080401) and the Otepää nature reserve (EE0080401) are located approximately 6.4 km to the west, approximately 2.9 km to the Mõneku nature reserve (EE0080472) and approximately 5.8 km to the Valli bog nature reserve (EE0080427) (Figure 8).

In the case of Natura nature reserves, the impact can generally be considered to be excluded within 100 m of the nature reserve[25]. In the case of particularly sensitive wetlands, the potential impact area can be estimated at up to 250 m. **The Sauniku nature reserve,** which was established to protect the habitat types listed in Annex I and the species listed in Annex II of the Habitats Directive, falls within the potential impact area (100 m from the potentially suitable area 1). Protected habitat type: transition mires and quaking bogs (7140). Species whose habitats are protected: bog orchid (*Liparis loeselii)*, yellow saxifrage (*Saxifraga hirculus)*.

As the area has been established for the protection of wetland habitat types and plant species growing in excessively wet conditions, the impact on the Sauniku nature reserve cannot be ruled out in the case of potentially suitable area 1. An appropriate assessment is necessary.

With regard to bird areas, the identification of potential impact areas is based on an analysis of the Estonian land bird fauna [26](hereinafter also referred to as MLA). The MLA identifies the extent of potential impact areas (depending on the species, zones 1-3([27]))for bird species that are important in terms of conservation and sensitive to wind turbines. According to the MLA, the most sensitive species in terms of birdlife is the black stork, for which the potential impact area (zone 3 area) can extend up to 14 kilometres. Therefore, the Natura preliminary assessment will consider Natura bird areas located up to 14 km from potential wind farm areas.

The nearest Natura bird area – Otepää bird area (EE0080401) – is located approximately 6.8 km from the nearest potentially suitable wind farm area (Figure 8). The Otepää bird area has been established to protect the habitats of bird species listed in Annex I of the Birds Directive and migratory bird species not listed in Annex I. Species whose habitats are protected: northern goshawk (*Accipiter gentilis)*, Eurasian wigeon (*Anas penelope)*, mallard (*Anas platyrhynchos)*, lesser spotted eagle (*Aquila pomarina)*, grey heron (*Ardea cinerea)*, hazel grouse (*Bonasa bonasia)*, little ringed plover (*Charadrius*

[25] The impact of onshore wind farms on wildlife and the recommendations of the Environmental Board for their planning in local government comprehensive plans (as of 10 November 2021)

[26] Estonian Ornithological Society, Eagle Club. 2022. Analysis of terrestrial birdlife across Estonia. Public procurement no. 239156. Map layers from the Environmental Agency's spatial data service. https://kliimaministeerium.ee/elurikkus-keskkonnakaitse/looduskaitse/uuringud-projektid-ja-analuusid#analuus-ja-lisad

[27] Zone 1 is the species' habitat, core area or migration corridor, where, according to the knowledge and assumptions used as the basis for the analysis, the construction of wind turbines would have a negative impact. Zone 2 is the area surrounding Zone 1, which buffers the most important habitat from any disruptive or other impact that would otherwise extend into it, thereby reducing the quality of Zone 1 as a bird habitat. Zone 2 also includes areas that are important for ensuring habitat connectivity, such as flight corridors between roosting and feeding sites. Zone 3 areas require attention, where the presence of target species in the area or the habitat use of target species must be clarified by (preliminary) research when planning wind turbines, or the risk of death must be assessed, etc.

dubius), black stork (*Ciconia nigra*), marsh harrier (*Circus aeruginosus*), red-breasted flycatcher (*Ficedula parva*), pygmy owl (*Glaucidium passerinum*), red-backed shrike (*Lanius collurio)*, honey buzzard (*Pernis apivorus)*, green woodpecker (*Picus viridis)*.

According to the MLA, there are no MLA zones 1, 2 or 3 areas associated with the location or resting place of any species in the bird area that would potentially extend to suitable wind farm areas. **The impact on the Otepää bird area is therefore ruled out. There are no habitats of species subject to conservation objectives within the area that would be connected to potential wind farm areas by important feeding areas or movement corridors.**

The Võrtsjärve bird area (EE0080571), located 7.3 km from the nearest potentially suitable area, also falls within the impact area of the potential wind farm areas. Species whose habitats are protected: reed warbler (*Acrocephalus arundinaceus)*, northern pintail (*Anas acuta)*, wigeon (*Anas penelope)*, mallard (Anas platyrhynchos), garganey (*Anas querquedula)*, greater white-fronted goose (*Anser albifrons)*, bean goose (*Anser fabalis)*, pochard (*Aythya ferina)*, tufted duck (*Aythya fuligula)*, bittern (*Botaurus stellaris)*, goldeneye (*Bucephala clangula)*, black tern (*Chlidonias niger)*, black stork (*Ciconia nigra)*, marsh harrier (*Circus aeruginosus)*, corncrake (*Crex crex)*, Bewick's swan (*Cygnus columbianus bewickii)*, coot (*Fulica atra)*, white-tailed eagle (*Haliaeetus albicilla)*, lesser *black-backed* gull (*Larus fuscus)*, black-headed gull (*Larus ridibundus)*, bluethroat (*Luscinia svecica)*, smew (*Mergus albellus)*, goosander (*Mergus merganser)*, osprey (*Pandion haliaeetus)*, ruff (*Philomachus pugnax)*, great crested grebe (*Podiceps cristatus)*, little crake (*Porzana parva)*, spotted crake (*Porzana porzana)*, common tern (*Sterna hirundo)*, wood sandpiper (*Tringa glareola)*, lapwing (*Vanellus vanellus)*.

According to the MLA, there is a potential overlap between the conservation target species, the great crested grebe, and zone 3, which is associated with the stopover site originating from Lake Võrtsjärv, and potentially suitable area 1. **An impact on the conservation objectives of the Lake Võrtsjärv bird area cannot therefore be ruled out**. **A relevant assessment must be carried out.**

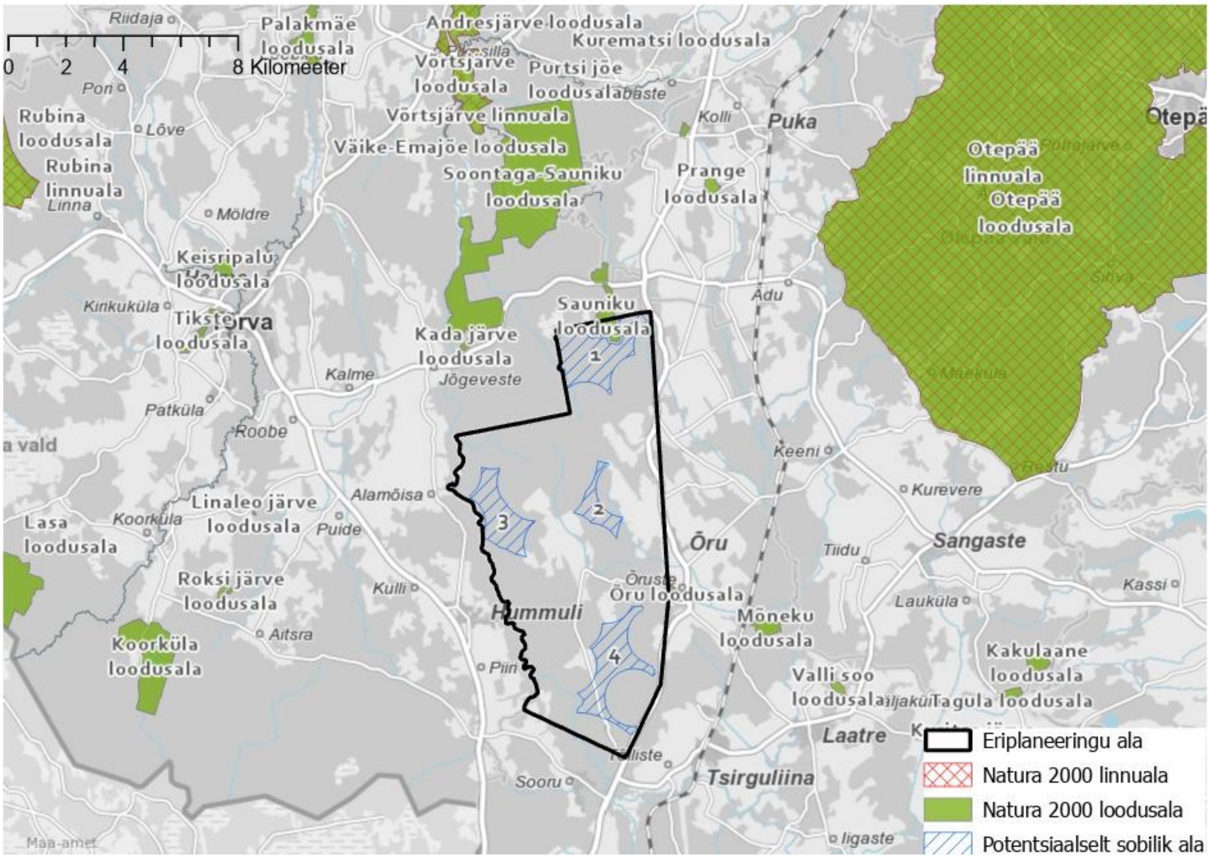

Figure 8. Location of special planning areas and potentially suitable wind farm areas in relation to Natura areas . Source: EELIS (Estonian Nature Information System), Environmental Agency 10.01.2024.

4.1.1.2 Relevant assessment of Natura

4.1.1.2.1 Characteristics of Natura areas

The Sauniku nature reserve was established to protect the habitat types listed in Annex I and the species listed in Annex II of the Habitats Directive. Protected habitat type: transition mires and quaking bogs (7140). Species whose habitats are protected: bog orchid (*Liparis loeselii)*, yellow saxifrage (*Saxifraga hirculus).*

The fen orchid is at the northern limit of its range in Estonia, growing only on the Åland Islands to the north-west of us and on the neighbouring Swedish coast. As a lime-loving species, the fen orchid is more widespread in western Estonia, but isolated occurrences are also known elsewhere in Estonia. In total, there are about fifty more or less viable populations in Estonia, but mostly only a few plants have been found in them, as the plants are difficult to spot and do not form an above-ground part every year. The bog orchid is a category II protected species, whose status has been assessed as vulnerable according to the Estonian Red List. According to the species protection action plan, the habitats of the bog orchid are mainly threatened by drainage and scrub encroachment.

The yellow stonewort belongs to protection category II in Estonia and is listed in Annexes II and IV of the Habitats Directive. The total population of yellow stonewort has fallen from 100 to 40. The main threats are the intensification of agriculture and forestry and drainage. The species can only be protected by preserving its habitats from change. The main habitat type for the yellow iris in Estonia is spring fens (draft action plan for the protection of the yellow iris). The species is listed as vulnerable in Estonia.

The main value of the Sauniku nature reserve is its mire communities and endangered species, the yellow bog orchid and the bog bilberry. The favourable status of habitats and growing sites is ensured through natural development. The conservation management plan for the area was approved by order no. 1-3/24/108 of the Deputy Director General of the Environmental Board on 22 March 2024.

Table 2. Conservation objectives and influencing factors for the Sauniku nature reserve.

Conservation value	Condition (area/self-sustaining)	Conservation objective	Impact rid	Protection measures planned in the protection plan Measures	Expected result	Comments
Natura objectives						
Liparis loeselii LKS – I, KE – yes LoD – I, LoA - yes	4.6 ha / 80 plants	Preservation of suitable growing site 4.6 ha. 80 plants	Drain	Leave the growing site to develop naturally. Impact of ditching impact study	Suitable growing site preserved 4.6 ha. 80 plants	
Yellow saxifrage (*Saxifraga hirculus*) LKS – I, KE – yes LoD – I, LoA - yes	20.7 ha / 200 gen. sapling	Preservation of suitable growing sites 20.7 ha. 200 gen. võsu	Drain	Leave the growing site to develop naturally. Impact of ditching impact study	A suitable growing site has been preserved on 20.7 ha. 200 gen. sapling	
National objectives						
single-leaved bog orchid (*Malaxis monophyllos*) KE – yes, LoD – no, LoA – no	0.63 ha / status unknown	Preservation of suitable habitat 0.63 ha. Clarification of data.	Drainage	Leave the habitat to develop naturally. Study of the impact of ditching Inventory	Suitable growing site has been preserved.	2017 inventoryany specimens were found.

Coralroot (*Corallorhiza trifida*) KE – yes, LoD – no, LoA – no	0.58 ha / 23 plants	Preservation of suitable habitat 0.58 ha.	Drainage	Leave the habitat to develop naturally. Impact of ditching impact study	Suitable habitat has been preserved. 20 specimens	

The Võrtsjärve bird area (EE0080571) is located 7.3 km from the nearest potentially suitable area.
The species whose habitats are protected are listed in Table 3.

The Võrtsjärve bird area covers 29,730 ha and is located in Tartu, Viljandi and Valga counties. The bird area includes the entire Lake Võrtsjärv and some of the meadows maintained on the lake shore. Lake Võrtsjärv is Estonia's largest inland lake. Lake Võrtsjärv is an eutrophic lake, and in recent decades, the spread of reeds has accelerated.

The Lake Võrtsjärv bird area is an internationally important bird area, regularly hosting significant numbers of globally threatened species or other species of global conservation value. It is an important stopover site for the smew (*Mergellus albellus)* (9% of the migratory population), the greater white-fronted goose (*Anser albifrons)* (3.5% of the migratory population), the northern shoveler (*Anas clypeata)* (2% of the migratory population) and the tundra swan (*Cygnus columbianus)* (1% of the migratory population). The greater white-fronted goose migration population (35,000 individuals) is known to be the largest in Estonia. On an Estonian scale, the Lake Võrtsjärv bird area is important for the great crested grebe (*Podiceps cristatus)*, goosander (*Mergus merganser)*, bean goose (*Anser fabalis)* and goldeneye (*Bucephala clangula)*, among others. A large number of other species also stop, feed and nest here to a significant extent. A total of 214 species have been recorded in and around Lake Võrtsjärv. The area is an internationally important bird area (IBA).

A conservation management plan for Lake Võrtsjärv for 2011-2020 has been drawn up for the area.

Threats to the bird area include land use decline, recreational activities and lake eutrophication.

Table 3. Conservation objectives for the Lake Võrtsjärv bird area based on the Natura standard database report.

Species		Area population				Area assessment			
Latin	Estonian	Type	Size		Unit	A|B|C|D	A|B|C		
			Min	Max		Pop.	Protection	Separation	Overall
Acrocephalus arundinaceus	reed warbler	r	100	150	p	B	A	B	A
Anas acuta	soopart	r	2	3	p	B	C	B	C
Anas platyrhynchos	blue-throated duck	r	100	120	p	C	B	C	B
Anas platyrhynchos	blue-throated duck	c	1500	1500	i	C	B	C	B
Greater white-fronted goose	greater white-fronted goose	c	14100	14100	i	B	A	C	A
Anser fabalis	rabahani	c	2500	2500	i	C	B	C	C
Aythya ferina	red-crested pochard	r	40	60	p	B	B	C	B
Aythya fuligula	tufted duck	r	40	60	p	C	C	C	C
Botaurus stellaris	bittern	r	25	35	p	A	A	C	A
Branta leucopsis	white-cheeked goose	c	320	320	i	C	C	C	C
Bucephala clangula	sõtkas	c	2000	2000	i	C	B	C	B
Calidris pugnax	radar	c	3000	3000	i	C	A	C	A
Black tern	black tern	r	100	150	p	B	A	B	A
Chroicocephalus ridibundus	black-headed gull	r	500	500	p	C	B	C	C
Ciconia nigra	black stork	r	1	1	p	C	C	B	B

Circus aeruginosus	roo-loorkull	r	10	15	p	B	A	C	A
Crex crex	corn crake	r	30	50	p	C	C	C	C
Cyanecula svecica	bluebird	r	2	2	p	B	A	B	A
Cygnus columbianus bewickii	little grebe	c	250	250	i	C	B	C	C
Fulica atra	lauk	r	20	30	p	C	B	C	B
Haliaeetus albicilla	white-tailed eagle	r	2	2	p	B	B	C	A
Larus fuscus	black-headed gull	r	1	1	p	C	B	B	C
Mareca penelope	viupart	r	2	2	p	B	B	B	C
Mareca penelope	viupart	c	1100	1100	i	B	B	B	C
Mergus albellus	small merganser	c	2140	2140	i	B	A	C	A
Mergus merganser	ice skater	c	1800	1800	i	C	B	C	B
Pandion haliaetus	fish eagle	r	1	1	p	B	B	C	B
Great crested grebe	great crested grebe	c	1700	1700	i	B	B	C	A
Podiceps cristatus	great crested grebe	r	80	120	p	B	B	C	A
Porzana porzana	spotted crake	r	50	70	p	B	A	C	A
Spatula querquedula	rägapart	r	35	45	p	C	B	C	B
Sterna hirundo	common tern	r	50	70	p	C	B	C	C
Zapornia parva	small cuckoo	r	1	1	p	B	C	C	C
Tringa glareola	mud snipe	c	1000	1000	i	C	A	C	A
Vanellus vanellus	lapwing	r	30	50	p	C	C	C	C

4.1.1.2.2 Impact on conservation objectives

Habitat type protected in the **Sauniku** nature reserve: transition mires and quaking bogs (7140). Species whose habitats are protected: *Liparis loeselii*, *Saxifraga hirculus*.

The known growth sites of protected species and the mire community that is the conservation objective extend potentially suitable area TU1 by 100 m. When establishing a wind farm, the species may be threatened primarily by changes in the water regime of the growth site/habitat. The construction of wind farms involves the construction of platforms, roads and, if necessary, embankments or drainage ditches to ensure the stability of the platforms and roads. In the case of Natura sites, the impact area of wind turbines and infrastructure is generally estimated to be 100 m from the site ([28]. In the case of communities that are sensitive to changes in the water regime, the potential significant impact area can be estimated at up to 250 m ([29]. In the case of particularly sensitive communities (transitional mires), the impact of the construction of a wind farm is limited to

[28] Impact of onshore wind farms on biota and recommendations of the Environmental Board for their planning in local government comprehensive plans (as of 10 November 2021).
[29] Helm, A., Kull, A., Veromann, E., Remm, L., Villoslada, M., Kikas, T., Aosaar, J., Tullus, T., Prangel, E., Linder, M., Otsus, M., Külm, S., Sepp, K., 2020 (updated 2021). Final report on the nationwide assessment and mapping of the status of forest, bog, meadow and agricultural ecosystems and the baseline levels of ecosystem services. ELME project. Commissioned by: Environmental Agency (public procurement no. 198846).

The impact of drainage structures may extend up to 400 metres[30]. The extent of the impact area in terms of plant species habitats and plant communities does not depend directly on the dimensions of the wind turbine tower and blades, but on the location of the construction areas associated with the construction of the foundation and infrastructure and the possible extent of changes in the soil water regime. In this case, the habitat of the protected species is located 100 m away in the nature reserve. However, it is a wetland habitat. **Therefore, the impact of planning TU1 wind turbines in a potentially suitable area on the conservation objectives of the Sauniku nature reserve cannot be ruled out.**

The Võrtsjärve bird area is an important stopover site for the little grebe, the little bittern and the great crested grebe. The threats to the Võrtsjärve bird area include a decline in land use, the tourism industry and the eutrophication of the lake. The minimum distance of the potentially suitable wind farm TU1 from the bird area is 7.3 km. Other areas are even further away. According to the MLA, wind turbines should not be built within 1 km of the coast of the sea and large lakes (e.g. Peipsi, Võrtsjärv). This distance is guaranteed for all areas. The Natura preliminary assessment revealed that, in terms of species-specific occurrence, the MLA zone 3 area associated with the stopover site of the great crested grebe, a species protected in the area, which originates from Lake Võrtsjärv, overlaps with the potentially suitable area TU1 (Figure 9).

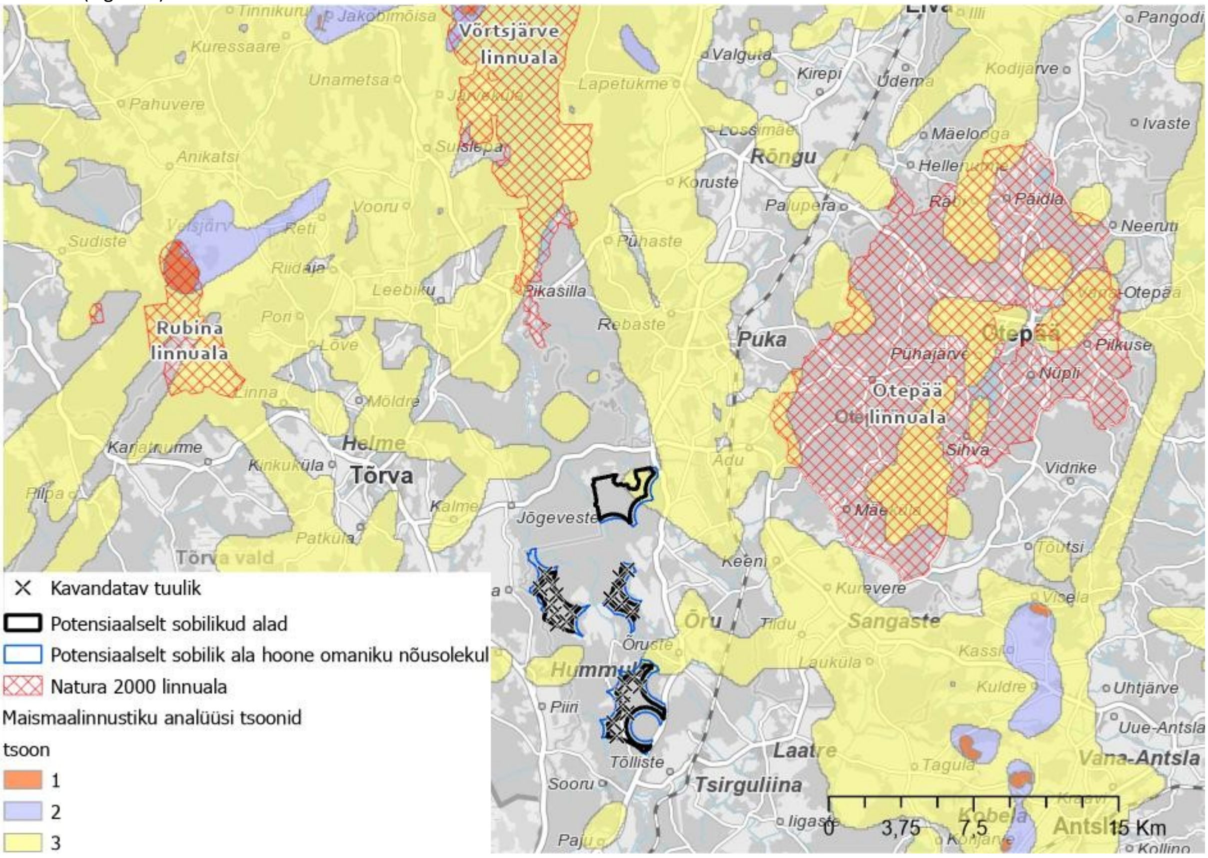

Figure 9. MLA zoning of the great crested grebe and the common snipe associated with the Lake Võrtsjärv bird area in relation to potentially suitable areas.

[30] University of Tartu. 2023. Guidelines for the implementation of mitigation and compensation measures for the negative impacts of land improvement systems. Updated version.

Table 4. Impact on the conservation objectives of the Lake Võrtsjärv bird area.

Species and protection category a	Habitat location	Description of habitat use	Impact assessment
Rästas-roolind	Habitat is not registered in EELIS .	The reed bunting prefers dense reed beds as its habitat. In the Võrtsjärve bird area, the reed bunting is protected in the Valga County part of the Võrtsjärve conservation area.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.
Viupart	The habitat is not registered in EELIS .	The common snipe is a numerous migrant in Estonia, but a rare breeder. It nests in grass near water bodies. According to the Võrtsjärve conservation management plan, important gathering places for common snipes in spring are the Tarvastu, Sangla and Valguta polders and the meadows along the Väike Emajõgi River.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. According to Annexes 6 and 7 of the Võrtsjärve Conservation Area Management Plan 2011-2020, the potential wind farm areas are located far from the most important spring and autumn migration gathering places for waterfowl and coastal birds. A buffer zone of 1 km, as recommended for large lakes, is guaranteed. km buffer zone is guaranteed. Adverse effects are ruled out.
Soopart e pahlsaba-part (II)	The habitat is not registered in EELIS .	The common pochard is mainly found on lakes, in narrow bays, bogs, marshy areas and river mouths. In summer, it prefers open and wet marshy areas with little vegetation. During the winter period, it prefers inland freshwater bodies. According to the Võrtsjärve conservation management plan, important gathering places for ducks in spring are the Tarvastu, Sangla and Valguta polders and the meadows along the Väike Emajõgi River.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The areas designated for species-related zoning in accordance with the MLA do not extend to potentially suitable areas. According to Annexes 6 and 7 of the Võrtsjärve Conservation Area Management Plan 2011-2020, the potential wind farm areas are located far from the most important spring and autumn migration gathering places for waterfowl and coastal birds. A buffer zone of 1 km, as recommended for large lakes, is guaranteed. km buffer zone is guaranteed. Adverse effects are ruled out.
Blue-throated loon	The habitat is not registered in EELIS .	The blue-throated duck nests in a sheltered spot on the ground near a body of water. According to the Võrtsjärve conservation management plan, important gathering places for ducks in spring are the Tarvastu, Sangla and Valguta polders and the meadows along the Väike Emajõgi River.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. According to Annexes 6 and 7 of the Võrtsjärve Conservation Area Management Plan 2011-2020, the potential wind farm areas are located far from the most important spring and autumn migration gathering places for waterfowl and coastal birds. A buffer zone of 1 km, as recommended for large lakes, is guaranteed. km buffer zone is guaranteed. Adverse effects are ruled out.
Rägapart	The habitat is not registered in EELIS .	The common snipe is a common but scarce breeding bird in Estonia. It inhabits lake shores and coastal meadows. According to the Võrtsjärve conservation management plan, important gathering places for waterfowl in spring are the Tarvastu, Sangla and Valguta polders and the meadows along the Väike Emajõgi River.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and the others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. According to Annexes 6 and 7 of the Võrtsjärve Conservation Area Management Plan 2011-2020, potential wind farm areas are located far from the most important spring and autumn migration routes of waterfowl and shorebirds.

			migration gathering places. A 1 km buffer zone, as recommended for large lakes, is guaranteed. km buffer zone is recommended for large lakes. Adverse effects are ruled out.
Greater white-fronted goose	The habitat is not registered in EELIS .	The greater white-fronted goose does not nest in Estonia. During migration, greater white-fronted geese stop in complex landscapes of wetland fields, feeding during the day in fields and natural grasslands and resting and spending the night in wetlands (lakes, sea bays, marshes or flooded meadows and polders). According to the Võrtsjärve conservation management plan, the geese's feeding areas are the polders around Lake Võrtsjärv (Tarvastu, Valguta and Tamme polders). The geese's resting area during spring migration is the central part of Lake Võrtsjärv up to Tondisaare.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and the others are even further away. According to Annexes 6 and 7 of the Lake Võrtsjärv Conservation Management Plan 2011-2020, the potential wind farm areas are located far from the most important spring and autumn migration gathering places for waterfowl and coastal birds (Tarvastu, Valguta and Tamme polders). At the same time, zone 3 (a low-intensity migration corridor) associated with Lake Võrtsjärv resting areas under the MLA overlaps with the eastern part of TU1. Bird surveys conducted in the area show that geese migrate across potentially suitable areas in spring and autumn, which is a significant migration route. The connection with Lake Võrtsjärv is unclear, but possible. There may be an adverse impact. Mitigation measures are necessary .
Rabahani	The habitat is not registered in EELIS .	Rabahani does not breed in Estonia, but is a numerous migrant. During migration, geese stop in complex landscapes of wetlands and fields, feeding early in the morning in fields and natural grasslands. Their resting and roosting areas are very diverse wetlands (lakes, sea bays, lagoons, peat bogs, flooded meadows and polders). Compared to the greater white-fronted goose, the bean goose feeds more on cultivated land and less on natural grasslands. According to the Võrtsjärv conservation management plan, the feeding areas for geese are the polders around Lake Võrtsjärv (Tarvastu, Valguta and Tamme polders). The resting area for geese during spring migration is the central part of Lake Võrtsjärv up to Tondisaare.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and the others are even further away. According to Annexes 6 and 7 of the Lake Võrtsjärv Conservation Management Plan 2011-2020, the potential wind farm areas are located far from the most important spring and autumn migration gathering places for waterfowl and coastal birds (Tarvastu, Valguta and Tamme polders). At the same time, zone 3 of the MLA-compliant Lake Võrtsjärv stopover area (a low-intensity migration corridor) overlaps with the eastern part of TU1. Bird surveys conducted in the area show that geese migrate across potentially suitable areas in spring and autumn, which is a significant migration route. The connection with Lake Võrtsjärv is unclear, but possible. There may be an adverse impact. Mitigation measures are necessary .
Red-crested pochard	The habitat is not registered in EELIS .	The red-necked phalarope is a migratory bird and a rare breeder in Estonia. During migration , it prefers reed beds alternating with open water areas.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.
Tuttvart	The habitat is not registered in EELIS registered	The Tuttvart is active on sea islands and the coast, near large and small lakes, on river banks, fish ponds and bog pools. They usually nest in dense colonies, often in colonies of black-headed gulls, as this reduces the risk of predation is lower.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no MLA-compliant species-related zoning areas within the potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.
Hüüp (II)	Habitat KLO9117394	The bittern lives in large reed beds, especially in reed-covered lakes or sea bays. The bittern is protected in the Võrtsjärve bird area in the Valga and Viljandi parts of the Võrtsjärve conservation area.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. Large lakes are guaranteed . Adverse effects are ruled out.

White-cheeked -lagle (III)	The habitat is not registered in EELIS .	A common migrant in Estonia, nesting mainly on small islands.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no MLA-compliant species-related zoning areas do not extend to potentially suitable areas. Adverse impact is ruled out.
Sõtkas	The habitat is not registered in EELIS .	The Sõtkas is a numerous migrant and winter visitor in Estonia, as well as an increasingly numerous breeding bird. According to the Võrtsjärve conservation management plan, the southern part of Lake Võrtsjärv is an important gathering place for them during autumn migration.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and the others are even further away. The areas designated for zoning in accordance with the MLA do not extend to the potentially suitable areas. According to Annexes 6 and 7 of the Lake Võrtsjärv Conservation Management Plan 2011-2020, the potential wind farm areas are located far from the most important spring and autumn gathering places for waterfowl and shorebirds. A buffer zone of 1 km, as recommended for large lakes, is guaranteed. km buffer zone is guaranteed for large lakes. Adverse effects are ruled out.
Black-tailed godwit (III)	Habitat KLO9120857	The black-tailed godwit nests in shallow areas at the edges of water bodies or in flooded areas on mudflats or floating vegetation.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area and others even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.
Black stork (I)	Black storks are protected in the Võrtsjärve bird area in the Kiviaru permanent conservation area (KLO3000521) and Kärma permanent conservation area (KLO3000924).	The habitats of black storks are primarily old, naturally diverse forest areas with minimal disturbance and favourable feeding grounds. The main food source of black storks is small fish and amphibians. The bird mainly searches for food in shallow, sheltered flowing or standing water bodies. Nesting sites are located in large forest areas far from human settlements. The species is very sensitive to disturbance. In the Võrtsjärv bird area, black storks are protected in the Kiviaru black stork permanent habitat (KLO3000521) and the Kärma black stork permanent habitat (KLO3000924).	When initially determining potential areas, a 3 km buffer zone around all known black stork habitats was taken into account. Potential wind farm areas are located more than 14 km away from black stork habitats in the bird area. This is a so-called zone 3 distance, i.e. an area requiring attention for this species according to the MLA. This ensures a sufficient distance to avoid adverse effects on the species. Adverse effects are ruled out.
Roo-loorkull (III)	Habitat KLO9131625	The reed bunting is a small but common breeding bird in Estonia that nests in reed beds. During the hunting season, they can also be seen in fields, meadows and coastal pastures. Reed buntings can be observed in greater numbers on the shores of Lake Võrtsjärv .	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no potentially suitable areas within the species-related zoning areas specified in the MLA. An adverse impact is ruled out.
Corncrake (III)	Permanent grasslands on the shores of Lake Võrtsjärv	The corn crake is an open landscape species, spending most of its life on the ground in tall vegetation in grain fields, wet meadows, floodplains and clearings. The corn crake's habitat is protected in the Lake Võrtsjärv bird area in the Lake Võrtsjärv conservation area in Tartu County.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no potentially suitable areas within the species-related zoning areas specified in the MLA. An adverse impact is ruled out.
Little grebe (II)	Migration stopover k KLO9131633	The little grebe only occurs in Estonia during migration and does not breed here. During migration, it prefers shallow lakes and sea bays where there is plenty of food. According to the Võrtsjärve conservation management plan, the little swan's resting places in the Võrtsjärve region are polders and fields where they can feed. Little swan (*Cygnus columbianus bewickii Yarr*.)	The main threat is the risk of collision during flights between roosting and feeding areas. In addition to collisions, it must be taken into account that man-made structures can also cause birds to abandon feeding areas and create a barrier effect in bird flight corridors.

		The migration of the little grebe from the tundra southwards along the coast of the Arctic Ocean to the White Sea, and from there to the Gulf of Finland and Lake Peipsi. Some birds move to the Baltic Sea, while others follow Lake Peipsi as a guide. The spring migration follows the same route across Estonia. The fat reserves stored in Estonia in spring largely determine the status of the lesser white-fronted goose population and its breeding success. Although collisions with wind turbines have not yet been observed in Estonia, this is a significant risk in the wintering areas of the little grebe and the song thrush, as the flight altitude of swans is the same as that of turbines and, as large birds, swans have limited manoeuvrability (Lesser White-fronted Goose Conservation Action Plan, 2018). When it comes to the impact of man-made structures, it is very important to prevent risks already at the planning stage of potentially hazardous facilities. When constructing new overhead lines, wind farms and other artificial structures, it is important to treat the gathering place of small swans during migration as a functional whole, the effective functioning of which is ensured by conditions at the nodes of the cluster – roosting areas and feeding places, as well as the movement corridors between them.	As the areas are more than 1 km away from Lake Võrtsjärv and there is no overlap with migration corridors (which are shown in zones 2 and 3 of the MLA map layer), it can be concluded that there will be no adverse impact. According to Annexes 6 and 7 of the Lake Võrtsjärv Conservation Management Plan 2011-2020, the potential wind farm areas are located far from the most important gathering places for waterfowl and shorebirds during spring and autumn migration.
Lauk	The habitat is not registered in EELIS .	The coot is a common breeding bird in Estonia, nesting on vegetation-rich lakes and shallow inland bays, as well as in the reeds of rivers and ponds.	No adverse impact has been identified.
White-tailed eagle (I)	Habitats KLO9127570 KLO9127573	The white-tailed eagle is widespread throughout Estonia's coastal areas and near large inland water bodies and rivers. The white-tailed eagle nests in old forests, where the average age of the nesting forest is 90 years in deciduous forests and 120-130 years in coniferous forests. The bird prefers to build its nest in pine forests and mainly prefers pine and aspen as nesting trees. The white-tailed eagle has almost no natural enemies, and therefore it can be assumed that the species' choice of habitat is based on feeding conditions and intraspecific competition. The white-tailed eagle (*Haliaeetus albicilla)* conservation action plan states that wind farms and individual large wind turbines must not be built closer than 2 km to eagle nests in order to prevent eagles from being killed by wind turbines and within 1 km of important feeding areas (coasts, wetlands, lakes). Wind turbines may also not be built on the main flight corridors between nests and feeding areas. The MLA provides a 2 km buffer zone around white-tailed eagle nests in Zone I.	According to the species protection action plan and the MLA, a 2 km buffer zone around the nest must be taken into account in order to rule out any adverse effects. In this case, the required distance is guaranteed for all habitats within the bird area. Adverse effects are ruled out.
Tõmmuka jackdaw (II)	The habitat is not registered in EELIS .	The black-headed gull is a rare breeding bird on small offshore islands. During the migration period, individual birds can be found anywhere at sea, but also inland. The black-headed gull is protected in the Võrtsjärve bird area in the Võrtsjärve conservation area in Viljandi County.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.

The habitat is not listed in EELIS.	The habitat is not registered in EELIS .	The black-headed gull prefers to nest colonially, readily inhabiting sea islands and coastal reed beds. However, they can also be found nesting on inland water bodies (bog lakes or polders). The nest is built on the shore of the water body. The black-headed gull is protected in the Lake Võrtsjärv bird area Lake Võrtsjärv conservation area in Viljandi County.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no potentially suitable areas within the species-related zoning areas according to the MLA. The recommended 1 km buffer zone with large lakes is guaranteed. Adverse effects are excluded.
Blue tit	The habitat is not registered in EELIS .	The bluethroat is a bird of the passerine family and its subspecies, the meadow bluethroat, is a rare breeding bird in Estonia, found in meadow grasslands and old peat bogs. In previous years, individual pairs have been found nesting in the Aardla polder (Ropka–Ihaste meadow).	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. A 1 km buffer zone with large lakes is guaranteed . Adverse effects are ruled out.
Väikekosk el (II)	The habitat is not registered in EELIS .	The little ringed plover is a rare migrant in Estonia. Lake Võrtsjärv is one of the best stopover sites. According to the Lake Võrtsjärv conservation management plan, the southern part of Lake Võrtsjärv is an important gathering place for them during autumn migration.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. The recommended 1 km buffer zone with large lakes is guaranteed. According to Annexes 6 and 7 of the Võrtsjärve Conservation Area Management Plan 2011-2020, the potential wind farm areas are located far from the most important gathering places for waterfowl and coastal birds during spring and autumn migration. Adverse effects are ruled out.
Jääkoskel	The habitat is not registered in EELIS .	In addition to the islands of Western Estonia and the northern coast of Estonia, the common goldeneye is also found on Lake Võrtsjärv and other water bodies in Southern Estonia. The common goldeneye mainly inhabits open water. It nests in all kinds of cavities, most often in tree hollows. According to the Võrtsjärv conservation management plan, the southern part of Lake Võrtsjärv is an important gathering place for them during autumn migration.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The areas designated for zoning in accordance with the MLA do not extend to potentially suitable areas. The recommended 1 km buffer zone around large lakes is guaranteed. According to Annexes 6 and 7 of the Võrtsjärve Conservation Area Management Plan 2011-2020, the potential wind farm areas are located far from the most important gathering places for waterfowl and coastal birds during spring and autumn migration. Adverse effects are ruled out.
White-tailed eagle (I)	KLO3000377	The osprey feeds on fish and hunts on larger rivers, lakes and sea bays. It flies up to 25 km to reach good feeding grounds. However, as a rule, it uses fishing grounds within a 10 km radius of its nest. In Estonia, ospreys generally nest in bog and forest landscapes, where their nests offer a view of the surrounding area for several kilometres. In the Võrtsjärve bird area, ospreys are protected in the Jõeküla osprey permanent reserve (KLO3000377).	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no potentially suitable areas within the species-related zoning areas specified in the MLA. An adverse impact is ruled out.
Radar (I)	The habitat is not registered in EELIS registered	In Estonia, the corncrake is primarily a bird of wet meadows, which readily inhabits floodplains and marshes. To a lesser extent, it also occurs in pastures with wide, boggy and worn areas. Near the nest, there are usually watery areas with sparse vegetation where the birds and later their young can feed. The species is protected in the Võrtsjärve bird area, Võrtsjärve conservation area in the Viljandi and Valga counties.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. The recommended 1 km buffer zone with large lakes is guaranteed. Adverse effects are ruled out.

Tuttpütt	The habitat is not registered in EELIS registered	The little grebe is a common breeding bird in Estonia, inhabiting lakes and bays and also nesting in the coastal zone of sea islands. Of the lakes, it prefers larger lakes with average nutrient and vegetation richness in the middle of the cultural landscape .	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no MLA-compliant species-related zoning areas within the potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.
Little bittern (II)	KLO9131635	The little crake is a rare breeding bird in Estonia. Its habitat consists of shallow sea bays and polders.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . An unfavourable impact is ruled out.
Spotted crake	The habitat is not registered in EELIS registered	The spotted crake lives in shallow wetlands with muddy, shallowly flooded soil and dense semi-aquatic vegetation, as well as trees. In Estonia, it prefers to nest in dense reeds or rushes on the seashore and in rushes, meadows, low and transitional bogs and polders located on the shores of inland water bodies. The species is less commonly found in coastal meadows and other wet grasslands. The species is protected in the Lake Võrtsjärv bird area in the Lake Võrtsjärv conservation area in Viljandi and Valga counties.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. The recommended 1 km buffer zone with large lakes is guaranteed. Adverse effects are ruled out.
Jõgitiir (III)	KLO9131627	The common tern builds its nest on islands or on the banks of rivers or lakes in the shade of lush vegetation, but it also does not shy away from areas populated by trees and shrubs. It lives in large colonies.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. There are no MLA-compliant species-related zoning areas within the potentially suitable areas. Large lakes are guaranteed. . Adverse effects are ruled out.
Mudatilde r	The habitat is not registered in EELIS .	The muddy tider is a common breeding bird in Estonia. Its habitat is bogs and fens, but during migration also the muddy shores of lakes, flooded meadows and hayfields. The species is protected in the Võrtsjärve bird area in the Võrtsjärve conservation area in the Viljandi .	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant zoning areas associated with the species do not extend to potentially suitable areas. A buffer zone of 1 km is recommended for large lakes . Adverse effects are ruled out.
Kiivitaja	The habitat is not registered in EELIS .	The corncrake is an open-country species that nests in bogs, fens, agricultural landscapes, hayfields and pastures, coastal meadows and islands. It can be found nesting almost everywhere except in large forest areas. The corncrake is protected in the Lake Võrtsjärv bird area in the Lake Võrtsjärv conservation area in Viljandi County.	The potentially suitable wind farm area TU1 is located *approximately 7.3* km from the bird area, and others are even further away. The MLA-compliant species-related zoning areas do not extend to potentially suitable areas. The recommended 1 km buffer zone with large lakes is guaranteed. Adverse effects are ruled out.

4.1.1.2.3 Impact on the integrity of Natura areas

Table 5. Checklist for the integrity of Natura areas.

Sauniku nature reserve	
Could the project or plan:	
Reduce the area of habitat types or the abundance of species for the protection of which the site was established?	No
Cause disturbance that could affect the size of populations or the balance or population density of species?	No
Cause species to relocate and thus reduce their range in the area?	No
Cause fragmentation of habitats or species listed in Annex I?	No
Causing a reduction or loss of key features (e.g. tree cover, openness to floodplains , annual flooding, etc.)?	Yes (part of TU1 closer than 400 m from conservation values)
Disturb the favourable conservation status of the area indicators used the balance, distribution and population density of key species used as indicators xml-ph-0004@deepl.internal?	No
Slow down or prevent the achievement of the conservation objectives of the area?	Yes (the part of TU1 that is closer than 400 m from conservation values)
Cause changes of critical importance, aspects aspects (e.g. nutrient balance) that determine the the favourable status of the area as a habitat or ecosystem?	Yes (the part of TU1 that is closer than 400 m from protected values)
Võrtsjärve bird area	
Could the project or plan:	
Reduce the area of habitat types or the abundance of species for which the area was established?	No
Cause disturbance that may affect the size of populations or the balance between species or population density?	Yes (especially in the case of TU1, disturbances during migration cannot be ruled out and mortality in collisions)
Cause species displacement and thus reduce their distribution range in the region?	No
Cause fragmentation of habitats or species listed in Annex I?	No
Causing a reduction or loss of key features (e.g. tree cover, openness to floodplains , annual flooding, etc.)?	No
Disturb the balance, distribution and population density of key species used as indicators of the favourable status of the area?	Yes (especially in the case of TU1, disturbances during migration cannot be ruled out and mortality in collisions)
Slow down or hinder the achievement of the conservation objectives of the area?	Yes (especially in the case of TU1, disturbances during migration cannot be ruled out disturbances and deaths in collisions)
Cause changes of critical importance, aspects aspects (e.g. nutrient balance) that determine the the favourable status of the area as a habitat or ecosystem?	No

4.1.1.2.4 Cumulative effects with other plans

There are no existing wind farms in the potential impact area of the Valga municipality **special plan.** Similarly, no additional wind farms are planned in the comprehensive plan for Valga Municipality.

Other wind farms may be planned within a 15 km radius of potential wind farm areas **under the special plan for the Tõrva municipality wind farm**. A draft special plan for the Tõrva municipality wind farm has been completed, which provides for the planning of a wind farm approximately 20 km away from the potentially suitable areas covered by the Valga municipality special plan. Considering the large distance, no significant cumulative impact is expected on any Natura area.

A second special plan for wind farms has also been initiated in Tõrva Municipality, for which there is no information available to assess the cumulative impact. As this is a much later plan, the cumulative impact must be assessed during the SEA for this plan, if necessary.

4.1.1.2.5 Planning of mitigation measures and conditions

The first stage of the local government spatial plan is generally appropriate to be treated as a higher-level strategic planning document and also as a 'plan' within the meaning of Article 6(3) of the Habitats Directive. The European Commission has stated in its guidance 'Management of Natura 2000 sites. Provisions of Article 6 of Directive 92/43/EEC on habitats' (2019/C 33/01), section 4.6.1, that an appropriate Natura assessment must be carried out before the plan is approved. The same guidance in section 4.7.3 is European Commission in turn has stated that
'A decision of approval may be given only after they are satisfied that the plan or project will not adversely affect the integrity of the site concerned.' Among other things, mitigation measures may prevent such an impact (section 4.6.6 of the guidelines). The relevant Natura assessment does not need to go into more detail or use more resources at the strategic planning document level than is necessary to achieve the conservation objectives of Natura sites, and it would be inappropriate and impractical to assess the impact in the level of detail normally required for a relevant assessment at the project level. Consequently, the level of detail of the higher-level strategic planning document itself determines the possible scope of the Natura assessment, i.e. the level of detail of the strategic planning document must be taken into account. If the level of detail of the strategic planning document does not allow for a final assessment of the effects of the planned activity, e.g. the construction and use phase (specific in terms of volume, location, etc.), as a result of the relevant Natura assessment, measures and conditions must nevertheless be provided for to exclude adverse effects on the Natura site and to allow the conclusion that there will be no adverse effects. To this end, measures or conditions must be proposed for the next planning or permit stage for each proposed activity or strategic planning document guideline that may have an impact on the conservation objectives and integrity of the Natura site.

At the preliminary site selection stage, there must be a fundamental conviction that, given the level of detail of the planning, it is possible, based on the available information, to carry out the planned activity at the selected site in such a way that adverse effects on Natura sites and conservation objectives are ruled out. The final conviction that the implementation of the plan will not have an adverse effect on the integrity of the Natura 2000 network area and conservation objectives must be established by the time the plan is adopted. This also means that **if, after the location has been selected, the design conditions procedure is to be continued, any adverse effects on Natura areas must be ruled out in the Natura assessment of the SEA report on the location selection.**

In this case, in order to rule out significant adverse effects on the proposed bird area, it is necessary to implement mitigation measures. The measures are presented in Table 6.

Table 6. Mitigation measures and their effectiveness.

Measure/condition	Effectiveness
In order to prevent adverse effects on the conservation objectives of the Sauniku nature reserve when planning the **TU1** wind farm in a potentially suitable area, the following measures must be taken: − prevent the construction of the wind farm and related infrastructure in the habitat type 7140 (transitional and floating bogs) and the growth areas of bog bilberry and yellow bog rush within 400 m of the protected area (except, if necessary, the reconstruction of an existing road that does not involve an increase in the impact of drainage towards the nature reserve). This ensures	Effective

Measure/condition	Effect
the preservation of the growth site/habitat type and the exclusion of possible changes in the water regime. − When planning the wind farm, constructing new drainage systems and reconstructing existing ones, it must be ensured in the construction projects that the drainage effect of the drainage system does not extend to the nature reserve. The project for water drainage during construction and drainage of the area, together with mitigation measures, must be prepared by a designer with the relevant competence and experience. The construction period for wind turbine foundation pits must be kept to a minimum in order to prevent long-term lowering of the water level in the surrounding areas. When preparing foundation construction projects, the extent of the lowering must be assessed. If the water level in the area of communities that are the conservation objective of the nature reserve may be lowered by more than 0.5 m, construction measures must be taken to prevent significant water level reduction in the habitat types of the nature reserve. The designer shall select the appropriate construction measures. surrounding the water level avoiding constructional measure may be e.g. use of sloping walls in foundation trenches.	
A bird survey has identified relatively active migration movements of geese in all potentially suitable areas. A direct connection with the Võrtsjärv bird area has not been confirmed, but it is likely to exist. According to the MLA, the zone 3 area of the great white-fronted goose associated with Võrtsjärv extends to area TU1. A bird survey conducted in the area (see also section 4.1.1.3) showed high goose migration activity in all areas. Based on the precautionary principle, the following measures should be taken when planning a wind farm: − during the migration period, wind turbines should be shut down during periods of high bird activity or by means of an appropriate control system in all location areas. Based on spot observations, migration is most active in this region in autumn from 1 to 20 October and in spring from 15 March to 15 May. Scientific studies have shown the effectiveness of such measures in preventing collisions and thus also in preventing bird deaths[31]. The length of the period and the need for implementation can be specified on the basis of follow-up monitoring.	Effective

4.1.1.3 Natura assessment results and conclusion

The location of the Natura 2000 network areas has been taken into account in the preliminary selection of the location for the special plan in order to ensure the favourable status of the areas and their conservation objectives. Natura 2000 areas with primary buffers were excluded as potentially suitable areas in the initial map analysis. A further analysis found that by implementing an additional protection buffer around the Sauniku nature reserve and stopping the wind turbines during the migration period using a time-based or corresponding control system, there would be no significant negative impact on any Natura bird and nature areas based on the available information.

The wind farm solution developed as part of the planning process rules out any significant adverse impact on the integrity and conservation objectives of Natura bird and nature areas. The solution takes into account the mitigation measures set out in Table 6.

[31] IFC (International Finance Corporation), EBRD (European Bank for Reconstruction and Development, KfW Group 2023. Post-Construction Bird and Bat Fatality Monitoring for Onshore Wind Energy Facilities in Emerging Market Countries. Good Practice Handbook and Decision Support Tool. https://www.ifc.org/en/insights-reports/2023/bird-bat-fatality-monitoring-onshore-wind-energy-facilities

4.1.2 Impact on vegetation

In the case of wind farms, **the impact on vegetation** may occur during the construction phase through the direct removal of vegetation from the construction sites and damage to vegetation associated with construction activities (trampling by machinery in the immediate vicinity of the construction sites).

The extent of the direct impact area is limited to the actual construction site area of the wind turbines and related infrastructure. Clearing (in forested areas) and soil works are carried out in the wind turbine assembly areas, areas used by construction machinery, areas at the bases of new connection corridors and areas with underground cables associated with the wind farm (underground cables are subject to a 1 m protective zone on both sides of the line's outer cables([32]).

Clearing will be carried out if the above-mentioned areas overlap with forest land. It is not necessary to clear the forest along the entire length of the wind turbine blade, as the blade extends significantly higher than the height of the forest.

The activity that causes the most vegetation removal is the construction of roads in the wind farm. The size of the road construction area depends largely on the existing roads in the area and their potential use, as well as the planned location of the wind turbines. At the preliminary selection stage of the wind farm location, the assessment of the road area is subject to uncertainty, as the approximate locations of the roads are determined, which may be specified during the design phase.

The need to remove vegetation depends very much on the exact layout of the wind farm. It can be roughly estimated that the area directly related to the construction of wind turbines is approximately 1 ha, to which 1–2 ha of construction areas related to roads and routes can be added.

Indirectly, the construction of a wind farm may affect plant communities through changes in the water regime or light conditions. The extent of indirect impacts depends on the type of community and the nature of the construction activity. In the case of dry communities, the impact may extend a few metres from the construction areas. In the case of wetlands, the impact may extend to several hundred metres from the construction areas.

There is little data in scientific literature on the impact of wind farms on vegetation during their lifetime. Scientific studies have observed possible changes in vegetation characteristics in connection with microclimatic changes caused by wind farms([33]) No significant impact on vegetation during the operational life of wind farms has been identified to date.

4.1.2.1 Assessment methodology

The impact on vegetation was assessed in potentially suitable areas mapped in the special plan area. To this end, existing data on protected plant species, valuable forest habitats, habitats under the Habitats Directive and areas of ecosystems in good condition were analysed in the Estonian Nature Information System, Environmental Agency (hereinafter EELIS) database and the Environmental Agency ELME map layer catalogue (2021). **The aim of the assessment was to identify known and potential higher vegetation value community parts in potentially suitable areas, the avoidance of which as a construction area would prevent significant adverse effects on vegetation.** By excluding potentially higher-value habitat types from the wind farm location, the likelihood of finding high-value plant communities through additional surveys is also significantly reduced.

Potentially suitable area 1 and the northern part of potentially suitable area 3 overlap with the so-called national priority areas for wind energy development, where nature studies have been commissioned by the Environment Agency. With regard to vegetation, vegetation studies have been completed at the time of preparation of this SEA report

[32] Regulation No. 73 of the Minister of Economic Affairs and Infrastructure of 25 June 2015, 'Extent of the protective zone of a building, procedure for operating in the protective zone and requirements for marking the protective zone', § 10(3).

[33] Diffendorfer et al. 2022. Wind turbine wakes can impact down-wind vegetation greenness. DOI 10.1088/1748 9326/ac8da9.

meadow habitats [34] , bog habitats [35] and forest habitats under the Habitats Directive [36] . The relevant research results have been used in the SEA report.

In areas not covered by national research areas, a vegetation study was carried out in parallel with the preparation of the plan, i.e. after the initial draft solution had been prepared. The survey is carried out in the potential locations of wind turbines and possible access roads/sites, i.e. in areas potentially affected by construction activities and in areas within a radius of at least 50 m. During the vegetation survey, the locations of protected vascular plants, fungi and moss species were mapped. Where a protected species was found, its abundance in the area was determined and its location mapped. In addition, communities of high ecological value are mapped in the area – areas that potentially meet the criteria for valuable forest habitats and communities that correspond to habitat types of higher representativeness (A and B) in the Habitats Directive. The survey is carried out if construction areas are planned in areas with potentially high biological diversity, for which vegetation data is insufficient. Areas with high biological diversity are considered to be potential and known areas of habitat types listed in the Habitats Directive (in the case of forests, forest stands older than 60 years), semi-natural communities and wetlands. Fieldwork for the vegetation inventory took place on 20, 21 and 25 July and 5 August 2024. The fieldwork was carried out by Eliisa Pass, Margit Turb and Liisi Peets. A GPS device was used during the inventory to record the route taken, important points of interest and areas worthy of protection. The inventory area was surveyed along transects located in the centre of the buffer zone in younger forests (under 60 years old). More thorough inventories were carried out in higher-value communities (i.e. forests over 60 years old). Particular attention was paid to potential orchid sites.

4.1.2.2 Protected plant species

Species under nature conservation in Estonia are divided into three categories. Category I includes species that are predominantly declining in number and critically endangered, with habitats in poor condition and at high risk of destruction, whose continued survival in the Estonian environment is doubtful if the threats continue. Category II protected species in Estonia are species that occur in a very limited area or in few habitats, and whose numbers are declining and range is shrinking. Category III protected species in Estonia are species that are relatively common, but whose numbers may be in critical decline. The overlap between potentially suitable areas and the habitats of protected plant species is presented in Table 7.

Table 7. Overlap of protected plant species locations with potentially suitable areas. Source: EELIS 16.09.2024. For potentially suitable areas, the locations of protected species mapped during the national wind farm survey commissioned by the Environment Agency and the results of the inventory of protected plants are shown on a light green background.

Code	Name in Estonian	Name in Latin	Protection category	Area covered by the category (ha) and additional information or number
Potentially suitable area 1				
KLO9349171 KAUR 3050	Common spotted orchid	*Dactylorhiza fuchsii*	III	0.31 ha (observation on 10 July 2023, 35 plants), boggy forest, condition good
KLO9349320 KAUR 3520	two-leaved orchid	*Platanthera bifolia*	III	0.03 ha (observation on 10 July 2023, one plant specimen), boggy forest, condition good

[34] Heritage Conservation Association. 2023. Vegetation survey to identify priority areas for wind energy development for the Environmental Agency (Habitats Directive grassland habitats). FINAL REPORT.

[35] Estonian Nature Fund. 2023. Survey of bog habitats and plant species in potential wind energy development areas. Public procurement "Vegetation survey to identify priority areas for wind energy development for the Environmental Agency" part 3 Contract no. 4–5/23/3.

[36] Consultare OÜ. 2023. Inventory of forest habitats in the Valga-Tõrva study area under the Habitats Directive. Public procurement "Inventory of forest habitats under the Habitats Directive for identifying priority areas for wind energy development (Environmental Agency)", part 14.

Code	Name Estonian	Name in Latin	Protection category	Area covered by the category (ha) and additional information or number
KLO9349321 KAUR 3521	two-leaved orchid	*Platanthera bifolia*	III	0.03 ha (observation on 10 July 2023, two plants), boggy forest, condition satisfactory
KLO9349165 KAUR 3001	Baltic marsh orchid	*Dactylorhiza baltica*	III	0.04 ha (observation on 10 July 2023, 13 plants), rich in meadow plants forest clearing, condition satisfactory
KLO9349172 KAUR 3049	common spotted orchid	*Dactylorhiza fuchsii*	III	0.13 ha (observation on 10 July 2023, 60 plants), boggy forest, condition good
KLO9349323 KAUR 3538	green-winged orchid	*Platanthera chlorantha*	III	0.03 ha (observation on 10 July 2023, five plants), young mixed forest, condition satisfactory
KLO9403015	feather moss	*Neckera pennata*	III	1.12 ha (observation on 26 March 2020, abundance 2 (VEP scale 1–3))
KLO9349390	pale red Finger orchid	*Dactylorhiza incarnata*	III	0.40 ha (observation on 20 June 2023, a few plants present)
KLO9349389	pale red finger orchid	*Dactylorhiza incarnata*	III	0.03 ha (observation on 20 June 2023, one plant specimen, area 10 m)
KLO9349391	pale red finger orchid	*Dactylorhiza incarnata*	III	0.56 ha (observation on 20 June 2023, one plant specimen)
KLO9349392	large marsh orchid	*Listera ovata*	III	0.56 ha (observation on 20 June 2023, one plant specimen)
KLO9349393	marsh helleborine	*Epipactis palustris*	III	0.56 ha (observation on 20 June 2023, rare)
Potentially suitable area 3				
KLO9345850	Creeping lady's tresses	*Goodyera repens*	III	3.31 ha (observation on 26 July 2019, eight specimens)
KLO9402079	feather moss	*Neckera pennata*	III	3.31 ha (observation on 26 July 2019, 15 specimens)
KLO9402084	Wulff's peat moss	*Sphagnum wulfianum*	III	3.31 ha (observation on 26 July 2019, three plant specimens)
KLO9402068	Heller's blue	*Crossocalyx hellerianus*	III	3.31 ha (observation on 26 July 2019, eight specimens)
KLO9349377	Devil's finger	*Dactylorhiza maculata*	III	0.56 ha (observation on 5 July 2023, rare)

The analysis revealed that only potentially suitable areas 1 and 3 contain locations of plant species in protection category III. There is no overlap with the locations of registered protected plant species in other areas. **Based on the developed planning solution, no additional locations of protected plant species were identified in areas TU2, 3 and 4 during fieldwork at the locations of wind turbines and roads.**

During the vegetation survey carried out in the areas of possible construction and their immediate vicinity in the developed preliminary planning solution (which consisted of 27 wind turbines and roads between them), the most common protected species found were 18 locations of the two-leaved toothwort, four occurrences of creeping lady's tresses, two occurrences of greater butterfly orchid, five occurrences of broad-leaved marsh orchid, three occurrences of bearberry, and one occurrence of brown beech. In addition, 8 locations of the common spotted orchid and 1 location each of the rarer species purple orchid, red helleborine, greater butterfly orchid and green lichen were mapped. During fieldwork, 33 locations of Category III plant species and 1 highly representative forest habitat type were mapped. The protected plant species identified are widespread in both Estonia and the region. In addition, many of the locations of protected species were in young or middle-aged commercial forests, and therefore these locations may not remain sustainable.

4.1.2.3 Forest communities, including valuable habitats

All four potentially suitable areas are predominantly forest land. The establishment of a wind farm requires the clearing of forest from the areas where the wind turbines will be built and from the areas where the infrastructure related to the wind farm will be located[37].

The overlap of potentially suitable areas with forest land, wetlands, open areas and arable land is presented in Table 8. In terms of land use, the construction of wind farms on arable land and open areas can be considered to have a lower environmental impact. In the case of wetlands and forests, the change in environmental conditions associated with the construction of a wind farm is greater and, as a rule, the environmental impact is also greater.

Table 8. Overlap of potentially suitable areas with forest land, wetlands, open areas and arable land land (ETAK data as of 17 September 2024).

Area no.	Area size, ha	Forest land area, ha (% of total area)	Wetland area, ha (% of total area)	Open are a, ha (% of total area)	Arable land area, ha (% of total area)
1	442.90	430.61 (97%)	9.25 (2%)	2.99 (1%)	0
2	128.33	126.33 (98%)	0.18 (0%)	1.45 (1%)	0.26
3	301.91	298.20 (99%)	2.23 (1%)	1.25 (0%)	0.12 (0%)
4	400.84	384.73 (96%)	0.20 (0%)	11.91 (3%)	1.39

In addition to the reduction in forest area, the ecological value of the affected forest communities is also important in assessing the significance of the environmental impact. Ecologically valuable parts of the forest are designated as valuable forest habitats. According to the Forest Act, a valuable forest habitat (VEP) is an area where there is a high probability of finding narrowly adapted, endangered, vulnerable or rare species. Habitats may be negatively affected if direct construction activities or related activities (e.g. logging) are planned in or in the immediate vicinity of their locations. The overlap of areas with habitats is presented in Table 9.

Table 9. Overlap of potentially suitable areas with valuable habitats. Source: EELIS 17.09.2024.

VEP code	VEP type	Area area, ha
	Potentially suitable area 1	
VEP127077	Wetland pine forests and birch forests	5.95
VEP127074	Alder forests	1.02
VEP208500	Other deciduous forests	1.12
VEP210405	Other deciduous forests	0.79
VEP150006	Wetland pine forests and birch forests	0.85
	Overlap of valuable habitats with potentially suitable areas 1. ha	**9.7**
	Percentage of valuable habitats overlapping with potentially suitable areas 1, %	**2.2**
	Potentially suitable area 3	
VEP127085	Pine forests and mixed pine forests	3.31
VEP127144	Aspen forests	1.04
VEP127143	Spruce forests and mixed spruce forests	1.84
VEP127212	Spruce forests and mixed spruce forests	0.94
VEP211197	River banks	0.06
VEP205347	Other deciduous forests	1.81
VEP204262	Surface cover	1.93
VEP204263	Spring areas	1.56
VEP204264	Pine forests and mixed pine forests	0.5

[37] Clearing is logging carried out to enable the land to be used for purposes other than forest management.

VEP code	VEP type	Area Overlapping area, ha
	Overlap of valuable habitats with potentially suitable area 3, ha	**12.99**
	Percentage of valuable habitats overlapping with potentially suitable area 3, %	**4.30**
	Potentially suitable area 4	
VEP127151	Wetland pine forests and birch forests	0.89
VEP204543	Pine forests and mixed pine forests	2.4
VEP206741	Aspen forests	3.04
	Overlap of valuable habitats with potentially suitable area TU4, ha	**6.35**
	Percentage of valuable habitats overlapping with potentially suitable area TU4, %	**1.58**

Potentially suitable areas 1, 3 and 4 partially overlap with valuable habitats. Considering the importance of valuable habitats in preserving biological diversity, wind turbines and related buildings, platforms and roads must be located in such a way that they do not overlap with valuable habitats. In the immediate vicinity of valuable habitats, the construction of drainage ditches and other structures that alter the water regime and significantly change the light regime should be avoided. In the case of VEP areas, a buffer zone of at least 50 m between the actual construction area (i.e. the blade may extend closer) and the VEP must be taken into account (unless existing conditions, such as an existing drainage system between the construction area and the VEP, prevent the additional impact of construction activities from spreading to the VEP area). In the case of valuable habitats located on protective soils, either a 250 m buffer zone or construction measures to prevent changes to the water regime must be implemented for structures that alter the water regime.

4.1.2.4 Habitats outside protected areas under the Habitats Directive

The legislative act governing nature conservation activities in the European Union is Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, adopted in 1992, or the Habitats Directive (HD). The aim of the Habitats Directive is to protect biotopes not only as habitats/growing sites for certain animal and plant species, but also as phenomena with intrinsic value. Habitats are defined in the directive as natural or semi-natural terrestrial or aquatic areas that are distinguishable from others by their geographical, abiotic or biotic characteristics. Areas with high-value habitat types under the Habitats Directive are protected as nature areas belonging to the Natura 2000 network. At the same time, habitats under the Habitats Directive have also been inventoried outside protected areas. Habitats under the Habitats Directive occur in all four potentially suitable areas (Table 10).

Table 10. Overlap of habitat types under the Habitats Directive with potentially suitable areas. Source: EELIS 19.09.2024. In the case of potentially suitable areas, the areas of meadow and bog habitats mapped during the national wind farm survey commissioned by the Environment Agency are shown on a light green background.

id	Habitat code	Habitat name	Area covered by the site, ha	Representativeness (and other important information value)
		Potentially suitable area 1		
-844842070	91D0*	Transitional bog and swamp forests	7.14	Representativeness: B[38] Structural preservation: I[39]
-847118887	91D0*	Transitional bog and swamp forests	1.40	Representativeness: B Structure preservation: II
-848734849	9010	Old natural forests	6.39	Representativeness: B Structure preservation: II
-848166362	9080	Bog and bog woodlands	1.69	Representativeness: B Structure preservation: II

[38] Representativeness: A – very good; B – good; C – considerable; D – poor representation; p – potential habitat.
[39] Structure preservation: I – very good; II – good; III – average.

id	Habitat code	Habitat name	Area covered Area, ha	Representativeness (and other important information about the value)
-847279164	9080*	Bog and bog woodlands	0.78	Representativeness: B Structure preservation: I
-868665206	91D0*	Transitional bog and bog forests	4.72	Representativeness: C Structure preservation: I
-864861293	91D0*	Transitional bog and swamp forests	0.85	Representativeness: B Structure preservation: I
-865470415	91D0*	Transitional bog and swamp forests	1.54	Representativeness: B Structure preservation: I
Overlap with potentially suitable area 1 total EELIS data			**24.51**	
KAUR 25291	6430	Moisture-loving high grasslands	1.13	Representativeness: B Structure preservation: II
KAUR 25292	6510	Aas-rebasesaba and ürt-red clover meadows	1.40	Representativeness: B Structure preservation: II
Overlap with potentially suitable area 1 total Based on KAUR data			**2.53**	
EELIS and KAUR areas combined			**27.02**	
Potentially suitable area 2				
540145481	9080	Bog and bog woodlands	8.21	Representativeness: C Structure preservation: III
Overlap with potentially suitable area 2 total			**8.21**	
Potentially suitable area 3				
473345083	9010	Old natural forests	2.68	Representativeness: B Structure preservation: III
1296345481	645	Floodplains	1.21	Representativeness: – Structure preservation: –
-1060045481	6450	Floodplains	0.40	Representativeness: – Structure preservation: –
-877413801	9010	Old natural forests	2.42	Representativeness: C Structure preservation: II
-873892932	9010	Old natural forests	3.37	Representativeness: B Structure preservation: I
-878086158	91D0*	Transitional bog and swamp forests	5.2	Representativeness: C Structure preservation: II
Overlap with potentially suitable area 3 total			**15.36**	
Potentially suitable area 4				
-1920845083	645	Floodplains	0.66	Representativeness: – Structure preservation: –
Overlap with potentially suitable area 4 total			**0.66**	

It is noteworthy that Area 1 borders Koopesoo, or Priipalu bog, to the north. This is one of the restored residual bogs. A large-scale bog water regime restoration project [40]was completed in the area in 2021. Considering the investment made in restoration activities, it is extremely important that other activities do not undermine the measures that have been implemented. It is expected that the restoration of the bog will improve the long-term condition of both the wetland and the surrounding wet forest habitat types.

The analysis showed that the largest area of habitats potentially suitable for the Habitats Directive is located in area 1 and the smallest in area 4 (the LD habitat area is located on the south-western edge of area 4, which is potentially suitable). When establishing a wind farm, wind turbines and related sites, roads

[40] https://www.rmk.ee/organisatsioon/el-fondid-1/uhtekuuluvusfond/kuivendatud-ammendatud-ja-huljatud-turbaalade-korrastamine

and cables in areas where representative LD habitat types are present. In the case of potentially suitable areas, it is appropriate to exclude large areas of representative LD habitat types from the site selection. In the immediate vicinity of LD habitat types, the construction of drainage ditches and other structures that alter the water regime and significant changes to the light regime should be avoided. A buffer zone of at least 50 m should be taken into account between the actual construction area (i.e. the wing may extend closer) and the occurrence area of the LD habitat type with A–B representativeness. For wetland habitat types in good condition (representativeness A–B), apply either a 250 m buffer zone or construction measures to prevent changes in the water regime in the case of structures that alter the water regime. A buffer zone is not necessary if existing conditions, such as the existing drainage system between the construction area and the LD habitat type, prevent the additional impact of construction activities from spreading to the LD habitat type.

4.1.2.5 Assessment results

Potentially suitable area 1 contains several LD habitats, category III protected plant species, valuable habitats, 2023 ELF inventory wetlands and wetland communities in need of conservation (Figure 10). For reasons related to vegetation, the establishment of a wind farm in the area is not ruled out, but it is necessary to preserve high-value plant communities. In accordance with the precautionary principle, it is important to preserve a sufficient buffer zone around Koopesoo and the surrounding forest communities (preferably at least 250 m) around Koopesoo and the surrounding forest communities in order to avoid damaging the bog restoration activities that have already been carried out and to enable the long-term improvement of the wetland community.

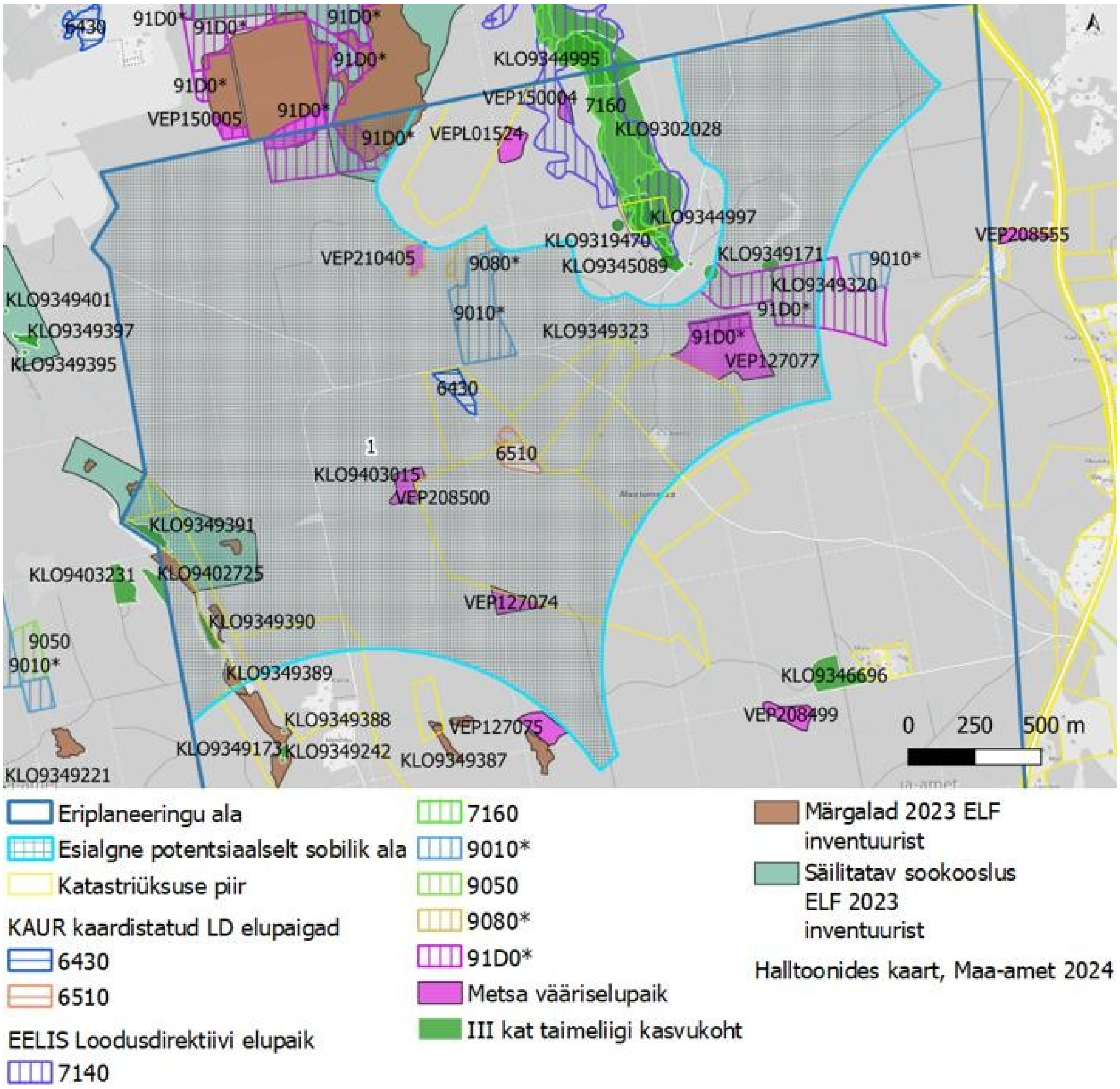

Figure 10. Location of potentially suitable area 1 in relation to high-value plant communities.

The overlap of **potentially suitable area 2** with known high-value communities and protected plant species is low. One forest LD habitat type (9080 with representativeness C, Figure 11) is known to occur. Part of the habitat type has been damaged by logging. There are no known vegetation-related exclusions for the potentially suitable area TU2. During fieldwork, a habitat of category III plant species was found at the edge of a prospective access road, which can be preserved during the reconstruction of the road.

With the layout of wind turbines and routes developed during the planning process, the LD habitat type area will largely be preserved. The access road will slightly reduce the area of the habitat type, but this is an area with low representativeness. The locations of the wind turbines overlap with clearings, young stands or managed/manageable forest areas (i.e. areas where logging has been carried out in the recent past or where a forest notification for logging has been issued). Where possible, existing forest roads or drainage ditches are preferred as road locations in order to minimise the adverse impact on vegetation.

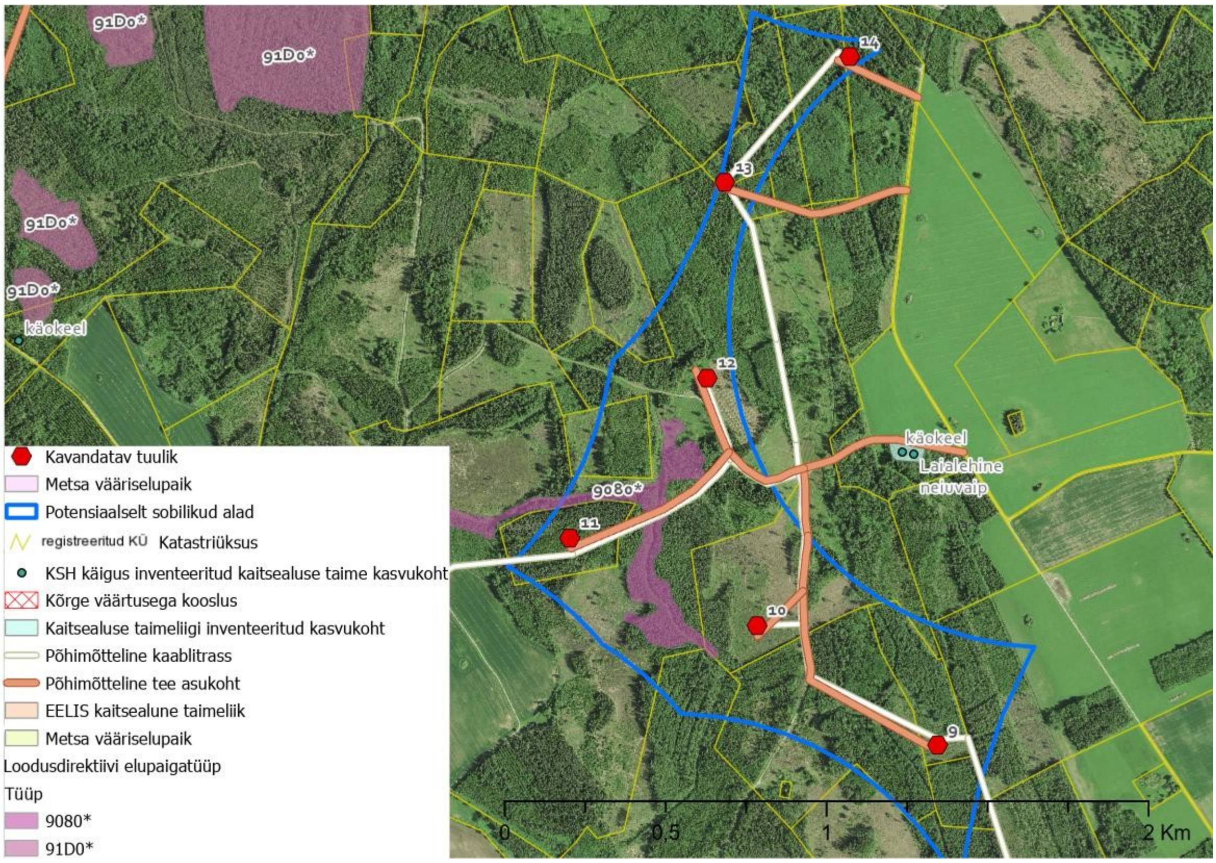

Figure 11. Potentially suitable area 2 and the location of wind turbines and wind farm infrastructure in principle with regard to high-value plant communities.

The most valuable plant communities in **potentially suitable area 3** are associated with unmanaged forest areas (Figure 12). A schematic layout of the wind turbines has been prepared for the plan (Figure 12). Based on the vegetation and plant communities, it is possible to locate up to nine wind turbines with the necessary infrastructure in the area without causing any significant adverse impact on the vegetation.

The layout of the wind turbines and routes developed during the preparation of the plan avoids overlap with LD habitat type areas, valuable habitats and the growing sites of protected plant species. The planned locations of the wind turbines overlap with clear-cut areas, young stands or managed/manageable forest areas (i.e. areas where logging has been carried out in the recent past or where a forest notification for logging has been issued). Where possible, existing forest roads or drainage ditches are preferred as road locations in order to minimise the adverse impact on vegetation.

Area 3 is the former site of the Uniküla missile base. The area has a road network and the ruins of the former missile base buildings. In the 1960s, the area was an extensively used military site. As the site has been unused for a very long time, the traces of human activity have been lost from the landscape in places.

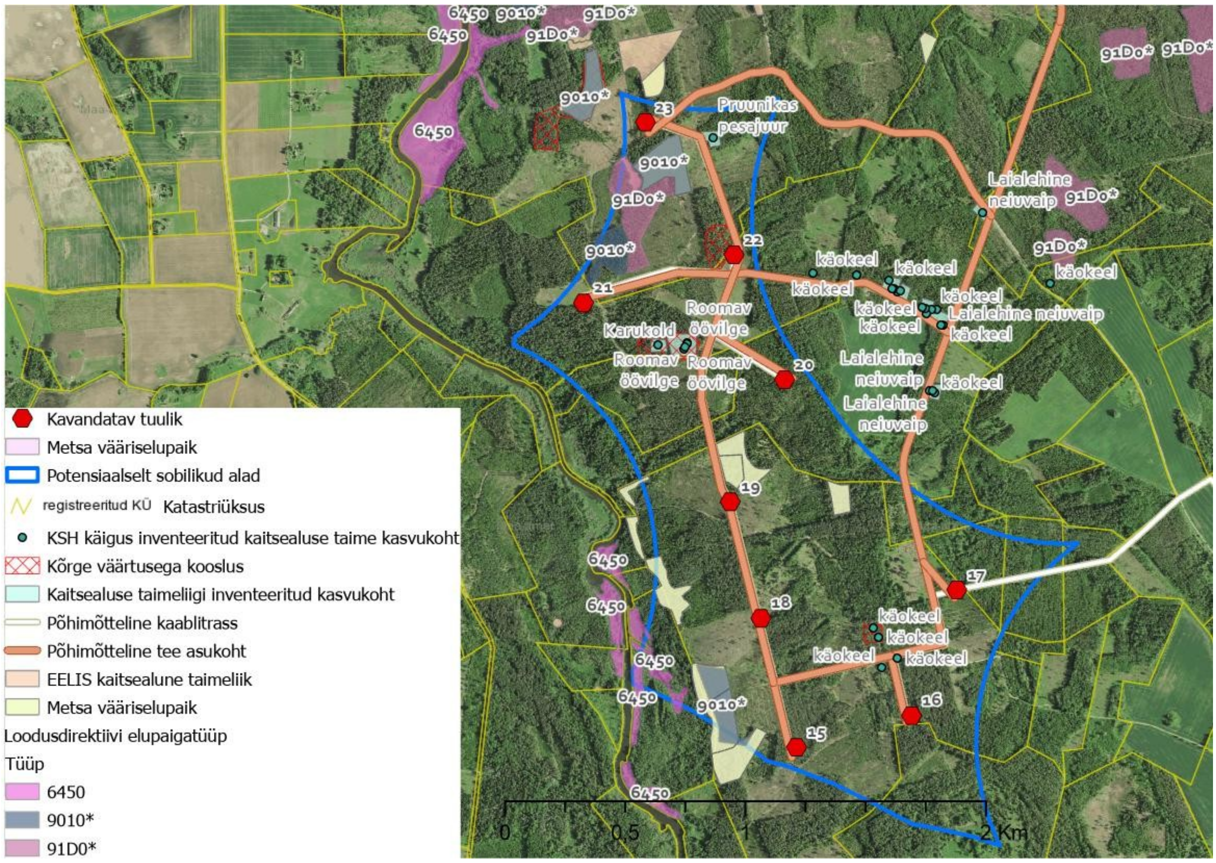

Figure 12. Potentially suitable area 3 and the location of wind turbines and wind farm infrastructure in principle with regard to high-value plant communities.

Potentially suitable area 4 overlaps with three valuable forest habitats and one LD habitat (Figure 13). Excluding forest habitats and LD habitats as wind farm locations, there is still sufficient space in the area where there are no restrictions on the establishment of a wind farm.

The layout of the wind turbines and routes developed during the planning process preserves the LD habitat type, valuable habitats and the growth sites of protected plant species. Compared to the initial draft solution, the locations of the wind turbines and roads have been adjusted based on the results of the vegetation inventory carried out during the SEA to avoid overlapping with valuable communities. The locations of the wind turbines overlap with clear-cut areas, young stands or managed/manageable forest areas (i.e. areas where logging has been carried out in the recent past or where a forest notification for logging has been issued). Where possible, existing forest roads or drainage ditches are preferred as road locations in order to minimise the adverse impact on vegetation.

In the case of the wind turbine layout developed during the planning process, the distance recommendation given in the SEA report for valuable forest habitats is not met for wind turbine position 7. For other positions, a buffer zone is provided to avoid impact, or there is an existing drainage system, road, logging area, etc. between the VEP and the wind turbine foundation area. The approximate corridors of roads and cables do not pass through the VEP areas and, where possible, existing roads, forest paths, etc. existing corridors in nature are followed, and no significant impact on the VEPs is expected.

In the case of wind turbine 7, the construction area of the wind turbine falls within the impact area of VEP127151. This is a pine forest located in a wetland, i.e. the community is sensitive to changes in the water regime. Construction at the desired location may have an adverse impact on the VEP area. In order to minimise the negative impact on the habitat community in this VEP, construction measures must be implemented in the design of this wind turbine to minimise changes to the water regime in the VEP area (see also section 4.1.2.6).

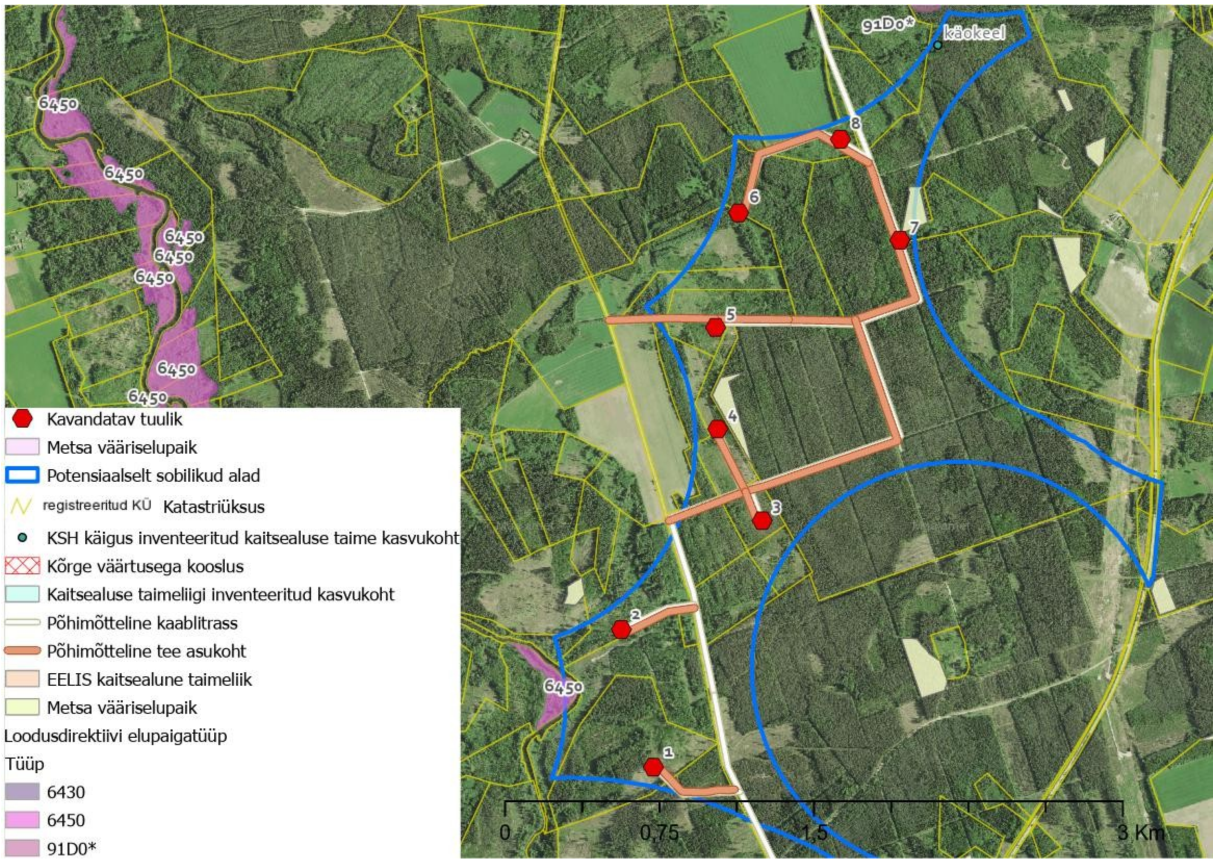

Figure 13. Potentially suitable area 4 and the location of wind turbines and wind farm infrastructure in principle with regard to high-value plant communities.

The developed planning solution ensures the preservation of valuable plant communities. The establishment of the wind farm will require the clearing of approximately 44 ha of forest. The layout solution seeks to make maximum use of existing infrastructure (forest roads) and, where possible, to give preference to clearings or young forest stands as locations for wind turbines.

4.1.2.6 Measures and need for further research and assessment

Measures to be implemented in the location selection stage when determining the principle locations of wind turbines:

- **valuable** forest **habitats must be preserved**. In the immediate vicinity of valuable habitats, the construction of drainage ditches and other structures that alter the water regime and significantly change the light regime must be avoided. In the case of VEP areas, **a 50 m buffer zone between the actual construction area and the VEP** must be taken into account or construction measures must be provided for to avoid changes in the water regime. A smaller buffer zone is permissible in situations where there is already, for example, a functioning drainage ditch, an existing road or a clear-cut area between the valuable habitat and the planned construction area, which precludes any additional significant impact of the construction activity on the valuable habitat.
- **Areas with habitat types A and B under the Habitats Directive (HD) must be preserved**. In the immediate vicinity of HD habitat types, the construction of drainage ditches and other structures that alter the water regime and significantly change the light regime must be avoided. In the case of excessively wet communities, **a 50 m buffer zone between the actual construction area and the LD habitat type** must be taken into account, or construction measures must be provided for to prevent changes in the water regime. A smaller buffer zone is permissible in situations where there is already a functioning drainage ditch, road or other structure between the LD habitat type in good condition and the planned construction area, which prevents construction activities from having a significant impact on the valuable community.
- The habitats of known protected plant and fungus species in protection categories I and II must generally be preserved. With the consent of the Environmental Board, damage to the habitats of protected plant and fungus species in protection category II

In the case of Category III habitats, the preservation of the species' habitat must be ensured. At the site selection stage, in order to avoid significant impact, the known locations of protected plant, fungus, moss and lichen species should be excluded as sites for wind farms and their infrastructure. In order to preserve the light and moisture regime in the habitats, do not designate possible construction areas closer than **20 m from the location of protected species.** A smaller buffer zone is permissible in situations where there is already, for example, a functioning drainage ditch, road or other structure between the habitat and the planned construction area, which prevents construction from having a significant impact on the habitat.

- Maintain a sufficient buffer zone (preferably at least 250 m) around Koopesoo and the surrounding forest communities to avoid damaging the bog restoration activities that have already been carried out and to allow the condition of the wetland community to improve in the long term.
- The exclusion of higher-value natural communities has significantly reduced the likelihood of protected plant, fungus, moss and lichen species occurring in potential wind turbine construction areas. Therefore, from a vegetation perspective, a significant adverse impact on high-value plant communities can be considered excluded, and the construction of a wind farm outside the excluded areas can be assessed as feasible from a vegetation impact perspective.

, electrical connections should be established with underground cables, which significantly reduces the need for clearing.

The following measures must be implemented in the further design of the wind farm:

- In the case of wind turbine pos 7[41], the construction area of the wind turbine remains within the impact area of VEP127151. This is a pine forest located in a wetland, i.e. the community is sensitive to changes in light and water regime. When establishing the position of the wind turbine, the following must be done:
    - maximise the use of the existing forest road area in the pos 7 area as the construction area in order to minimise the size of the area to be cleared. Maintain a forest strip of at least 10 m adjacent to the VEP area to avoid changes in light conditions and the risk of windbreak in the VEP area.
    - When constructing possible new drainage systems related to the wind turbine in area 7, it must be ensured in the construction projects that the draining effect of the drainage system does not extend to the valuable forest habitat. The project for water drainage during construction and drainage of the area, together with mitigation measures, must be prepared by a designer with the relevant competence and experience.

    The construction period of the foundation pit for the wind turbine to be built must be kept to a minimum in order to avoid a long-term lowering of the water level in the valuable forest habitat VEP127151. When preparing the foundation construction project, the extent of the lowering of the water level must be assessed. If the water level in the VEP area may be lowered by more than 0.5 m, construction measures must be taken to prevent significant water level reduction in the VEP area. The designer shall select a suitable construction measure. A construction measure to prevent water drainage in the surrounding areas may be, for example, the use of slotted walls in the foundation trench.
- In the further design of the wind farm (including the specification of the locations of roads and routes), the location of high-value plant communities (LD A and B representative areas, forest VEP, habitats of protected plant species) must be taken into account. When further specifying the locations of wind turbines and routes, it must be ensured that changing the locations does not cause a greater adverse impact on vegetation than the solution assessed in the SEA. This means that, as a general rule, it is not permissible to move wind turbine positions closer to valuable plant communities than the assessed locations. An exception may be permissible if construction measures are implemented to reduce the impact. A corresponding assessment must be submitted in the preliminary EIA assessment for the building permit application.
- When constructing cable routes in semi-natural communities or areas covered by the Habitats Directive, the excavated material must be removed in layers – grass separately, soil separately and bedrock separately. After the cables have been laid, fill the channels as much as possible

[41] If the measures for the protection of birdlife set out in section 4.1.3.3 are implemented, item 7 will not be implemented and the implementation of these measures will not be necessary.

in a nature-friendly manner, first with the bedrock, then the soil layer and finally the turf taken from the same route area earlier.
- Mowing of the edges of wind farm buildings, structures and service roads should not be carried out more than once a year, if possible. Relatively infrequent mowing helps to promote species diversity.
- When restoring the landscaping of , avoid using alien species and establishing monocultural grass cover. Prefer native plant species and seed mixtures.

4.1.3 Impact on birdlife

Wind farms can affect birds in three main ways:

1) birds may be killed by collision with wind turbine blades or masts[42].
2) disturbance may cause a reduction in habitat use or the relocation of birds from potentially suitable areas[43] .
3) Habitat destruction and alteration causes changes in bird stic [44].

The impact of wind turbines on birds is most evident in collision mortality – flying birds may collide with wind turbines (primarily with the blades, but there are also examples of birds flying into the mast) and associated infrastructure, resulting in death or injury. Bird collisions with wind turbines are not particularly frequent, but there are several known examples of large numbers of birds or protected species being killed in wind farms. The risk depends primarily on the location of the wind farm, the terrain and the behavioural characteristics of the bird species. Gliders such as storks and cranes, and especially birds of prey([44]) ,which often do not avoid wind s([45]) ,collide with wind turbines relatively frequently.

The risk of collision is also linked to the barrier effect – in order to avoid wind farms, birds must fly past or above them, which reduces the usability of certain habitats or increases the birds' energy expenditure. The barrier effect has a more significant impact on larger wind farms or in cases where the wind farm is located on a regular bird migration route (e.g. a migration route or daily flight path between nesting and feeding areas). Considering the size and location of the special planning areas in Valga Municipality, which are inland and away from the main migration corridors, no significant barrier effect on bird populations is expected in the case of this special plan.

The establishment of a wind farm will also result in a direct loss of bird habitat and a decline in habitat quality due to disturbances. The direct loss of habitat resulting from the construction of wind turbines is generally relatively minor, but the construction of access roads and electrical connections must also be taken into account at the wind turbine construction sites. Disturbances affecting habitat quality caused by wind farms occur during the construction phase, during the operation of the wind turbines and during the dismantling phase. The sources of disturbance may be the wind turbines themselves (including noise, flickering light shadows and vibration caused by the turbines) and/or other infrastructure associated with them, or increased human activity associated with the wind farm[45] (both wind farm maintenance and other traffic using the access roads). The extent and significance of the disturbance varies depending on the species and species group and their possible habituation to wind turbines.[45] . Bird groups that are considered to be more sensitive to wind farm-related disturbances (and therefore more likely to avoid wind farms) include swans, geese, cranes, waders and some species of passerines. Studies have confirmed that, for example

[42] Thelander, C. G. & Smallwood, K. S. 2007. The Altamont Pass Wind Resource Area's effects on birds: a case history. Birds and Wind Farms (eds M. de Lucas, G. Janss & M. Ferrer): 25–45. Quercus Editions, Madrid.

[43] Drewitt, A. L. & Langston, R. H. W. 2006. Assessing the impacts of wind farms on birds. Ibis 148: 29–42.

[44] Gove, B., Langston, R. H. W., McCluskie, A., Pullan, J. D. & Scrase, I. 2013. Wind farms and Birds: an updated analysis of the effects of wind farms on birds, and best practice guidance on integrated planning and impact assessment. Report prepared by BirdLife International on behalf of the Bern Convention, RSPB/BirdLife in the UK, Sandy, UK. 89 pp.

[45] Hötker, H., 2017. Birds: displacement. In: Martin R. Perrow (ed): Wildlife and Wind Farms, Conflicts and Solutions. Volume 1 Onshore: Potential Effects.

Forest birds (e.g. capercaillies)[46,47] avoid wind farm areas. As a result of disturbances, birds may no longer use a potentially suitable habitat in or near the area, or may use it less frequently, resulting in a reduction in the area of habitat available to the population.

The primary task in reducing the impact on birdlife is therefore to carefully select the location of the wind farm. The primary task in selecting a location is to avoid planning wind turbines in areas that are most sensitive from the point of view of birdlife and near the habitats of endangered species that are sensitive to disturbance or prone to collision.

4.1.3.1 Assessment methodology

The impact on birds was assessed in potentially suitable areas mapped in the special planning areas. To this end, existing data on protected bird species was analysed from the EELIS (Estonian Nature Information System, Environmental Agency), PlutoF and nationwide terrestrial bird analysis databases([48]).

The EELIS data was analysed for Category I protected species within a 5 km radius of the study areas, for Category II protected species within a 2 km radius, and for Category III protected species in areas overlapping with the study areas. The data was updated as of 08.08.2025.

A bird survey was then conducted([49]) in potentially suitable areas and within a 500 m radius of these areas – hereinafter referred to as *the study area*. All species were recorded during the survey, but priority was given to protected and conservation-important species, especially hawks, falcons, black storks, cranes, geese, etc. Observation points were selected in the study area in such a way as to ensure that at least half of the study area was covered, preferably at least 75–80%. The initial selection of observation points was made using orthophotos, and the number and location of observation points was later specified during preparatory fieldwork.

In spring (March–May), summer (June–August) and autumn (September–November) 2023, censuses were conducted from designated census points. The minimum number of census hours from each observation point was 36 hours in spring and autumn and 18 hours in summer. The length of one observation cycle (one count from one observation point) was 2–3 hours. The counting times were preferably distributed evenly throughout the daylight hours. Depending on the bird group and phenomenon, it was necessary to pay more attention to certain parts of the day. For example, in the case of migration, most species are more active during the four hours after sunrise, while birds of prey are more active around midday, when rising air currents have formed.

During fieldwork, the following were recorded bird species, number (in the case of flocks), flight altitude (using laser binoculars or estimating flight altitude using objects of known height), the time spent by the bird in the study area (seconds) and, preferably, the flight trajectory as a sketch on a fieldwork card or smart device.

An inventory of breeding birds was carried out during the study. For this purpose, the nesting territories of protected bird species were mapped using the point count method [50] and a decoy count was carried out for woodpeckers, hazel grouse and capercaillie [51]. In addition, an inventory of forest birds (primarily capercaillies) was carried out in study areas 1 and 4. Large nesting sites were searched for separately in study areas 3 and 4 (in addition, nests of woodpeckers, hazel grouse

[46] Coppes, J., Braunisch, V., Bollmann, K., Storch, I., Mollet, P., Grünschachner-Berger, V., Taubmann, J., Suchant, R., Nopp-Mayr, U., 2020. The impact of wind energy facilities on grouse: a systematic review. Journal of Ornithology (2020) 161:1–15. [47] Taubmann, J., Kämmerle, J-L., Andrén, H., Braunisch, V., Storch, I,, Fiedler, W., Suchant, R. and Coppes, J., 2021. Wind energy facilities affect resource selection of capercaillie Tetrao urogallus. Wildlife Biology 2021 (1),. https://doi.org/10.2981/wlb.00737.

[48] Estonian Ornithological Society, Eagle Club. 2022. Analysis of terrestrial bird species across Estonia. Public procurement no. 239156.
Map layers from the Environmental Agency's spatial data service.

[49] The full study report is presented in Annex 3 to the SEA report, but as the report contains data on the locations of Category I and II species
, it is for internal use only.

[50] https://www.eoy.ee/ET/13/14/punktloendus/

[51] https://www.keskkonnaagentuur.ee/seireankeedid (Woodpeckers)

and during the decoying of corncrakes) and in study areas 1 and 2, nests were searched for in parallel with decoying counts, and the occupancy of known corncrake nests was also checked.

During the study, an assessment of the suitability of the black stork's feeding area and the sustainability of its habitat was compiled.

Based on the analysis of the database and the data collected during the surveys, the survey areas were divided into three zones from an ornithological perspective:

1) Red areas – areas unsuitable for wind turbine locations – areas where the construction of wind turbines may have a significant adverse effect on bird populations, there may be a significant adverse impact on bird species in protection categories I or II, which cannot be mitigated by technical or temporary measures;
2) Yellow areas – areas unsuitable for wind turbines – areas where the construction of wind turbines may have a significant adverse impact on birdlife. Such areas were mainly classified as habitats of bird species in protection category III. Unsuitable areas should be preserved as much as possible (at least 50% of the area).
3) Green areas (coloured areas in the following figures) – areas where there are no restrictions on the construction of wind turbines due to birdlife.

In 2025, Meelis Leivitsa also prepared an expert opinion on the impact of the Valga wind farm on the local capercaillie population. In order to prepare the expert opinion, a field survey was conducted in the spring of 2025 in four potentially suitable areas, and based on the survey results, the capercaillie habitat KLO9137151 was registered in the area. The results of the expert opinion were taken into account when supplementing the SEA report and preparing the planning solution.

4.1.3.2 Assessment results

4.1.3.2.1 Results of the bird assessment for potentially suitable area 1

Overview of registered habitats of protected species

The black stork (*Ciconia nigra*) habitat KLO9128283 is located 2.6 km from study area 1. According to the Estonian Red List of Threatened Species (2019 assessment), the black stork is classified as 'critically endangered'. The nest (id -1036847573) is located 3 km from the study area. The habitat was last checked on 2 May 2024 as part of national monitoring, when it was not inhabited by the target species. According to the monitoring, the nest was last occupied in 1999, when there were three chicks in the nest**. Thus, based on the monitoring, the habitat has not been occupied for the last 24 years.**

Based on the Land Board's forest change map data (for the period 2012–2021) and orthophotos, no large-scale logging has taken place in the habitat forest. Therefore, the forest area suitable for the habitat has been preserved. The EELIS database does not contain any information that the nest has collapsed, nor is there any information on the condition of the nest tree.

Based on an analysis of the feeding areas of black storks equipped with GPS transmitters (hereinafter GPS analysis)[52], there is one known feeding water body for black storks in the study area (Soontaga stream, VEE1012700). The feeding areas for black storks were determined on the basis of data from all years monitored with suitable transmitters (2007–2022). Based on the analysis of GPS data, this is not a priority feeding water body. The feeding area is located outside the potentially suitable wind farm area, and the plan does not provide for the installation of wind turbines in this feeding area, i.e. the connection between the nesting site and the feeding area is guaranteed.

The registered habitat **of the osprey (*Pandion haliaetus*)** KLO9129625 is located 2.6 km from the area. According to the Estonian Red List of Threatened Species (2019 assessment), the osprey belongs to

[52] Eagle Club. 2022. Acquisition of information on eagles and black storks equipped with satellite and GSM transmitters and analysis of nesting season data, and supplementary feeding of black storks.

The nest (id -1178468493) is located 3.1 km from the study area. As part of national monitoring, the habitat was last checked on 25 July 2024, when it was not inhabited by the target species. According to monitoring data, the nest was last occupied in 2023 and before that in 2018, but nesting was unsuccessful on both occasions. According to the EELIS database, the nest was occupied during all monitoring periods between 2000 and 2018. The 2020 monitoring data indicate that this is an artificial nest.

Based on the Land Board's forest change map data (for the period 2012–2021) and orthophotos, no
large-scale logging has been carried out in the forest habitat. Thus, the forest area suitable for the habitat has been preserved.

The registered habitat **of the lesser spotted eagle (*Clanga pomarina*)** KLO9129608 is located 2.9 km from the study area. The nest (id -1772107859) is located 3 km from the study area. According to the Estonian Red List of Threatened Species **(** 2019 assessment), the lesser spotted eagle belongs to the category
"near threatened". As part of national monitoring, the habitat was last checked on 21 July 2024, when it was not inhabited by the target species. Based on monitoring, the nest was last occupied by a lesser spotted eagle in 2011, when the nest was established and one chick was raised there. Based on the MLA specificity map layer available from the Environmental Agency's spatial data service, a reduced 1 km zone 1 area is recommended for this habitat.

Based on the Land Board's forest change map data (for the period 2012–2021) and orthophotos, no large-scale logging has been carried out in the forest habitat. However, regeneration felling has been carried out in forest areas adjacent to the habitat.

The registered habitat **of the lesser spotted eagle (*Clanga pomarina*)** KLO9129305 is located 3.3 km from the study area. The nest (id 212990292) is located 3.6 km from the study area. As part of national monitoring, the habitat was last checked on 21 July 2024, when it was uninhabited by the target species and the nest had collapsed. According to the monitoring, the nest was last established in 2019, when the nest was established but breeding failed. According to the EELIS database, the nest was also inhabited in 2018, when it was first registered. According to the Land Board's forest change map data (for the period 2012–2021), no large-scale logging has taken place in the forest habitat since the nest was first registered.

According to the Estonian Red List of Threatened Species (2019 assessment), the northern goshawk belongs to the 'vulnerable' category. Area 1 overlaps with the habitat of **the northern goshawk (*Accipiter gentilis*)** KLO9133077. This habitat also overlaps with a potentially suitable wind farm area. The habitat was registered on 31 July 2023 (the habitat was registered both during the RePower survey organised by KAUR and during the bird survey conducted in the course of preparing this plan). This is a habitat in satisfactory condition, which has been inhabited in both 2023 and 2024. The nesting tree is a spruce.

Study area 1 overlaps with the habitat of **the northern goshawk (*Accipiter gentilis*)** KLO9120519. The last habitat observation according to the EELIS database was on 24 April 2023, when the nest had fallen down. The habitat was registered in the EELIS database in 2015 and has been established with varying success between 2015 and 2020. Successful nesting was last recorded in 2020. The nests remaining in the habitat have been archived in EELIS as they have been destroyed.

Study area 1 overlaps with the habitat of **the capercaillie (*Tetrao urogallus*)** KLO9131764. The last observation in the EELIS database is from 16 April 2021, when three capercaillie cocks were counted and it was noted that the lek was inhabited. This is a habitat registered on the basis of habitat modelling, the boundaries of which were specified by the Environmental Board in 2024. According to map data, no significant logging has taken place in the habitat in recent years. According to the Estonian Red List of Threatened Species (2019 assessment), the capercaillie belongs to the 'vulnerable' category.

The capercaillie (*Tetrao urogallus*) habitat KLO9101751 is located 1,670 m from the study area. The last observation in the EELIS database is from 22 April 2018, when three capercaillie cocks were counted. No significant logging has been carried out in the habitat in recent years based on map data.

According to the MLA, there is an overlap between study area 1 and zone 3 areas, i.e. the modelled habitats of the hazel grouse (*Tetrastes bonasia*). According to the MLA, there is little overlap between study area 1 and zone 3 areas of the greater white-fronted goose (*Anser albifrons)* in the northern part. During the KAUR Repower study, several locations of bird species in protection category III were recorded in the area.

Observations of capercaillies and other grouse

Fieldwork on capercaillie and other grouse species was carried out in study area 1 in Valga between April and May (03.04.2023, 07.04.2023, 16.04.2023, 22.04.2023, 10.05.2023). For capercaillies, the model of capercaillie leks compiled by M. Leivits (2021) was used as a basis, and potential leks were selected, where characteristic short droppings were sought under and around lekking trees. Longer droppings were identified as feeding trees, which are important feeding areas for capercaillies. In Koopesoosse (also known as Priipalu bog, which was restored by RMK ([53]) 2021–2022. a), four trail cameras were installed in April (the trail cameras recorded at four different points) to obtain additional information about the cocks visiting the mating grounds in addition to the morning capercaillie count. The trail cameras were placed near potential mating trees, which were identified based on the presence of short droppings. The trail cameras were removed in the first half of October.

Morning monitoring of capercaillie leks in Koopesoo was carried out on 6 May 2023, but no capercaillie cocks were seen during the morning observation. Trail cameras recorded 1–3 capercaillie cocks during the mating season (one mating capercaillie cock on 28 April 2023, afternoon observations of cocks on 5 May 2023, one individual displaying at 1 p.m. on 18 May 2023, and one capercaillie cock on 27 September 2023). During monitoring in the morning (6 May 2023), 5–6 displaying capercaillies (LK III category) were recorded.

One pair of cranes (LK III cat) raised their young in Koopesoo, and hobbits (LK III cat) were actively feeding in the bog. In addition, one feeding raven (LK III cat) was recorded.

The results of the fieldwork showed that the main capercaillie mating area is concentrated in the Koopesoo bog (overlapping with potential suitable area 1), where 1–3 capercaillie cocks were observed mating based on trail camera footage. During fieldwork, a maximum of two capercaillie cocks were seen at a time taking flight from pine trees near the Koopesoo bog. To the west of Koopesoo are feeding forests suitable for capercaillie, which were identified on the basis of long feeding droppings. In the capercaillie search area, which remained in the potentially suitable area 1, the tail feathers of a capercaillie cock killed by a predator were recorded. In the southern search areas, which lie outside the potentially suitable area 1, capercaillie feeding traces were seen. The south-eastern feeding area, which lies outside the potentially suitable area 1, has been severely drained by recently constructed drainage ditches and is not suitable as a breeding area. The capercaillie observations in the south-eastern part, which lies outside the potential suitable area 1, are also related to the capercaillie feeding area.

As the Koopesoo bog was restored only a few years ago, the importance of this area as a mating area for capercaillies may increase in the future. It is important to ensure an undisturbed movement corridor between the Virna capercaillie mating area and the Koopesoo capercaillie mating areas so that individuals can move between these mating areas without disturbance. According to the MLA, a buffer zone with a radius of 1 km around the repopulated mating area (zone 2) and connecting corridors between sub-areas are provided for, covering as much suitable habitat as possible. **From the capercaillie's point of view (taking into account the mating and habitat areas and the associated buffer zone), it is very difficult to build wind turbines in the Valga study area 1, as the majority of the potential development area is located within a one-kilometre buffer zone of the capercaillie's mating area. The construction of a wind farm in this area would require compensation for the capercaillie's habitats.** The southern capercaillie search areas are suitable for feeding, as is the south-western search area. The south-eastern capercaillie observations are also related to the capercaillie's feeding area. **It is also important to ensure an undisturbed connection corridor from the southern Virna lekking area to the Koopesoo lekking area in order to maintain habitat connectivity.**

Capercaillie fieldwork was carried out in the spring, based on the capercaillie lekking site model. The Koopesoo bog is suitable as a capercaillie lekking site, where 1-3 cocks were recorded during the capercaillie lekking period with the help of trail cameras. The importance of Koopesoo as a capercaillie lekking area is likely to increase in the future due to the restoration work carried out there, which will have a positive effect on capercaillie lekking through the restoration of the water regime. Outside Koopesoo, capercaillies were mainly observed in feeding areas.

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[53] https://media.rmk.ee/files/Priipalu_projekt.pdf

Lakes used for attracting woodpeckers, cuckoos, hazel grouse and black grouse; protected and important breeding birds and their habitats

Of the woodpeckers, the great spotted woodpecker (1) and the middle spotted woodpecker (1) were recorded in the area. Of the woodpeckers, the black woodpecker (8), the grey-headed woodpecker (1) and
lesser spotted woodpecker (2) and grey-headed woodpecker (3) were recorded. In addition, the lesser spotted flycatcher ( ) (5), horsefly (5),
red-backed shrike (1), grey shrike (1), meadow pipit (2), corncrake (4), woodcock (4), wood sandpiper (3), woodpecker (3), corn crake (1), wood sandpiper (5), woodcock (9), barn swallow (1).

During fieldwork in the Valga study area 1, **a corncrake nest** was identified, where the species was discovered during fieldwork in the spring of 2023 and was also present on 25 February 2024. This is likely to be a bird from the south, as the nearest southern location, 1.4 km away (KLO9120519, Mustumetsa), both nests (-854891712 and 1020767630) have fallen, which is confirmed by the 2023 monitoring data in the EELIS database, and during fieldwork, no nests could be found in the trees there.

One observation point was located 900 m from the nesting site, and a corncrake was spotted in flight on 3 May 2023 from a point to the southeast, and another observation was made during migration on 17 October 2023. The kestrel's hunting strategy involves rapid dives towards the ground to catch its prey (primarily grey wagtails, wagtails, magpies, jackdaws, collared doves, wood pigeons and fieldfares; among mammals, its prey has mainly consisted of squirrels and hares ([54]), the risk of collision with tall wind turbines (>200 m) is very low. There are only a few known cases of crow deaths due to wind turbines ([55]) ,which may be related to the species' feeding strategy – the vast majority of the species' food sources can be found on the ground (e.g. red squirrels, hares) or at lower flight altitudes (<100 m; pigeons, ducks, crows).

A total of four nests inhabited in 2023 (including data from the KAUR study) were found in study area 1 (both honey buzzards and buzzards belong to LK III), three of which belonged to buzzards and one eastern nest to honey buzzards. The possible feeding areas of buzzards and honey buzzards were analysed below. As buzzards hunt their prey in open terrain, the location of open terrain near the nesting area is important for assessing possible feeding areas. The buzzard's main hunting ground is forest land, where it searches for prey at the edges of forests, in forest clearings, on felled areas and in clearings, and sometimes in meadows. The buzzard often stops near ditches and other small bodies of water.

According to data from Estonian researchers, the home ranges of buzzards determined using GPS transmitters in Estonia ranged from 3.2 $km^2$to 4.7 km^2 ni [56]. During the summer period in July, the range was 1.7–2.8 km^2. This means that the main range of activity from the nest can extend to 0.74–1.2 km. Forests can be an important hunting ground for buzzards. In forests, they lie in wait near hedges, ditches and ditches, and in commercial forests also on clear-cut areas. However, open habitats usually play the main role as hunting grounds for buzzards. They are certainly not used completely at random, but areas closer to the forest edge are preferred. Birds equipped with GPS transmitters have shown that the flexible buzzard uses most of the biotopes found in the vicinity for hunting, but certain habitats are still preferred. For example, our buzzards appreciate the abundance of grasslands([56]).

The construction of wind farms poses a collision risk to buzzards. Of all birds of prey, buzzards suffer the highest mortality rate in wind farms, followed by kestrels, red kites and sea eagles [57] . In Northern Europe, the highest mortality rate among birds of prey due to wind turbines has been found among buzzards, which avoid wind turbines to a very small or moderate extent (250–500 m distance)[57] .

Spot observations

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[54] Environmental Protection Agency, 2022. Action plan for the protection of the corncrake.
[55] Rydell, J.; Ottvall, R.; Pettersson, S.; Green, M. The Effects of Wind Power on Birds and Bats - an Updated Synthesis Report 2017; Swedish Environmental Protection Agency (Naturvårdsverket): Stockholm, 2017; p 132.
[56] Väli, Ü., Sein, G., Laansalu, A., Sellis, U. What habitats do our birds prefer? Eesti Loodus, November 2015.
[57] Rydell, J.; Ottvall, R.; Pettersson, S.; Green, M. The Effects of Wind Power on Birds and Bats - an Updated Synthesis Report 2017; Swedish Environmental Protection Agency (Naturvårdsverket): Stockholm, 2017; p 132.

In study area 1 in Valga, the spring migration of geese was rather modest, with a total of 580 individuals counted (most observations were made per family, with a smaller number of greater white-fronted geese and tundra swans identified). Over 80% of the geese (475 individuals) flying north were located in the rotor safety zone (range 90–180 m).

During the spring migration, 16 whooper swans (LK II category) were observed flying at an altitude of 30–50 m. There were 38 migration observations of the common crane (LK III category), with the largest number of birds seen being 23 individuals flying northwest at an altitude of 300 m.

One of the most exciting migration finds were a few common goldeneyes (LK II category), which were heading north, probably towards Lake Võrtsjärv. All individuals flew within the rotor safety zone. The MLA states that there is no need to consider the common goldeneye in inland Estonia, as they rarely stop on inland waters during migration and not at all in winter. Migration over land takes place above the wind turbines.

During the spring migration period, mouse-eared bats (LK III cat, 9 observations) were observed in the rotor safety zone, six of which were in the rotor danger zone.

Among the rarer birds of prey, a lesser spotted eagle was observed during the spring period (LK I cat; three spring observations, where in one case the bird was flying at an altitude of *approx.* 70 m, in another case the eagle rose higher in the air column, and in the third case the species was flying in the north-western part of the area) and the Eurasian hobby (LK III cat; random observation, bird flying overhead).

During the summer census period, the most frequently observed bird of prey was the common buzzard (five observations at an altitude of 150 m). Individual observations were made of the following resident birds of prey: common buzzard (LK III cat), common buzzard (at an altitude of 150 m). Of the falcons, a merlin was observed in the rotor safety zone (100 m).

Of the protected species, barn swallows (LK III cat; 8 individuals) were observed in the rotor safety zone, seven of which were flying at an altitude of 130–150 m. A flock of four great spotted woodpeckers was also observed flying southeast at an altitude of 120 m. A wood pigeon was observed three times at an altitude of 116 m flying northwest. Two great spotted woodpeckers (LK III category) were observed flying at an altitude of 150 m.

During the summer point count, 11 grey herons were observed in the rotor safety zone (160 m) among the important bird species.

During the autumn census period, a total of 725 geese/ducks were counted, 76% of which flew in the rotor safety zone (548/725).

Although 66 songbirds were observed during migration, none of them flew within the rotor safety zone (the flight range was between 30 m and 78 m on average). One small bird flew within the rotor safety zone at a height of 100 m during migration.

Of the birds of prey, the most frequently observed was the buzzard, which was in the rotor safety zone twice at a height of 125 m. Kestrels were observed four times, with the birds staying at an average height of 90 m (two observations) and 150 m (two observations). A buzzard was observed once in the rotor safety zone at a height of 90 m. A lesser spotted eagle was observed twice, once in the buffer zone of the study area at a height of 250 m and once at the southern end of the study area at a height of 100 m, heading southwest. A merlin was observed once at a height of 23 m, heading west.

<u>Zone 1 zoning</u>

From the perspective of **the capercaillie** (taking into account its breeding and habitat areas and the associated buffer zone), it would be very difficult to construct wind turbines in study area 1 in Valga, as the majority of the potential development area is located within a one-kilometre buffer zone of the capercaillie's mating area, and their construction could lead to a deterioration in the capercaillie's habitat. The southern capercaillie search areas are suitable as feeding areas, as is the south-western search area. The capercaillie sightings in the south-eastern part are also related to the capercaillie feeding area. It is also important to ensure an undisturbed connection corridor from the southern Virna breeding area to the Koopesoo breeding area in order to ensure connectivity between populations.

The birdlife in study area 1 is species-rich due to the mosaic landscape, where wetlands alternate with higher pine and mixed forests, allowing several species to nest in different habitats. **The nesting of the corncrake and a high abundance of the common snipe** were observed in the area**.**

There is a difference in the zoning of the suitability of Area 1 in this SEA report and the zoning of the bird survey of the potential priority development areas of the KAUR RePower project. The main reason for the difference is the somewhat more thorough studies of capercaillie habitats carried out during the bird survey used as the basis for this SEA, on the basis of which it has been assessed that Koopesoo is a capercaillie habitat with a likely improving status, around which a disturbance-free area must be preserved.

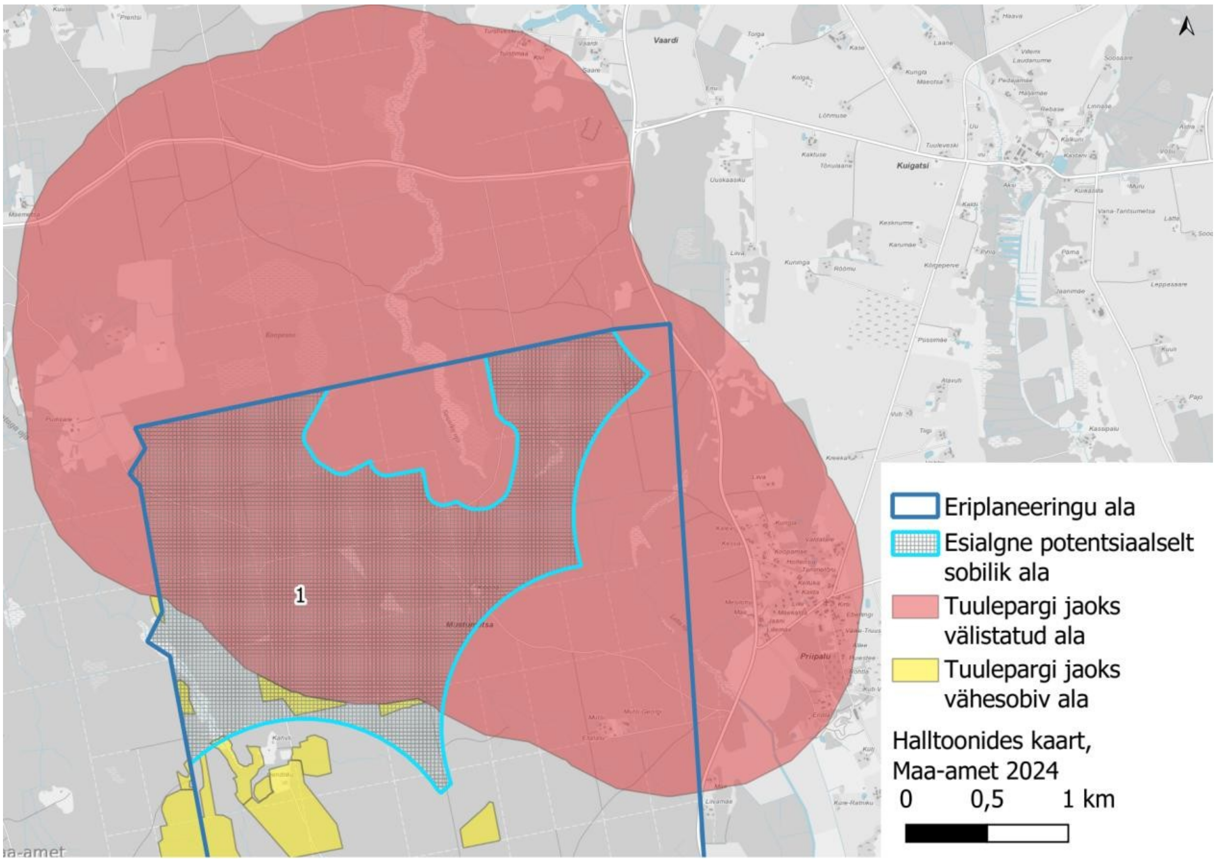


Figure 14. Proposed bird protection zoning in study area 1.

4.1.3.2.2 Results of bird assessment for potentially suitable area 2

<u>**Overview of registered habitats of protected species**</u>

The registered habitat KLO9129608 **of the lesser spotted eagle (*Clanga pomarina*)** is located 3.5 km from study area 2. Based on the MLA specificity map layer available in the EELIS database, a reduced 1 km zone 1 area is recommended for this habitat.

The registered habitat **of the lesser spotted eagle (*Clanga pomarina*)** KLO9129606 is located 3.8 km from survey area 2. The habitat was last checked on 16 July 2024 as part of national monitoring, when it was inhabited (1 chick). According to the monitoring, the habitat was last established by the lesser spotted eagle in 2008. According to the EELIS database, the nest had already collapsed during the 2015 monitoring, but during the 2024 monitoring, the habitat was inhabited again. Based on the MLA specificity map layer, a reduced 1 km zone is recommended for this habitat
1 area, but as the habitat was repopulated in 2024, it is appropriate to apply a 2 km buffer zone.

The registered habitat **of the lesser spotted eagle (*Clanga pomarina*)** KLO9129605 is located 2.39 km from the study area. The nest (id - 1999279627) is located 4.1 km from the study area. The habitat was last checked on 16 July 2024 as part of national monitoring, when it was uninhabited. Based on monitoring, the habitat was last

last inhabited by a golden eagle in 2015. Based on the Land Board's forest change map data (for the period 2012–2021) and orthophotos, extensive regeneration felling has been carried out in the area adjacent to the habitat.

Based on an analysis of the feeding areas **of black storks** equipped with GPS transmitters [58],there is one known feeding water body for black storks in the study area (Raamsoo stream, VEE1011800). Based on the analysis of GPS data, this is not a priority feeding water body in the section overlapping with the study area. The section used as a feeding water body is located outside the potentially suitable wind farm area.

The habitat **of the capercaillie (*Tetrao urogallus*)** KLO9101751 is located 1000 m (500 m from the buffer zone) from the development area. The last observation in the EELIS database is from 22 April 2018, when three capercaillie cocks were counted. According to map data, no significant logging has taken place in the habitat area in recent years.

According to the MLA, almost the entire study area overlaps with capercaillie zones 1 and 2, which means that, according to habitat modelling, it is a suitable habitat for capercaillie and its buffer zone. However, the capercaillie lekking site and brood biotope models do not show any significant lekking sites or brood biotopes for capercaillies in study area 2 (there are practically no pixels with a strength of >70%). The forests in study area 2 have been managed very intensively over the last 10–11 years (based on data from the Forest Register for 2012–2022). Based on fieldwork in study area 2 and its 500 m buffer zone, no observations or traces of capercaillie were found based on decoy counts, point counts of breeding birds and point observations. Therefore, based solely on modelling data, the study area cannot be considered a favourable habitat for capercaillies, but an important connection corridor (including feeding area) for capercaillies remains north of the Virna hunting area towards the Nauska lakes and Soontaga stream.

No occurrences of bird species in protection category III have been registered in study area 2 based on EELIS.

According to MLA, there is an overlap between study area 2 and zone 3 areas, i.e. the modelled habitats of the hazel grouse (*Tetrastes bonasia*).

Observations of capercaillies and other grouse

Fourteen observations of grouse were made during fieldwork, six of which were hazel grouse and eight were black grouse. No traces of capercaillie activity or individuals were observed in area 2. Black grouse were observed during the mating season on 6 May 2023, when a maximum of three cocks were observed mating in the eastern fields, and on 19 May 2023, when a maximum of two cocks were observed mating in the eastern fields. On 26 May 2023, one black grouse was observed displaying on the western farmland. The black grouse displays took place either within the 500 m buffer zone on the farmland or outside the buffer zone. In autumn, a single cock was seen on 30 September 2023 in the eastern part of the area, and a single black grouse was observed on 10 October 2023 in the western part of the area on a spruce tree. On 3 November 2023, a grouse was seen flying north in the western part of the field (flight altitude 20 m), and on 17 November 2023, nine cocks were seen flying in a north-westerly direction in the eastern part of the field.

Lure finds of woodpeckers, cuckoos, hazel grouse and black grouse; protected and important breeding birds and their habitats

Of the woodpeckers, the following were recorded in the area: great spotted woodpecker (2), black woodpecker (1), and Eurasian three-toed woodpecker (1). Of the woodpeckers, the following were recorded: black woodpecker (8),
white-backed woodpecker (3), grey-headed woodpecker (2), lesser spotted woodpecker (1), and wryneck (1). In addition, the following were recorded:
, the Eurasian tree sparrow (5), the Eurasian collared dove (7), the Eurasian woodcock (4), the Eurasian curlew (2), the Eurasian turtle dove (1), the Eurasian wryneck (1),
common crane (1), wood sandpiper (1), woodcock (1), grey heron (1). No response to the call of the corncrake was received in the area.

Nest boxes

Nests were not searched for separately in study area 2, but were observed in study area 2 during the decoying of woodpeckers, hazel grouse and woodcocks, when older forests were searched for nests in tree crowns. During the point count of breeding birds and regular point counts, attention was also paid to hawks, including various territorial and chick calls in the area, and when these were heard, possible nesting trees were searched for and mapped potential possible habitats based on territorial observations .

[58] Eagle Club. 2022. Acquisition of information on eagles and black storks equipped with satellite and GSM transmitters and analysis of nesting season data, and supplementary feeding of black storks.

One probable buzzard nest was found in the study area. In addition, several potential nesting sites were mapped, partly in the study area, partly in the buffer zone for the black kite and buzzard, the buzzard in the study area, a potential nesting site for the black kite was mapped in the buffer zone, a nesting site for the honey buzzard, and the nesting territories of the kestrel were mapped in the buffer zone.

Point observations

In the Valga study area 2, the spring migration of geese was greater than in study area 1. A total of 2,031 geese were counted, of which 936 were greater white-fronted geese and 103 were tundra swans. The family of geese remained at 992 geese. The minimum flight altitude was 50 m and the maximum 300 m. *Approximately* 60% of the geese (1,208 individuals) flying during migration were located in the rotor safety zone.

During spring migration, 65 whooper swans (LK II category) were observed flying at an altitude of 30–40 m. Of the whooper swans, 55 individuals headed north. Four individuals of the mute swan (important species) were observed, and three individuals remained in the swan family.

A total of 28 curlews (LK III category) were observed during migration, five of which flew within the rotor safety zone.

A total of 14 (mouse) buzzards were observed during spring migration, 10 of which flew within the rotor safety zone.

A little bittern was observed once (06.05.2023) in the rotor safety zone (150 m) and a corncrake was observed once in flight (150 m). A kestrel was observed once at a height of 90 m. The following protected species of birds of prey were also observed, but not within the rotor safety zone: a buzzard (one observation) and a red kite (four observations).

Of the important species, one kestrel (90 m) and two silver gulls (100 m) were observed in the rotor safety zone. During the summer

period, a total of eight buzzards were observed flying at an average height of 157 m
(range 150–200 m). A total of six buzzard sightings were made at an altitude of 150 m. A total of two black kite (LK III cat) sightings were made at an altitude of 14 m. One sighting of a red kite was recorded at an altitude of 150 m, and one sighting of a kestrel was recorded at an altitude of 150 m.

On four occasions, white-tailed eagles (LK III category) were observed at an altitude of 150 m. In the case of grey herons,
a flock of 11 birds at an altitude of 150 m heading north.

Four observations of common gulls were made at an altitude of 120–150 m. Four observations of barnacle geese were made in the safety zone
at an altitude of 90–150 m.

The autumn migration of geese (greylag goose, bean goose, tundra bean goose, white-fronted goose) was more modest compared to the spring migration, when a total of 359 geese were counted. The migration took place at altitudes between 80 m and 300 m. The predominant migration altitude was 240 m and higher (98% of geese), and two tundra bean geese were observed at an altitude of 170 m in the rotor's danger zone.

The whooper swans in the rotor safety zone – 107 individuals – were observed at an average altitude of 106 m. The observations of the lesser white-fronted geese (14 individuals flying south-west) were made in the collision safety zone at an altitude of 103 m. Observations of swans of an undetermined family were made for 99 individuals flying at an altitude of 108 m. All swans in the rotor safety zone (220 individuals) were migrating in a south-westerly (SW) direction.

Both spring and autumn migration observations of swans were made predominantly in the eastern buffer zone (18 observations) or outside it (8 observations) than in the western buffer zone (2 observations) or outside it (1 observation). As the main flight direction was southwest, this flight trajectory covered the forests in the study area.

Of the birds of prey, the most frequently observed during the autumn migration period in the rotor safety zone were buzzards (eight observations)
at an altitude of 160 m, and one hairy-legged buzzard (LK III cat) at an altitude of 180 m.

Three observations were made of white-tailed eagles, with the birds flying at an altitude of 145 m on two occasions and

at an altitude of 180 m. White-tailed eagles were observed in the eastern buffer zone of the study area on 17 October 2023 and 17 November 2023.

One observation of a red kite was made at an altitude of 110 m. A merlin was observed flying at an altitude of 100 m at the border of the study area buffer zone.

Three buzzards were also observed at a height of 90 m and 270 cormorants at a height of 100 m.

Zone 2

According to the survey, this is not a habitat for highly important protected species (category I), but it is a migration and transit corridor mainly for geese and swans (spring and autumn migration) and songbirds (especially in autumn), and to a lesser extent for hawks.

In the case of Area 2, areas directly excluded from wind farm development for bird protection were not zoned. It is recommended that the habitats of mapped Category III protected bird species be preserved as intact as possible (Figure 15). In terms of the layout of the wind turbines, more than 50% of the habitats of species in protection category III will be preserved, and the wind farm solution has been designed to minimise habitat fragmentation.

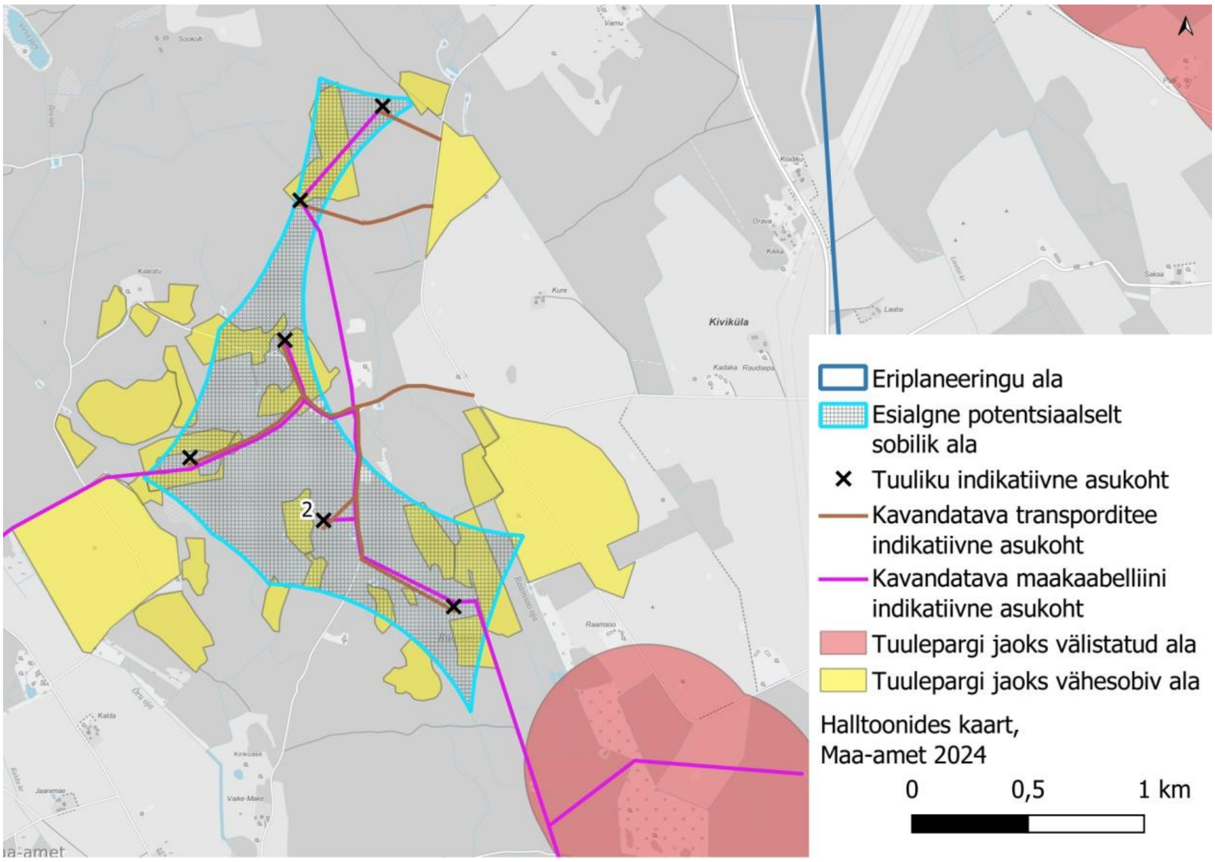


Figure 15. Bird protection zoning scheme in study area 2.

4.1.3.2.3 Results of bird assessment for potentially suitable area 3

Overview of registered habitats of protected species

There are no registered habitats of Category I protected bird species within a 5 km radius of study area 3. Based on data from GPS-equipped black storks, there are also no feeding waters for black storks in the study area.

The habitat **of the capercaillie (*Tetrao urogallus*)** KLO9101751 is located 500 m from the study area. The last observation in the EELIS database is from 22 April 2018, when three capercaillie cocks were counted. According to the MLA, almost the entire study area overlaps with capercaillie zones 1and 2, which means that, according to habitat modelling, it is a suitable habitat for capercaillie and its buffer zone.

The study area overlaps (potentially suitable wind area adjacent) with the habitat of **the northern goshawk (*Accipiter gentilis*)** KLO9119206. The last EELIS-compliant habitat observation was on 12 May 2023, when nests -1807914332; 890787226 and KLO9113035 were unoccupied. A proposal has been made to archive nest 890787226, as it has been destroyed due to clear-cutting in the vicinity of the nest. Previously (2018–2020), nest 890787226 was a successful nesting site. There is an extensive area of clear-cut forest between the potential wind turbine locations and the nest of the corncrake. Based on the above, it can be assumed that the condition of the habitat has deteriorated due to logging. The construction of one wind turbine within the 1 km buffer zone recommended in the analysis of the mainland bird population will not have any additional significant adverse impact on the habitat. Construction work must be carried out within the 1 km buffer zone outside the nesting period from 31 July to 1 March.

No bird species listed in protection category III according to EELIS have been recorded in study area 3.

According to the MLA, there is an overlap between *study* area 3 and zone 3 areas, i.e. the modelled habitats of the hazel grouse *(Tetrastes bonasia*).

Observations of capercaillies and other grouse

Capercaillie search areas were not mapped in study area 3, as there are practically no possible mating areas based on the mating model. Based on the orthophoto, these are actively managed stands, where, in principle, based on the model, lekking could only occur in isolated northern forest patches, but these have been intensively managed in recent years and do not offer much hope for stable capercaillie lekking. During fieldwork, a single capercaillie feather was found in the centre of the study area, but no other signs of capercaillie activity were observed in study area 3.

The hazel grouse was mainly found in the central part of the study area and in the southern areas, both within and outside the buffer zone.

Lure finds of woodpeckers, cuckoos, hazel grouse and black grouse; protected and important breeding birds and

their habitats

Of the woodpeckers, the great spotted woodpecker (1) was recorded in the area. Of the woodpeckers, the black woodpecker (9), the lesser spotted woodpecker (4), the white-backed woodpecker (5) and the grey-headed woodpecker (1) were recorded. In addition, the lesser spotted flycatcher (3), the Eurasian wren (6), the Eurasian tree sparrow (3),
the wood sandpiper (8), the meadow pipit (2), the woodcock (1), the barn swallow (1), the nightjar (1) and the red-backed shrike (1). The corncrake was called three times, near the location (KLO9119206) and in older pine-dominated natural forests, but the species could not be heard.

Rush nests

Separate searches for brushwood nests were conducted in older (60+) forests in the central and southern parts of the study area on 15 March 2024 and 20 March 2024, where a possible red-backed shrike nest and one buzzard nest were found in the corncrake location (KLO9119206), a possible kestrel nest and one buzzard nest were found. One buzzard nest was found in a logging area. One kestrel nest was found during a national survey.

Spot observations

During the spring migration period, a total of 998 geese/swans were observed, 96% (957/998) of which flew in the rotor safety zone at an average altitude of 160 m. The most common species during migration were the greater white-fronted goose (437), the tundra swan (207) and unidentified geese (333).

Approximately 16% (6/38) of the observed cranes flew within the rotor safety zone.

Of the birds of prey, the most common were buzzards, 54.5% of which flew within the rotor safety zone (6/11, at an average altitude of 100 m and 150 m). The predominant direction of migration was south and southwest. All of the buzzard observations (5/5) were made in the rotor safety zone at an altitude of 150 m. The buzzard observations were made on the north-west to south-east line, mainly in the central and south-eastern parts of the study area. This is the hunting territory of the common buzzard. All three observations of the black kite were also made in the rotor safety zone at a height of 140 m. The common buzzard was observed twice, once flying in the rotor safety zone at a height of 150 m.

Of the bird species in protection category I, the osprey was observed twice: once in the western part of the study area in the buffer zone at a height of 150 m near the Väike Emajõe River, and once on the southern border of the study area at a height of *approximately* 200 m, moving southwards. The lesser spotted eagle was observed in the south-western part of the study area, at the boundaries of the buffer zone.

Of the important species, the Eurasian hobby was observed four times, and all observations were made in the rotor safety zone at an average altitude of 90–130 m.

Of the hawks, the most frequently observed species was the honey buzzard, with 67% (8/12) of observations located in the rotor safety zone at an altitude of 150 m. All six observations of buzzards were located in the rotor safety zone at an average altitude of 150 m and 167 m.

One osprey was observed during the summer period in the north-western part of the study area, where it circled at an altitude of 200 m and then swooped down, probably to the Väike Emajõgi River to catch prey. One sea eagle was spotted flying at an altitude of 200 m in the north-western part of the study area.

The osprey was observed three times, and 67% (2/3) of the observations were in the rotor safety zone at an average height of

90 m.

Of the important species, cormorants were also observed in the rotor safety zone, with all 40 observations located in the rotor safety zone at an average height of 130 m and 150 m. A common tern was observed in the rotor safety zone at a height of 120 m on one occasion. One barn swallow was also observed in the rotor safety zone at a height of 150 m on one occasion.

During autumn migration, only a few geese (three observations) and one greater white-fronted goose were observed in the area.

Thirty-eight cranes were observed flying at a height of 120 m in the rotor safety zone.

Of the birds of prey, buzzards were observed, with *approximately* 88% (7/8) of observations located in the rotor safety zone at an average height of 94 m. All three sightings of the Eurasian hobby were in the rotor safety zone at a height of 90 m. The wind turbine was observed twice in the rotor safety zone at a height of 100 m. One sighting of a white-tailed eagle was made in the centre of the study area, where the eagle was heading south at a height of 100 m.

Zone 3 zoning

Based on the study, there are no habitats of Category I protected bird species in the study area. Restrictions must be imposed during the bird migration period, taking into account geese, cranes and hawks. It is also important to switch off the wind turbines during the breeding season if birds of prey enter the rotor safety zone.

The construction of wind turbines should be avoided in the Väike Emajõe primeval valley, as it contains older forests that are better habitats for birds and the river is frequented by ospreys. It is recommended that the habitats of mapped Category III protected bird species be preserved as intact as possible (Figure 15). In terms of the layout of the wind turbines, over 50% of the habitats of species in protection category III will be preserved, and the wind farm layout has been designed to minimise habitat fragmentation and avoid the Väike Emajõe primeval valley as a location for wind turbines.

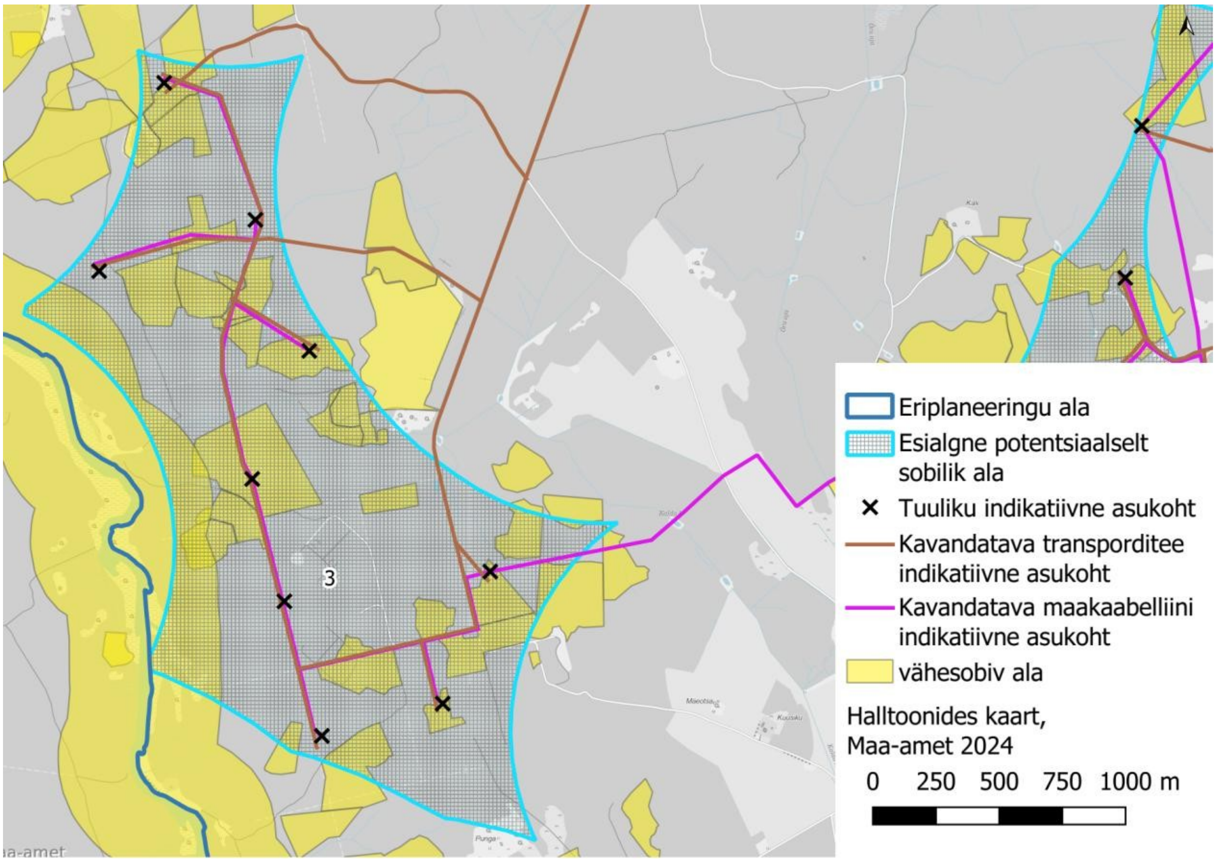


Figure 16. Bird protection zoning scheme in study area 3.

4.1.3.2.4 Results of bird assessment for potentially suitable area 4

Overview of registered habitats of protected species

The black stork (*Ciconia nigra*) habitat KLO9128282 is located 2.5 km from study area 4. The nest (id -626942051) is located 3 km from study area 4. The habitat was last checked as part of national monitoring on 16 July 2024, when it was not inhabited by the target species. Monitoring data has been available in the EELIS database since 2011, and the habitat has not been occupied during that time. The 2017 monitoring report notes that the nest has been destroyed.

Based on the Land Board's forest change map data (for the period 2012–2021) and orthophotos, no large-scale logging has taken place in the forest habitat.

During the fieldwork carried out as part of the study, the nest was found in a pine tree, but it has largely collapsed. However, based on the data from the Forest Register (2012–2022), orthophotos and field observations, the habitat has remained intact.

Based on an analysis of the feeding areas of black storks equipped with GPS transmitters [59], there is one known feeding water body for black storks in the study area (Naadimõtsa ditch, VEE1011902). Based on the analysis of GPS data, this is a partially priority feeding water body. The feeding water body overlaps with a potentially suitable wind farm area. This feeding water body is part of a maintained land improvement system headwater area of up to 10 km², which is a headwater protection zone (NAADI-1 (TTP 484). As this is an actively drained area, it can be assumed that, due to the impact of drainage, the water body is particularly important in the spring, when amphibians, which are an important food source for black storks during this period, can be found there. The closest black stork sightings date back to 2017: one sighting was 2.7 km from the development area

[59] Eagle Club. 2022. Acquisition of information on eagles and black storks equipped with satellite and GSM transmitters and analysis of nesting season data and supplementary feeding of black storks.

distance, one >4 km distance and one observation was made >4 km distance. These are isolated observations. During fieldwork in 2023, no black storks were seen in the development areas.

In Estonia, a study of feeding areas was conducted in 2007–2010 based on the feeding sites of ten black stork chicks equipped with GPS transmitters. The most common feeding sites for storks were ditches and small excavated streams, which differed in use from natural streams and large excavated streams. However, when taking into account the total length of watercourses around the nest, the black stork's preference for watercourse types was quite different. Ditches were avoided, but there was no difference between large and small natural and deepened streams. Consequently, most feeding occasions took place in ditches, which were numerous in the surrounding landscape, but are not the best quality feeding sites. Considering the choice of feeding water bodies in the landscape surrounding the nest, black storks clearly preferred natural and deepened streams, which were also revisited most often ([60] .

In general, it can be said that there are no suitable feeding waters for black storks in development areas 1–3, as evidenced by PlutoF observations, and no suitable feeding waters have been identified in development areas 1–3 based on GPS surveys, but suitable feeding waters are located east of the development areas.

It is important to preserve the primary feeding area in study area 4 and not to plan wind turbines closer than 500 m to the primary feeding areas. It is also necessary to ensure the connectivity of the feeding area in survey area 4 and the eastern habitat (KLO9128282), which means that wind turbines must not be built in the area between the priority feeding area and the habitat.

In addition, the black stork habitat KLO9133649, located 3.2 km from the study area, is listed in the 2024 register. This is a re-entry in the register based on previously archived entries KLO9101991 (last nesting in 1989, collapsed in 2009) and KLO9108861 (nesting failed in 2009, nest collapsed in 2012). According to EELIS data, the habitat is sustainable and its repopulation is possible. The habitat is delimited according to the boundaries of existing permanent habitats and corrected on the basis of cadastral boundaries. The known nests KLO9101991 and KLO9108861 in the habitat have collapsed.

The registered habitat **of the lesser spotted eagle (*Clanga pomarina*)** KLO9129606 is located 4.3 km from the study area. The habitat was last checked on 16 July 2024 as part of national monitoring. According to the monitoring, the habitat was last established by the lesser spotted eagle in 2008. According to EELIS, the nest had already collapsed during the 2015 monitoring. The habitat was repopulated in 2024.

The registered habitat **of the lesser spotted eagle (*Clanga pomarina*)** KLO9129605 is located 4.2 km from the study area. The nest (id - 1999279627) is located 3 km from the study area. As part of national monitoring, the habitat was last checked on 16 July 2024, when it was not occupied. Based on monitoring, the habitat was last occupied by the lesser spotted eagle in 2015.

Based on the Land Board's forest change map data (for the period 2012–2021) and orthophotos, the habitat
relatively extensive logging has taken place in the forest.

The small eagle owl (*Clanga pomarina*) registered habitat KLO9129604 is located 4.39 km from the study area. The habitat was last checked on 2 August 2022 as part of national monitoring, when it was uninhabited. According to the monitoring, the habitat was last inhabited by the lesser spotted eagle in 2015. Based on the orthophoto, large-scale logging has been carried out in the forest habitat.

The registered habitat KLO9129601 **of the lesser spotted eagle (*Clanga pomarina*)** is located 4.2 km from the study area. As part of national monitoring, the habitat was last checked on 15 July 2024, when it was inhabited and one chick was growing in the nest. Based on monitoring, the habitat has been inhabited throughout the period 2016–2024. Logging has been carried out near the habitat, but the forest habitat has largely been preserved.

The registered habitat KLO9129600 **of the lesser spotted eagle (*Clanga pomarina*)** is located 4.5 km from the study area. The habitat was last checked on 20 July 2024 as part of national monitoring, when it was inhabited.

[60] Environmental Board. 2018. Black stork (*Ciconia nigra*) conservation action plan.

Based on monitoring, the habitat has been inhabited throughout the period 2003–2024. The area surrounding the habitat forest has recently undergone regeneration felling, but the core of the habitat forest has been preserved.

The habitat **of the northern goshawk (*Accipiter gentilis*)** KLO9130897 is located 130 m from the study area. The nest was registered in 2022, when nesting was successful. The habitat was also inhabited on 3 June 2024, when there were two chicks in the nest (id -78008892). There are several clear-cut areas between the location of the possible wind turbines and the goshawk's nest. The Environmental Board has additionally confirmed the habitat (KLO9130897) on 31 January 2024 with clear-cut forest notification no. 50000685407. Based on the above, it can be assumed that the condition of the habitat has deteriorated due to logging. The construction of one wind turbine within the 1 km buffer zone recommended in the analysis of the mainland bird population will not have any additional significant adverse impact on the habitat. Construction work must be carried out within the 1 km buffer zone outside the nesting period from 31 July to 1 March.

Based on the MLA, almost the entire study area overlaps with 4 capercaillie zones 2 areas. The connectivity between capercaillie habitats is discussed separately in section 4.1.3.2.5.

According to EELIS, the habitat of the common buzzard (*Buteo buteo*) KLO9126365 has been registered in study area 4 among bird species in protection category III. The nest was registered on 20 March 2020.

According to the MLA, there is overlap in study area 4 with hazel grouse (*Tetrastes bonasia*) zones 1, 2 and 3, i.e. the modelled habitats of the species and the habitats mapped on the basis of random observations and their buffers.

According to the MLA, there is little overlap in study area 4 with zone 3 of the greater white-fronted goose (*Anser albifrons*) in the northern part.

Lakes, ponds, woodcock and hazel grouse decoy sites; protected and important breeding birds and their habitats

Of the woodpeckers, the great spotted woodpecker (1) was recorded in the area. Of the woodpeckers, the black woodpecker (6), grey-headed woodpecker (2), white-backed woodpecker (3), lesser spotted woodpecker (1) and middle spotted woodpecker (1) were recorded. In addition, the lesser flycatcher (6), horsefly (16), wood pigeon (4), tree pipit (4), wren (2), corn bunting (1), red-backed shrike (1), turtle dove (1), crane (2), wood sandpiper (1), barn swallow (1), wagtail (1), long-tailed tit (1), and goldcrest (1).

Nests

Nests were mapped in the study area during the woodpecker, wood pigeon and crow attraction, when older forests were searched for nests in tree crowns. During the point count of breeding birds and regular point counts, attention was also paid to hawks, including various territorial and chick calls in the area, and when these were heard, possible nesting trees were searched for and potentially suitable habitats were mapped based on territorial observations. One small unoccupied nest was discovered in a spruce tree in the northern part of the area. The nest was unoccupied and may have belonged to a buzzard.

Separate searches for nests were conducted on one day in older (60+) forests in the eastern and southeastern parts of the study area on 01.04.2024, but no nests were found.

Spot observations

During the spring migration period, a total of 779 geese were observed, of which the most common species was the greater white-fronted goose (94 individuals). Greylag geese accounted for 12% (94/779) of the geese, flying at an average altitude of 150 m in the rotor safety zone.

A total of 17 cranes were observed, of which approximately 59% (10/17) flew in the rotor safety zone at an average altitude of 175 m above the rotor.

Of the birds of prey, the most frequently observed during the migration period were buzzards, all seven of which were observed in the rotor safety zone at an altitude of 180 m. Three observations were made of honey buzzards, two of which were observed in the rotor safety zone at an average altitude of 115 m. The Eurasian hobby and the Eurasian kestrel were both observed once in the rotor safety zone at a height of 150 m.

Of the birds of prey in protection categories I-II, a lesser spotted eagle was observed in the western part of the area near farmland outside the buffer zone at a height of 200 m during the spring period. One observation of a buzzard was made at a height of 200 m near the same area.

In summer, the most frequently observed birds of prey were honey buzzards (3 observations) and buzzards (2 observations), all of which were located in the rotor safety zone at a height of 150 m. A red kite was observed once in the rotor safety zone at a height of 150 m. One lesser spotted eagle was observed in the northern part of the study area at a height of 150 m.

Barn swallows were observed on three occasions, one of which flew within the rotor safety zone at a height of 100 m

.

Other significant species observed included kestrels, of which *approximately* 31% (4/13) flew within the rotor safety zone at an altitude of 130 m

.

Autumn goose migration remained low in the study area (77 observations in total). A total of 96 songbirds were observed, 42% (40/96) of which flew in the rotor safety zone at an average height of 110 m and 150 m. Little swans were observed on two occasions.

Ducks were observed on 131 occasions, with birds flying in the rotor safety zone at an average altitude of 130 m and 150 m

.

Of the hawks, buzzards were observed most frequently during migration (5 observations in total), with birds observed twice in the rotor safety zone at an altitude of 150 m. A kestrel was observed once in the rotor safety zone at an altitude of 90 m on the eastern side of the study area. The white-tailed eagle was observed twice – in one case, the species was flying overhead (direction unknown) at a height of 100 m in the eastern buffer zone, and in the other case, the eagle was seen in the western buffer zone at a height of 80 m, heading west. A black kite was observed three times, flying in the rotor safety zone at an average height of 105 and 180 m.

Zone 4 zoning

Based on the study, there are no habitats of Category I protected bird species in the study area. In the case of Area 4, the possible feeding water body of the black stork, together with the buffer zone, was zoned as an area excluded from wind farm development for bird protection. It is recommended that the mapped habitats/feeding areas of Category II and III protected bird species be preserved as intact as possible (Figure 15). In terms of the wind turbine layout, over 50% of the mapped
When developing the wind farm solution,
the minimum fragmentation of habitats has been taken into account.

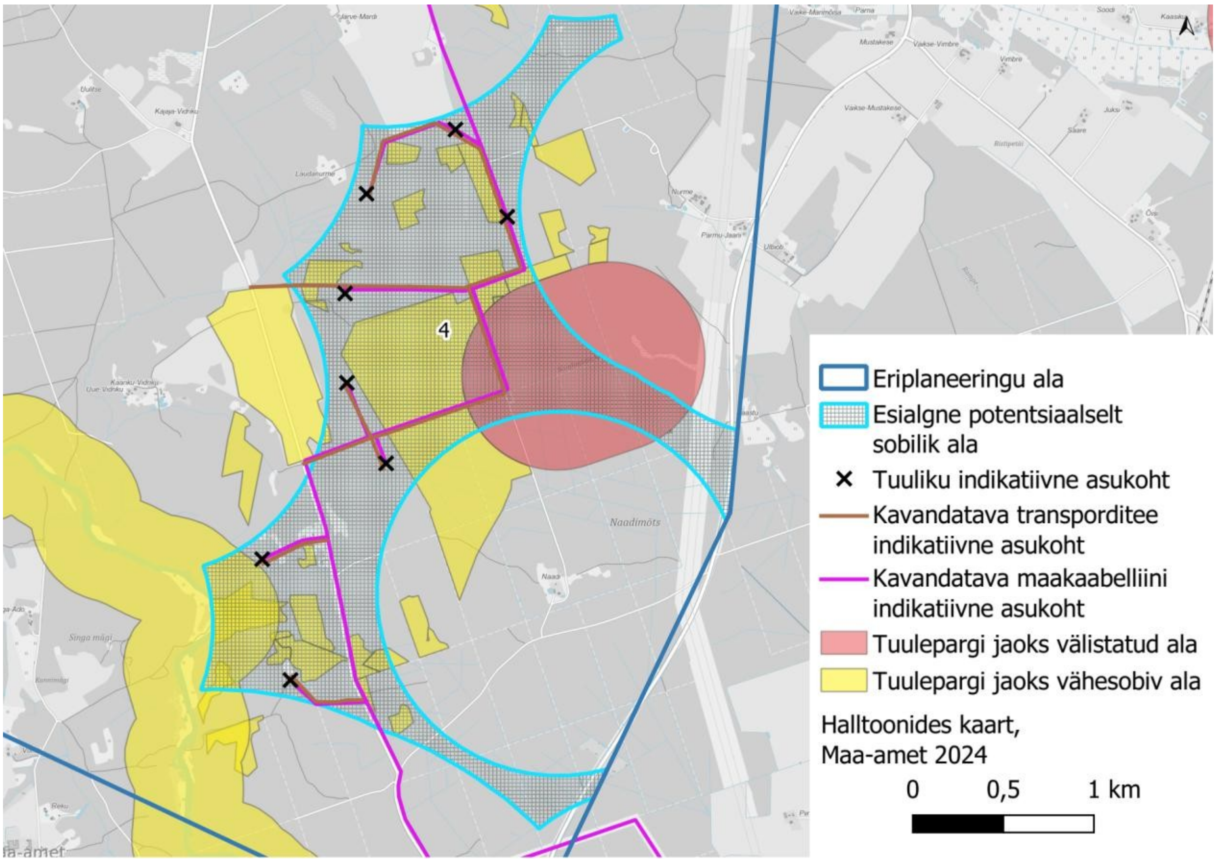


Figure 17. Bird protection zoning scheme in study area 4.

4.1.3.2.5 Impact on the connectivity of capercaillie habitats

The location of capercaillie habitats and the connectivity between habitats are discussed in the bird survey report presented in Appendix 3 of the SEA report and in the expert opinion prepared by Meelis Leivits on the impact of the Valga wind farm on the local capercaillie population, presented in Appendix 5. This chapter has been prepared on the basis of these materials.

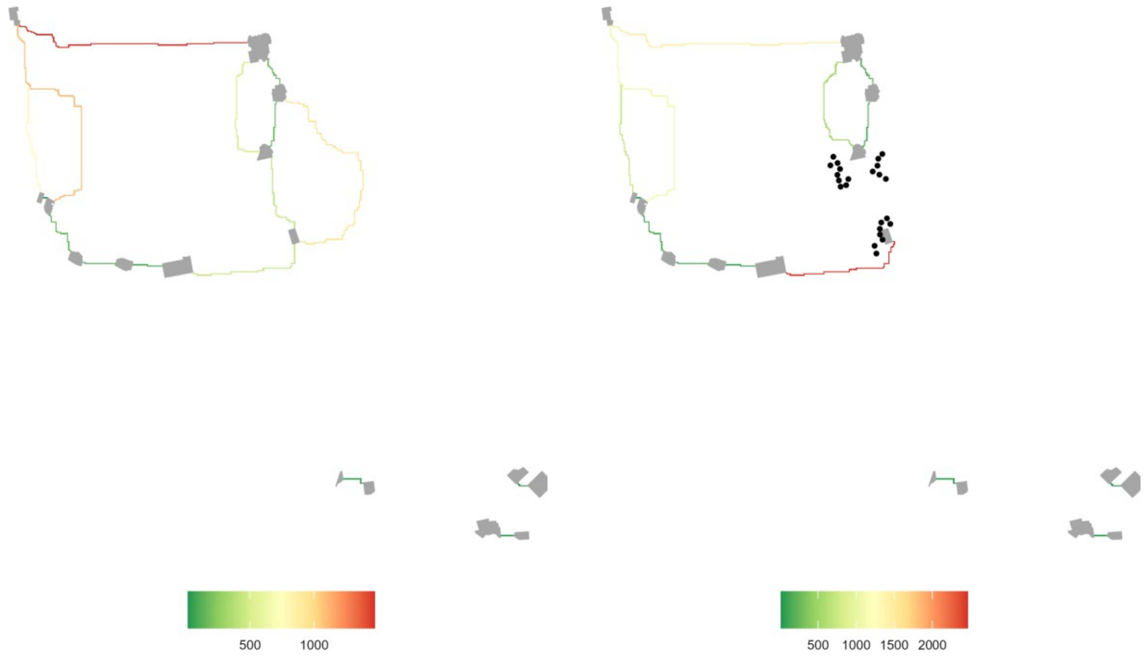
In terms of connectivity between capercaillie habitats, the most important factor is the preservation of an undisturbed connection between the Koopesoo and Virna habitats. The construction of a wind farm in area 1 would have a significant adverse impact on this connectivity. The best mitigation measure is not to construct a wind farm in area 1.

In addition, it is important to preserve the Virna habitat in order to avoid significant disturbances to the habitat associated with the construction of the wind farm. Based on scientific research, wind turbines should be located far enough away from capercaillie leks to reduce disturbance and prevent the decline of leks. Taubmann et al. (2021)61 investigated how wind farms affect the resource selection of capercaillies using GPS tracking in central Sweden. The study found that during the mating season, capercaillie cocks avoided areas with increased turbine noise, visibility and shadow. In summer, both cocks and hens avoided proximity to turbines (up to 865 m, 95% CI 784–1025 m) and areas with high turbine density and proximity to turbine access roads. The study shows that forest-dwelling species sensitive to human disturbance are likely to be affected by the presence of wind turbines. **To avoid significant adverse effects on the capercaillie habitat in Virna, a buffer zone of at least 1 km around the habitat must be ensured.**

[61] Taubmann, J., Kämmerle, J.-L., Andrén, H., Braunisch, V., Storch, I., Fiedler, W., Suchant, R., Coppes, J., 2021. Wind energy facilities affect resource selection of capercaillie Tetrao urogallus. Wildlife Biology 2021, wlb.00737. https://doi.org/doi.org/10.2981/wlb.00737

With regard to the cohesion of the population, it should be noted that with the disappearance of the Virna and Murakasoo leks (abundance -> 0), the settlement potential of the northern leks (Purtsi 2, Koopesoo) will decrease. However, this change is so small that no noticeable change in settlement potential can be identified. As this is an area with a low population density anyway, it is difficult to draw any conclusions based on this result.

The results of modelling the corridors connecting capercaillie habitats are summarised in the following figure.



(a) Movement corridors before development

(b) Movement corridors after development

Figure 18. Movement corridors before and after development. The colour scale indicates the total movement resistance of the corridor.

The connection between the Purtsi 2, Virna, Koopesoo and Virna playgrounds and the south-western Estonian and Latvian populations (Mõttuse, Nihu, etc.) depends solely on the southern connection. This line runs from the Purtsi 2 playground via the Koopesoo, Virna and Murakasoo playgrounds towards the Mõttuse playground in the south-west. The total resistance value from the Purtsi playground to the Mõttuse playground is 1166 units when using the corridors with the lowest resistance values. The connection corridor between the Rubina and Purtsi 2 sites crosses cultivated land and has an extremely high obstacle value (1476 units). Therefore, this connection route is only theoretical.

Taking the avoidance radius of wind turbines to be 1 km, we obtain the following results:

- The connection between Virna and Murakasoo becomes impassable.
- The tax on the connecting road between Murakasoo and Mõttuse increases from 435 to 2464 units.

Therefore, it can be said that with a 1 km avoidance radius, the entire Soontaga population becomes theoretically connected from the south. This will result in the isolation of the Purtsi 2, Koopesoo and Virna play areas. This has a significant negative impact on the connectivity between habitats.

In order to avoid the isolation of the Soontaga capercaillie population, the following measures must be implemented:

- Add a 1 km buffer zone to the Murakasoo lekking site (centre) registered during the preliminary studies for the plan, analogous to the MLA zone 1. km buffer zone to the Murakasoo breeding site (centre) registered during the preliminary studies for the plan, which is analogous to MLA zone 1
- Add an 800 m buffer zone to the corridor connecting the Murakasoo playground to the Mõttuse playground, which is analogous to MLA zone 1
- Avoid the construction of wind turbines in the buffer zones. Move wind turbines 3, 4 and 5 to the western edge of the agricultural area. Move wind turbines 6 and 8 to the north-eastern edge of the agricultural area. Wind turbine 7 (south-east of no. 8) should also be moved to the east or north-east.

The reason why no additional zone 2 has been added to the Murakasoo playground is that it is currently unclear to what extent this area is a permanently functioning playground. As the Murakasoo playing field is a normal commercial forest, this means that the average age of the forest within a 1 km radius will at some point begin to decrease as the trees reach maturity and are cleared. This process will take place over a longer period of time and may prove to be a more significant factor in terms of reducing the settlement potential of the Murakasoo playground. The degrading effect of the newly reconstructed drainage systems in the Murakasoo habitat will have an even longer-term impact. Due to drainage, the ground vegetation of the community will change over time (important bog plants such as cottongrass will disappear) and new growth (birch, alder or aspen) will develop, making the habitat unsuitable over time. It should also be noted that the new ditches act as a vector for the spread of small predators in the habitat, thereby increasing predation pressure and reducing the breeding success of capercaillies. It is clear that the Murakasoo playground is an important stepping stone. Therefore, in order to ensure connectivity, it is appropriate to implement a 1 km buffer zone, which has been added to the centre of the playground.

In drawing up the planning solution, it has been concluded that due to other restrictions (the location of residential buildings and public roads and the need for associated buffers), it is not possible to relocate wind turbines 3, 4, 6 and 8 to the extent necessary to preserve the Murakasoo capercaillie habitat. Based on this, their construction has been abandoned in the plan. The only wind turbine planned for the vicinity of the Murakasoo playground is position 5, which is located as far away from the centre of the playground as possible (a 1 km buffer zone is guaranteed between the centre of the wind turbine and the centre of the playground). The location of the wind turbine will also remain in an area that has been heavily affected by recent clear-cutting, where there are no favourable living conditions for forest birds. With this solution, it can be estimated that the Murakasoo habitat will continue to function as a stepping stone between habitats after the construction of the wind farm. The mating area associated with this habitat may shift eastwards due to the construction of the wind farm. At the same time, there are also forest communities suitable for capercaillies to the east of the current mating area, meaning that the mating area may be preserved. The sustainability of this play area is more related to forestry activities, which cannot be determined by the wind farm plan. With this solution, the movement of capercaillies between Murakasoo and Virna will also be preserved and no barrier effect is expected. This is especially true considering that, in addition to the shortest route connection corridor described in M. Leivits' expert opinion, it is likely that forest birds will also use the Tagujärve bog area and the forest area along the Väike Emajõe River. Therefore, in addition to the extent of the connection corridor mapped in the expert opinion, the surrounding area suitable for the movement of forest birds will also remain natural.

4.1.3.2.6 Impact on the feeding areas of black storks

The location of black stork habitats and the suitability of feeding waters are discussed in the bird survey report presented in Appendix 3 of the SEA report.

During fieldwork in 2023, no black storks were observed in potentially suitable areas. As part of the KAUR RePower study, a black stork was spotted once (observation by Annali Alberts on 05.07.2023) in the Lota stream area (in the eastern part of the potentially suitable area 1 in this report).

In Estonia, a study of feeding areas was conducted in 2007–2010 based on the feeding sites of ten GPS-tagged black storks. The majority of the storks' feeding sites were located on ditches and small excavated streams, which differed in their use from natural streams and large excavated streams. However, when the total length of watercourses around the nest is taken into account, the white-tailed eagles' preference for watercourse types was quite different. Ditches were avoided, but there was no difference between large and small natural and deepened streams. Consequently, feeding occurred most frequently in ditches, due to their large number in the surrounding landscape, but these are not the best quality feeding sites. Considering the choice of feeding water bodies in the landscape surrounding the nest, black storks clearly preferred natural and deepened streams, which were also revisited most often ([62]).

Based on fieldwork and literature, the Väike-Emajõgi River bordering study areas 3 and 4 is not a suitable feeding water body for black storks in these sections, as its depth is 2-3 m in the Jõgeveste section, for example. From Hummuli onwards, the river valley widens, the floodplain becomes marshy and the river bends become wider. Downstream from Jõgeveste, the marshy floodplain is up to 2 km wide in places. After Soontaga village, the riverbed becomes winding again and forms old river channels ([63]). Therefore, there are no water bodies suitable for feeding black-headed gulls in sections 3 and 4 of the study area bordering the Väike-Emajõgi River. In area 4, the Kalda ditch flows into the Väike-Emajõgi River, which is deep and steep about 500 m before it flows into the river, preventing fish from swimming upstream. After 500 m, the ditch flows along flatter ground, with one branch heading north and the other east. Several water intake ponds have been built on the Kalda ditch, providing a temporary food source (amphibians) in the spring. In study area 4, drainage ditches that have recently been straightened also flow into the Väike-Emajõgi River. These ditches are also located on a steep slope where the water flow is very fast, and deep sediment basins have been built on the ditches before they flow into the river, which are not suitable for feeding black-headed gulls. As the water flow in the ditches located on the slope is very fast and sediment-rich during the high water period and the water level is very low during the low water period, such ditches unfortunately do not support fish stocks, but rather act as ecological traps.

A suitable water body for feeding could be the Õru stream (VEE1011700), which is approximately 2.5 m wide and mostly 0.2-0.3 m deep (up to 0.6 m deep in some places)[64]. Õru stream borders research area 2 to the east, where aerial observations failed to detect any black storks. Previously important feeding sites (Raamsoo Stream, Soontaga Stream, Naadimõtsa Ditch), which are based on GPS surveys, are likely to be an indicator of which feeding waters in this area are suitable for black storks. In study areas 1-4, there may no longer be sufficient food sources (especially fish) and suitable sustainable feeding waters for black storks. The watercourses in study area 1, where black storks were observed once during the Repower study, can be considered to have higher potential.

In general, it can be said that development areas 2–4 lack suitable feeding waters for black storks, as evidenced by PlutoF observations and spot observations made during this study. Based on GPS surveys, no suitable feeding waters have been identified in development areas 2–4, but suitable feeding waters are located to the east of the development areas, where GPS data points are also more dense.

Based on the above, no significant adverse impact on the feeding waters of the black stork is expected in the case of the wind farm solution. Development areas 3 and 4 are located between the long-uninhabited habitats of the black stork KLO9133649, KLO9128282 and Väike Emajõe, but considering the nature of the river in these sections, no significant reduction in feeding waters is expected due to a possible barrier effect on the habitat. The wind farm is planned in two groups in relation to these habitats (areas 3 and 4 are two potential barriers with a range of approximately 3 km, between which there is a 3 km area free of wind turbines) allows access to the river to be maintained around and between the groups of wind turbines, thereby reducing the potential barrier effect on the Väike Emajõe River.

[62] Black Stork (*Ciconia nigra*) Conservation Action Plan, 2018.
[63] Estonian rivers. Järvekülg, A. Tartu, 2001.
[64] Estonian rivers. Järvekülg, A. Tartu, 2001.

The wind farm layout developed during the preparation of the special plan takes into account the preservation of areas of high bird conservation value, and based on this, it is possible to establish a wind farm in the area without significant adverse effects on birdlife if mitigation measures are implemented (section 4.1.3.3).

4.1.3.3 Measures, need for further studies and assessment

Measures at the site selection stage for wind farm planning:

- preserve as much as possible the mapped habitats of protected species and species important for conservation management, at least 50% of the mapped habitats in the case of protection category III and at least 90% of the habitats in the case of protection category II. Where species of protection categories II and III co-occur, take into account the requirement to preserve habitats of species of the higher protection category (II) (90%).

  , preference should be given to areas with a lower representation of protected species (e.g. clearings, young forests) and where there are no protected species in natural forests in the vicinity.

  Do not construct overhead lines in forest landscapes; instead, give preference to underground cabling.
- make maximum use of existing roads and, when constructing new roads, take into account the location of protected species to reduce the fragmentation of the habitats of protected species.
- Ensure a 1 km buffer zone around habitats listed in EELIS and a 1 km buffer zone around the registered habitat of the capercaillie in Murakasoo, measured from the centre of the lek. Also ensure a wind turbine-free connection corridor between Murakasoo and Virna that is at least 1600 m wide. In order to preserve the function of the connection corridor and the Murakasoo habitat as a stepping stone, the planning of wind turbines 3, 4, 6, 7 and 8 in area TU4 must be abandoned and wind turbine 5 must be moved as far away as possible from the centre of the capercaillie mating area.

Measures for the construction and operation period of the wind farm:

- In order to protect forest breeding birds, clearing and major soil works must be scheduled for the period 21 July to 28 February. Avoid changes to the water regime and other impacts that are not essential for the development. When further specifying the locations of wind turbines and routes during the design phase, it must be ensured that changing the locations does not cause a greater adverse impact on birdlife than the assessed solution. The relevant assessment must be presented in the preliminary EIA assessment of the building permit application.
- Construction work on wind turbines 1 and 15 must be carried out outside the nesting period from 31 July to 1 March, as these wind turbine locations are within a 1 km buffer zone of the corncrake's habitat.
- When constructing the wind turbine, it is recommended to increase its visibility to birds (use a colour combination that reduces the risk of collision or other technology that improves the visibility of the wind turbine to birds).
- During the migration period, wind turbines should be shut down during periods of high bird activity or using a corresponding control system in all location selection areas. Based on spot observations, migration is most active in this region in autumn from 1 to 20 October and in spring from 15 March to 15 May. Scientific studies have shown the effectiveness of such measures in preventing collisions and thus also in preventing bird deaths([65]. The length of the period and the need for implementation can be specified on the basis of follow-up monitoring.
- In the TU3 location selection area, wind turbines should be switched off when birds of prey approach in order to reduce the risk of collision, using machine learning programmes such as http://nvisionist.com/nvbird-wtg/ or similar. The implementation of this measure can be recommended in all location selection areas, as birds of prey in protection categories I and II (lesser spotted eagle, white-tailed eagle,

[65] IFC (International Finance Corporation), EBRD (European Bank for Reconstruction and Development, KfW Group 2023. Post-Construction Bird and Bat Fatality Monitoring for Onshore Wind Energy Facilities in Emerging Market Countries. Good Practice Handbook and Decision Support Tool. https://www.ifc.org/en/insights-reports/2023/bird-bat-fatality-monitoring-onshore-wind-energy-facilities

Ospreys, etc.) use the airspace in all study areas to reach their feeding grounds, e.g. farmland, Väike Emajõgi River.

- If possible, equip birds of prey nesting in the vicinity with GPS devices to assess their risk of death and/or flight trajectory due to the construction of wind turbines.

Proposal for follow-up monitoring:

- Conduct a bird inventory using a counting method comparable to the methodology used in the baseline study for planning (conduct a point count of birds, luring woodpeckers, hazel grouse and capercaillie) at least twice in the five years following the final or substantial completion and commissioning of the wind turbines in the relevant development area (the first time after the wind turbines are commissioned and the second time five years after the first inventory). The counting methods shall comply with the guidelines prepared by the Environmental Board([66]) .
- Search for dead birds, including tests of searcher performance and predation load, shall be carried out in the two years following the final or substantial completion and commissioning of the wind turbines in accordance with the methodology. The methodology is described in section 5.3 of the analysis of land birds. Searches for dead birds shall be carried out twice a month during snow-free periods. Monitoring is carried out under all wind turbines in the wind farm (in the case of wind farms with more than ten wind turbines, the number of wind turbines to be monitored may be specified in cooperation with the Environmental Board) within a radius at least equal to the length of the wind turbine blade, measured from the tower of the wind turbine (the search area may be reduced depending on the search conditions). The monitoring scheme may be specified based on the analysis of the monitoring results. If the monitoring reveals an undesirable environmental impact on birdlife, the experts conducting the monitoring must propose a suitable set of measures to prevent, minimise or compensate for the environmental impact.

4.1.4 Impact on bats

The impact of wind farms on bats can be divided into two categories based on the mechanism of impact: loss and alteration of habitats, and bat mortality. The occurrence and extent of both impacts depend on the location of the wind turbines in the landscape, which is why it is important to assess the suitability of the planning area as a habitat for bats prior to the construction of wind turbines. In addition to the location of the wind turbines, the extent of the impact may also vary depending on the season. In terms of impact, two periods are mainly distinguished: the migration period and the summer period, with the risk of death being higher during the autumn migration. In general, the potential impacts of habitat change are considered to be minor (often small), while the impacts of mortality are considered to be high to very high, depending on the location s ([67]).However,recent studies ([68]) have shown that, in the case of modern wind turbines built in forest landscapes, bat species avoid the vicinity of wind turbines (the impact extends to several hundred metres), which is presumably due to the decline in habitat quality associated with the construction of wind turbines. The way to mitigate both the risk of bat mortality and habitat loss is the same: when planning a wind farm, good bat habitats must be avoided.

[66] Mägi, M., Saad, P. 2024. Methodology for biodiversity studies in wind farms and minimum requirements for follow-up monitoring

[67] Rodrigues, Luisa, Lothar Bach, M. -J Dubourg-Savage, B Karapandža, D Kovać, T Kervyn, Jasja Dekker, et al., eds. 2014. Guidelines for Consideration of Bats in Wind Farm Projects. EUROBATS Publication Series 6. Bonn: UNEP/EUROBATS.

[68] Ellerbrok, J.S., Delius, A., Peter, F., Farwig, N. and Voigt, C.C., 2022. Activity of forest specialist bats decreases towards wind turbines at forest sites. Journal of Applied Ecology 59(2); Gaultier, S.P., Lilley, T.M., Vesterinen, E.J. and Brommer, J. E., 2023. The presence of wind turbines repels bats in boreal forests. Landscape and Urban Planning 231 (2023) 104636).

The main cause of bat mortality is direct contact with moving wind turbine blades, but under specific conditions, mortality due to barotrauma is also possible [69,70]. Bat fatalities have been recorded mainly in onshore wind farms in Europe and North America, but some data are also available from other regions t([71)(,72)(,73)]. The available data on mortality is largely related to whether and how bat mortality has been monitored.

The problem of bat mortality is widespread and, in some places, significant, but the extent of the impact varies greatly from place to place. According to a summary published in 2016, the number of bats killed in wind farms varies greatly across European onshore wind farms, ranging from 0 to 11 bats per MW ([74)] However, a 2010 study([71)] puts the range at 0–23 bats killed per MW. The risk of death is generally higher in locations where wind turbines are located in or near habitats suitable for bats, such as forests and water bodies, the home range of some bat colonies, or in areas where bats congregate during migration[71,74] . Thus, both resident populations, where the impact may be greater on females and young animals ele[75] , and migratory populations[72] are [affected]. In addition, it should be noted that many bat species are habitat-specific, and a wind farm located in the home range of a breeding colony is likely to affect the population over a long period of time.

The risk of coming into contact with wind turbine blades and thus being killed also varies between species. Wind turbines mainly threaten species that fly high and use open habitats, while species that fly low and close to trees are rarely killed by wind turbines. In north-western Europe, where the bat fauna is largely similar to that of our region, the majority (98%) of bats killed in wind farms belong to the families *Nyctalus, Pipistrellus, Vespertilio* and *Eptesicus*([71)] All of these families are also represented in the bat fauna of Estonia. Species belonging to *the Myotis* and *Plecotus* families have a low risk of death according to the same source, as they usually hunt closer to the ground and tend to avoid open landscapes. The distribution of bat species found in Estonia into species with high and low collision risk is presented in Table 11. At the same time, the parameters of wind turbines and their possible impact must also be taken into account in the near future. The studies on which Table 11 is based were conducted mainly in the vicinity of wind turbines with a mast height of approximately 90–100 m, located in open areas or on the edges of forests and on the coast. However, as the height of wind turbines increases, it is likely that

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[69] Baerwald, Erin F., Genevieve H. D'Amours, Brandon J. Klug, and Robert M. R. Barclay. 2008. 'Barotrauma Is a Significant Cause of Bat Fatalities at Wind Turbines'. Current Biology 18 (16): R695–96. https://doi.org/10.1016/j.cub.2008.06.029.

[70] Lawson, Michael, Dale Jenne, Robert Thresher, Daniel Houck, Jeffrey Wimsatt, and Bethany Straw. 2020. "An Investigation into the Potential for Wind Turbines to Cause Barotrauma in Bats." PLOS ONE 15 (12): e0242485. https://doi.org/10.1371/journal.pone.0242485.

[71] Rydell, Jens, Lothar Bach, Marie-Jo Dubourg-Savage, Martin Green, Luisa Rodrigues, and Anders Hedenström. 2010. "Bat Mortality at Wind Turbines in Northwestern Europe." Acta Chiropterologica 12 (2): 261–74. https://doi.org/10.3161/150811010X537846.

[72] Voigt, C.C., A.G. Popa-Lisseanu, I. Niermann, and S. Kramer-Schadt. 2012a. "The Catchment Area of Wind Farms for European Bats: A Plea for International Regulations." Biological Conservation 153: 80–86. https://doi.org/10.1016/j.biocon.2012.04.027.

[73] Gaultier, Simon P., Anna S. Blomberg, Asko Ijäs, Ville Vasko, Eero J. Vesterinen, Jon E. Brommer, and Thomas M. Lilley. 2020. 'Bats and Wind Farms: The Role and Importance of the Baltic Sea Countries in the European Context of Power Transition and Biodiversity Conservation'. Environmental Science & Technology 54 (17): 10385–98. https://doi.org/10.1021/acs.est.0c00070.

[74] Arnett, Edward B., Erin F. Baerwald, Fiona Mathews, Luisa Rodrigues, Armando Rodríguez-Durán, Jens Rydell, Rafael Villegas-Patraca, and Christian C. Voigt. 2016. "Impacts of Wind Energy Development on Bats: A Global Perspective." Bats in the Anthropocene: Conservation of Bats in a Changing World, edited by Christian C. Voigt and Tigga Kingston, 295–323. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-25220-9_11.

[75] Kruszynski, Cecilia, Liam D. Bailey, Lothar Bach, Petra Bach, Marcus Fritze, Oliver Lindecke, Tobias Teige, and Christian C. Voigt. 2021. 'High Vulnerability of Juvenile Nathusius' Pipistrelle Bats (Pipistrellus Nathusii) at Wind Turbines'. Ecological Applications n/a (n/a). https://doi.org/10.1002/eap.2513.

Wind turbines will also be installed above forests where significantly less is known about bat habitat use.
significantly less.

Table 11. Distribution of bat species found in Estonia based on the risk of death in onshore wind farms[67,71] .

Species name	Species name in Latin	Risk class (Rydell 2010)	Risk class (Rodrigues 2014)
pond bat	*Myotis dasycneme*	low risk	medium risk
pond bat	*Myotis daubentonii*	low risk	low risk
Daubenton's bat	*Myotis brandtii*	low risk	low risk
long-eared bat	*Myotis mystacinus*	low risk	low risk
Natterer's bat	*Myotis nattereri*	low risk	low risk
brown long-eared bat	*Plecotus auritus*	low risk	low risk
park bat	*Pipistrellus nathusii*	**high risk**	**high risk**
pipistrelle	*Pipistrellus pipistrellus*	**high risk**	**high risk**
pygmy bat	*Pipistrellus pygmaeus*	**high risk**	**high risk**
northern bat	*Eptesicus nilssonii*	**high risk**	medium risk
silver bat	*Vespertilio murinus*	**high risk**	**high risk**
great spotted bat	*Nyctalus noctula*	**high risk**	**high risk**
small noctule	*Nyctalus leisleri*	**high risk**	**high risk**
European long-eared bat	*Barbastella barbastellus*	low risk	medium risk

Bat mortality in wind farms can be seasonal, with the number of animals killed often higher during the autumn migration period, which is why wind turbines located on migration routes increase the risk of bat mortality. Therefore, bat mortality in wind farms is a problem with cross-border implications. For example, some of the bats killed in wind farms in Germany are very likely to originate from the Baltic States ([72] [,75] .

The European bat conservation agreement EUROBATS has compiled guidelines for taking bats into account in wind farm planning[67] . The guidelines state that wind turbines should not be installed in forests or less than 200 metres from their edges, as this increases the risk of bat mortality. However, a recent study on greater mouse-eared bats showed that a 500-metre buffer zone should be implemented around breeding colonies, as wind turbines installed less than 500 metres away must be shut down depending on bat activity([76] . More recent studies have shown that wind turbines have a repellent effect on large bats (60 individuals were equipped with GPS transmitters) from a distance of 500 m ([77], while for northern bats, a repellent effect has been demonstrated from 600 m and for flying squirrels from 800 m from the nearest wind turbine([78]

Particular attention should be paid to broadleaf forests. In the Estonian context, it is also appropriate to consider mixed forests as an important forest type, as they are known to be important habitats for bats. When planning wind farms, the immediate vicinity of colonies and important bat habitats/feeding areas should also be avoided. At the same time, EUROBATS points out that in the densely forested Nordic countries, it may be unavoidable to build wind turbines in forest areas. In such cases, specialist experts should be involved in the site selection process and, based on the best available knowledge and, where necessary, data collected during fieldwork, areas should be selected where there are likely to be few bats and the risk of mortality is as low as possible([19] .

[76] UNEP/EUROBATS IWG on wind turbines and bat populations. Report of the IWG to the 27th Meeting of the Advisory Committee Sarajevo, Bosnia and Herzegovina, 27-29 March; EUROBATS: Sarajevo, 2023; p 54.

[77] Reusch, C., Paul, A. A., Fritze, M., Kramer-Schadt, S., & Voigt, C. C. 2023. Wind energy production in forests conflicts with tree-roosting bats. Current Biology. 33(4): 737-743.e3.

[78] GAULTIER, S. P., LILLEY, T. M., VESTERINEN, E. J., & BROMMER, J. E. (2023). The presence of wind turbines repels bats in boreal forests. Landscape and Urban Planning, 231, 104636.

4.1.4.1 Assessment methodology

In potentially suitable areas of the Valga municipality special plan, an assessment of the impact on bats was carried out based on a bat survey[79] . During the survey:

- existing bat distribution data was compiled in the EELIS database;
- a bat survey was conducted:
    - The aim of the bat survey was to determine whether there were any important gathering places, feeding places, summer colonies and shelters for bats in the area. It was also necessary to determine the activity of bats in spring, summer and autumn.

      Bats were recorded from sunset to sunrise, and observations were carried out on nights with favourable weather conditions for bats – air temperature >10˚C, calm and no precipitation. The selected bat survey methodology and the counting points selected in the wind farm area made it possible to assess the species composition and abundance of bats in the study area. Attention was paid to the fact that the blades of the wind turbines are higher than the treetops, which was taken into account when selecting the survey methodology.

The EELIS database was analysed for bat sightings within a 2 km radius of the study areas. The use of EELIS data has been updated as of 08.08.2025.

The Wildlife Acoustics Song Meter Mini Bat automatic detector was used in the bat survey areas. The data was processed using *Wildlife Acoustics Kaleidoscope Pro 5 Analysis Software.* In spring and early summer, the detectors were installed at a height of 1.8–2.0 m on tree trunks. In August, the detectors were installed at a height of 10–20 m in the tree canopy to monitor migration above the canopy. The usual home range size of bats was estimated to be 5,000 m, which was taken into account when placing the detectors in the landscape. However, a buffer zone of only 5,000 m does not guarantee the representation of different habitats and the location of colonies during the breeding season. Therefore, 2-3 detectors were installed in the study areas and moved from time to time.

The bat data obtained in the study reflect their relative abundance in the study area, as it is not possible to distinguish individuals flying continuously at the same point, e.g. from a roosting colony. Based on the data, it was possible to identify spring and autumn migration routes and, to some extent, summer feeding areas.

The study treats bats as a family, as processing the data separately is time-consuming and it is often impossible to distinguish between pond bats and water bats based on spectrogram data. Representatives of the *Pipistrellus* family are also treated together.

Based on camera analysis, breeding forests important for bats were selected, including those listed in Annex 1 [80]of the Bat Conservation Action Plan. Therefore, forests that are at least 100 years old are considered important breeding and feeding forests, as they provide bats with habitats in tree hollows or bark crevices. It can be assumed that 100-year-old forests also produce more insect mass (moths, diptera, etc.) suitable for feeding bats due to their many microhabitats. In addition, forests with at least 55-year-old aspen trees covering at least 10% of the area of the compartment are considered suitable for feeding and breeding. A 200 m buffer zone (200 m on both sides of the river, i.e. 400 m in total) has been taken into account for water bodies (Väike Emajõgi), where wind turbines will not be built, as the riparian communities and water bodies provide necessary feeding opportunities for bats (e.g. flying squirrels). The edge effect was taken into account when converting forest land to agricultural land, where a buffer zone of at least 200 m must be left for bats to feed at the edge of the forest (*Pipistrellus)* or in open areas with feeders such as the greater mouse-eared bat. When planning wind turbines in edge areas, it is essential to implement wind turbine shutdowns during the bat activity period to avoid significant bat mortality.

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[79] The full study report is presented in Appendix 3 to the KSH report, but as the report contains data on the locations of Category I and II species
, it is for internal use only.

[80] Appendix 1. GUIDELINES FOR ASSESSING THE IMPACT OF WIND FARMS ON BATS IN ESTONIA. Draft (08.02.2023).

A 200 m buffer zone has been implemented around bat breeding colonies and roosting sites, based on the latest scientific literature.

Based on the results of fieldwork, areas in the wind farm area were mapped where there are good habitats and feeding grounds for bats, where bat populations are high and where the construction of wind turbines should be avoided or mitigation measures should be used.

4.1.4.2 Assessment results

Data from databases

EELIS data revealed that there is one known important bat habitat within a 2 km radius of study areas 2, 3 and 4. This is Hummuli Manor Park (KLO1200584), which is a summer roost for bats. According to EELIS, this is a very important habitat. The park borders the Väike Emajõgi River, which is a feeding area for bats. The following species have been recorded in the manor park: brown long-eared bat (*Plecotus auritus,* (KLO9108818), Daubenton's bat (*Myotis daubentonii)* (KLO9108820), northern bat (*Eptesicus nilssonii)* (KLO9108815), and Natterer's bat (*Myotis nattereri)* (KLO9108767). According to the national red list, the brown long-eared bat, Daubenton's bat, and northern bat are in a favourable condition, but Natterer's bat is in the near threatened category.

4.1.4.2.1 Fieldwork results for study area 1

Of the land types, study area 1 was dominated by woody vegetation (91%), with arable land and wetlands each accounting for 4% and flat areas 1%.

The vast majority of stands are old pine forests (51%) with an average age of 84 and an area of 577 ha, followed by middle-aged (55 years) spruce forests (22%). Coniferous forests account for over 70% of the area's stands. Middle-aged deciduous forests (55 years old) account for 23% of the area. The most suitable forests for bats, where the age of aspen trees is at least 55 years and their share is at least 10%, cover a total of 26 ha.

In study area 1, two bat detectors were used in parallel at a total of three points. A total of 482 bat vocalisations were recorded in the study area. At point 2, bats were recorded for one night during their spring migration (10–11 May), but a feeding ground for wild animals was discovered nearby and it was decided to move the detector to point 3 for safety reasons, where it recorded from 21 May to 7 July 2023, i.e. during the spring migration period and the summer breeding period. Point 1 recorded bats during the autumn migration period (4–28 August 2023). (Figure 19)

Figure 19. Locations of bat detectors used in study area 1 in Valga.

During the spring migration (10.05–31.05), a total of 93 bat vocalisations were recorded at detectors 2 and 3, of which the most common were the greater mouse-eared bat (49) and the northern bat (30). Figure 20).

During the summer breeding season (1 June–8 July), a total of 196 bat calls were recorded by detector 2, most of which were northern bats (144) and greater mouse-eared bats (33, Figure 20).

During the autumn migration (04.08–28.09), a total of 193 bat calls were recorded at tree canopy height near detector 1. The northern bat was recorded most frequently (119), followed by the pipistrelle (*Pipistrellus,* 53), with fewer than ten vocalisations from other species (Figure 20).

The relative abundance of bats in study area 1 remained rather modest. No mass spring migration was observed in study area 1, but the greater mouse-eared bat was the most common species during the migration period. According to the national red list, the common pipistrelle belongs to the near threatened category [(explanation: locally distributed and moderately abundant species. The long-term population trend is stable, but the short-term trend has turned negative. As this is a long-lived species, a further decline in the population can be expected (many barn owls are killed in European wind farms([81])].

The results also show that the detectors were not located near breeding colonies, although during the breeding season, increased activity of northern bats was observed near detector No. 3, as well as a slight increase in the relative abundance of greater mouse-eared bats, which probably indicates the presence of more individuals in the area during the breeding season. Autumn migration activity was *approximately* twice as high as spring migration activity in the area. While the main species during spring migration was the greater mouse-eared bat, the main species during autumn migration was the northern bat.

81 UNEP/EUROBATS IWG on wind turbines and bat populations. *Report of the IWG to the 27th Meeting of the Advisory Committee Sarajevo, Bosnia and Herzegovina, 27-29 March*; EUROBATS: Sarajevo, **2023**; p 54.

One reason for the low abundance of bats in the study area may be the scarcity of old aspen stands. For example, old aspen stands account for less than 1% of the total forest area, with coniferous forests making up the vast majority, *approximately* 74% (Figure 20).

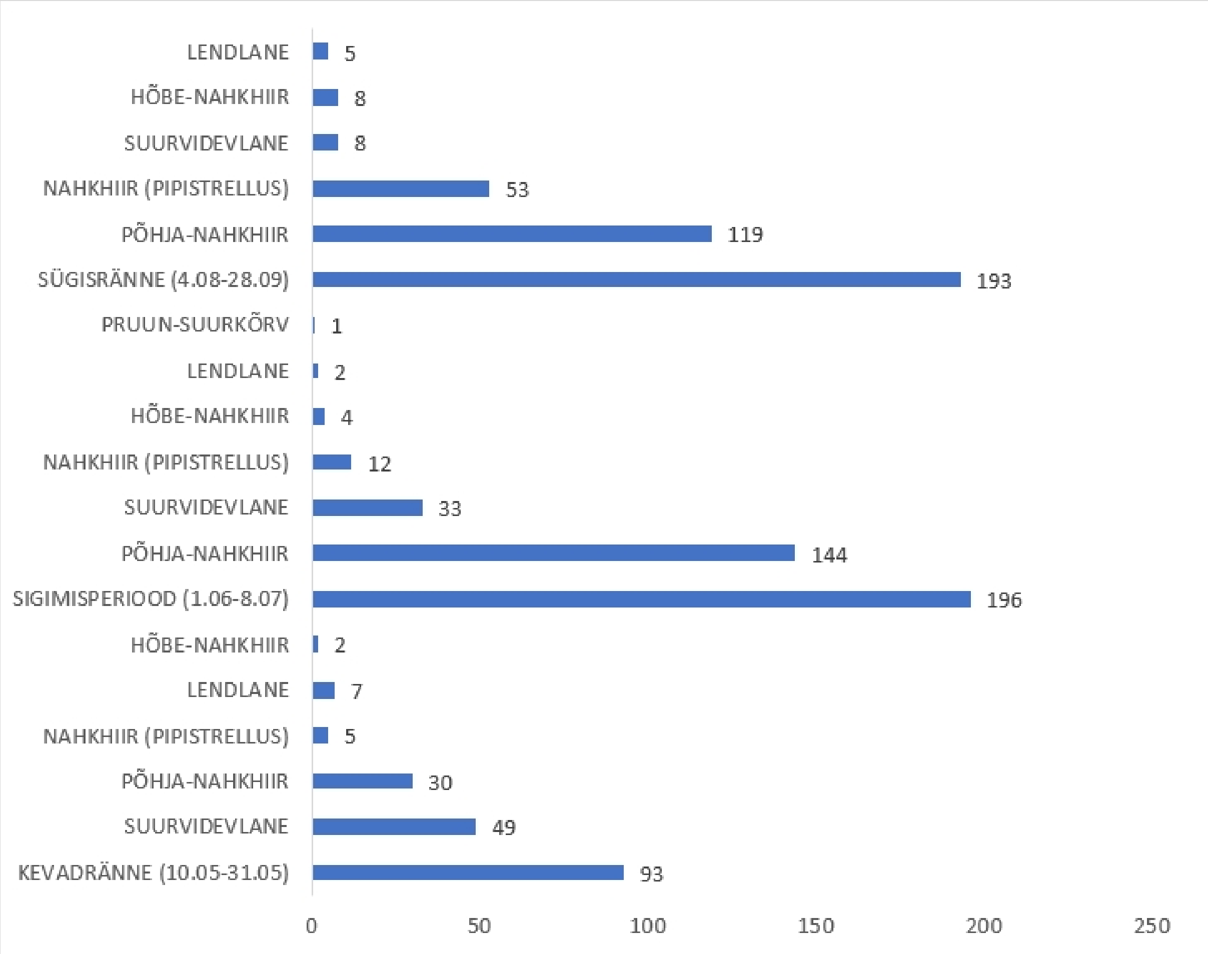

Figure 20. Results of fieldwork on bats in study area 1 during spring migration, breeding season and autumn migration. The x-axis shows the number of bat calls recorded, i.e. the number of flyovers.

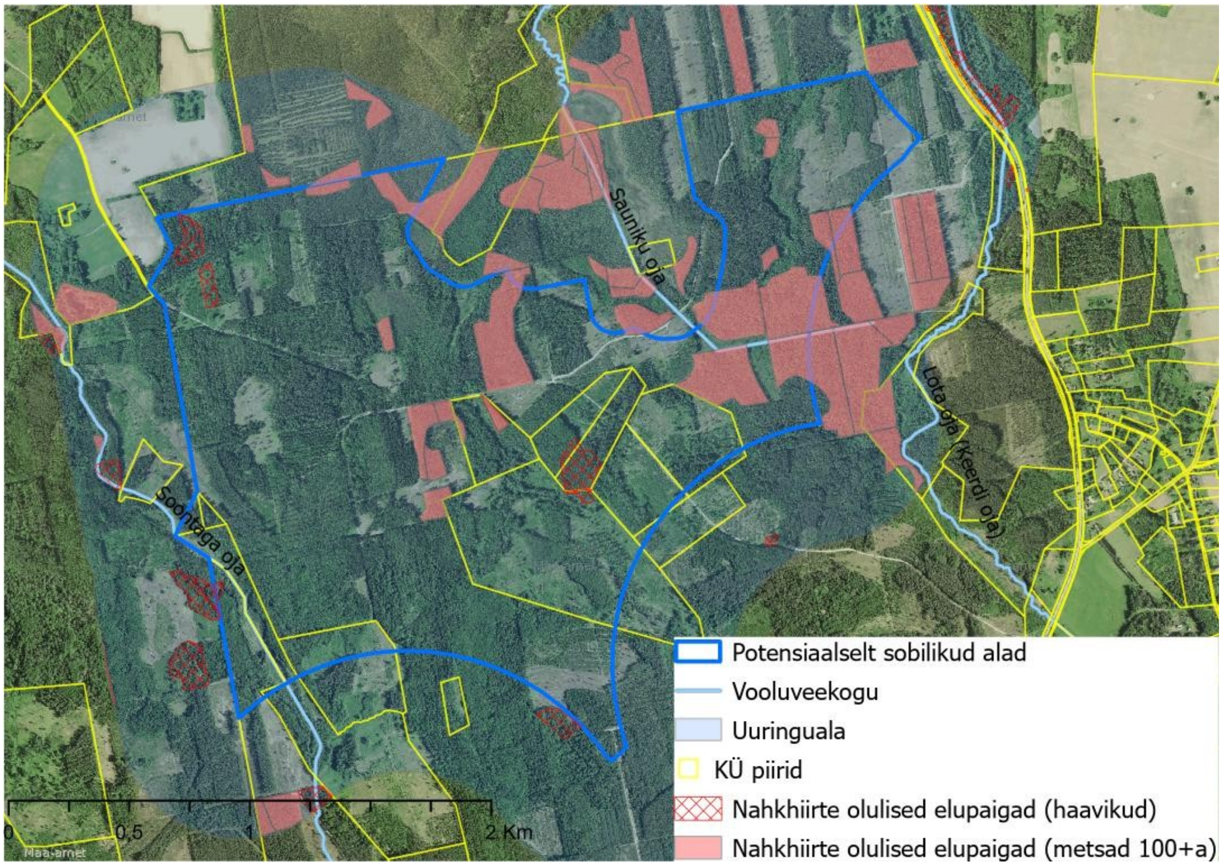

Figure 21. Habitats and feeding areas important for bats in study area 1, where wind turbine planning should be avoided. should be avoided.

Potentially suitable area 1 has areas that are important as bat habitats, but there are also areas within the area are of lesser value as bat habitats.

4.1.4.2.2 Fieldwork results for study area 2

Based on the distribution of land use, study area 2 was predominantly covered by woody vegetation (84%), with 15% arable land and 1% open areas; there were no wetlands in the study area.

Based on the structure of the forest stand, study area 2 is dominated by older (57 years) birch forests (42%), followed by middle-aged (50 years) spruce forests (32%). Spruce and birch forests make up *approximately* ¾ of the forest stand (74%). There are 37 ha of forests important for bats, where the age of aspen trees is at least 55 years and their proportion is 10%.

In the northern part of study area 2, detectors recorded at four points: at location 1, the detector recorded at tree canopy height from 04.08.23 to 17.08.2023; at location 2, the detector recorded at a height of 2 m from 25.05.2023 to 13.06.2023; at point 3, the detector recorded at tree canopy height from 18 August 2023 to 29 September 2023, and at point 4, the detector recorded at a height of 2 m from 13 June 2023 to 8 July 2023 (Figure 22).

In the centre of study area 2, automatic detectors recorded on the following dates: at point 5 at a height of two metres from 25 May 2023 to 13 June 2023, at point 6 at a height of two metres from 19 May 2023 to 2505.2023, at point 7 at a height of two metres from 14.06.2023 to 09.07.2023, and at point 8 at the height of the tree canopy from 10.09.2023 to 20.09.2023 (Figure 22).

In the southern part of study area 2, the automatic detector recorded at point 9 on 20.05.2023–25.05.2023 (Figure 22).

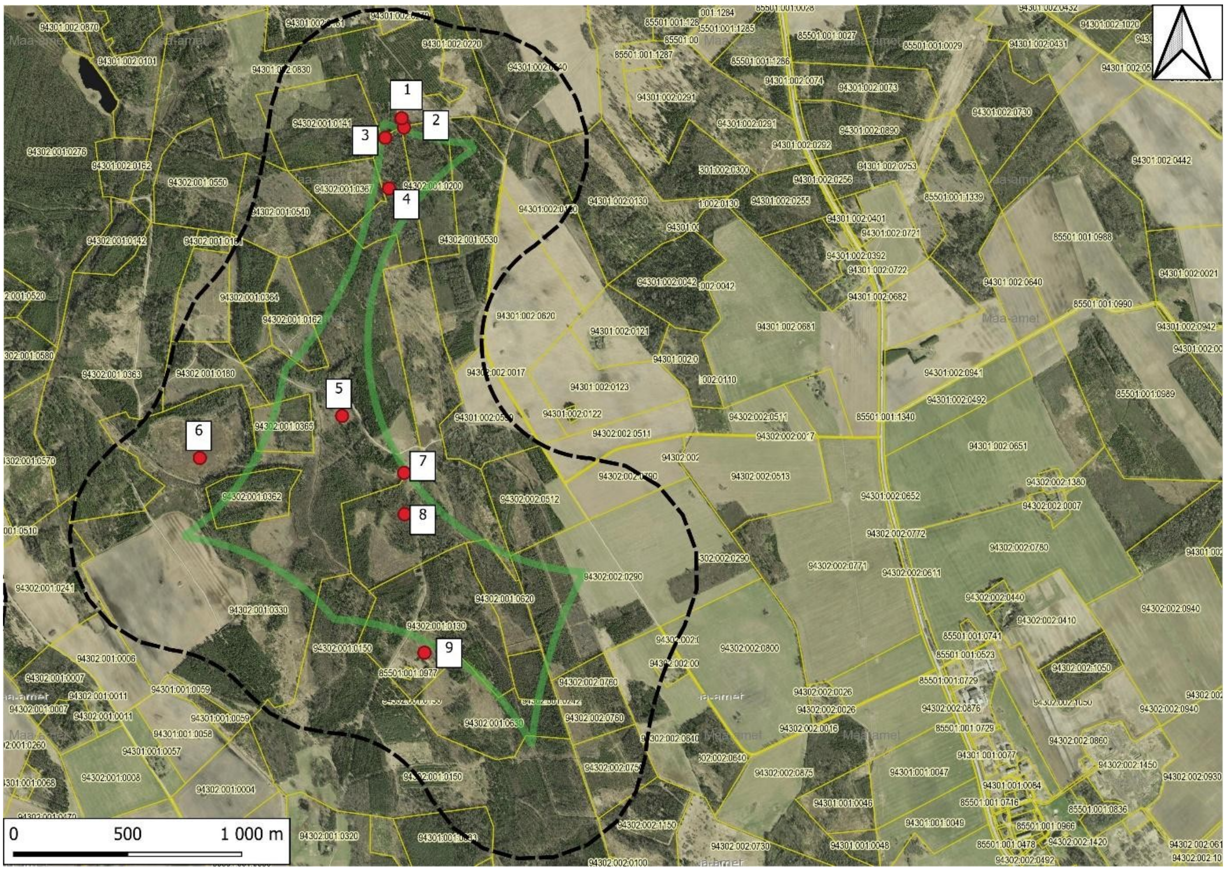

Figure 22. Locations of bat detectors in study area 2 in Valga.

A total of 3,886 bat calls were recorded in the second study area: 267 calls during spring migration (19.05–31.05), 1 , 486 calls, and during autumn migration (4 August–29 September)

2133 vocalisations (Figure 23).

A total of 71.9% of bat vocalisations (2795/3887) were recorded at the northern monitoring points, 25.6% of vocalisations (994/3887) in the central part of the area, and 2.5% of bat vocalisations (98/3887) in the southern part.

During the spring migration, there were three major groups of bat species: northern bats (176 vocalisations), greater mouse-eared bats (36 vocalisations) and pipistrelles (24 vocalisations).

During the breeding season, northern bat calls were most common (1177), followed by greater mouse-eared bat (138 calls) and the brown long-eared bat (85 vocalisations).

During the autumn migration, northern bats were recorded most frequently (1943 vocalisations), followed by silver bats (78 vocalisations) and greater mouse-eared bats (45 vocalisations).

On registered immovable property 94302:001:0210, located in the northern part of study area 2, there is a 9.36 ha mixed forest with a predominance of older aspen and birch trees, which cannot be found in the Forest Register database. Part of survey area 2 is also covered by property 94302:001:0200, which has 1.65 ha of older alder forest (57 years old).

An increased activity cycle of northern bats was observed in study area 2. The recording peaks show a higher activity cycle during the breeding season (20–26 June) and autumn migration (18–26 August and 7–13 September). Based on the data, it can be assumed that this location was probably home to a bat breeding colony during the breeding season and may also have been an important feeding ground. The autumn activity period indicates that northern bats may have roosted at this location or that it was a transitional shelter area used by bats during migration to reach their wintering grounds. When installing wind turbines, a minimum distance of 500 m from the northern boundary of the development area must be taken into account in order to ensure a buffer zone for bats or to switch off nearby wind turbines at night during the breeding season when the average wind speed is <5 m/s (Figure 25).

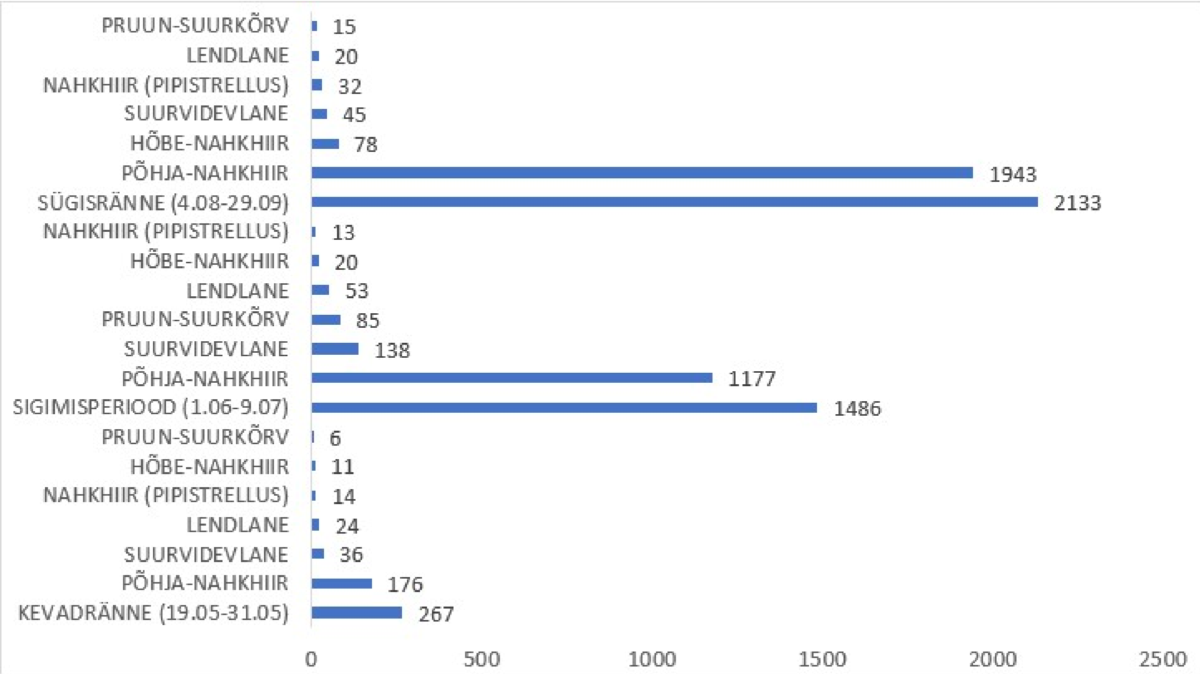

Figure 23. Results of fieldwork on bats in study area 2 during spring migration (19.05–31.05), the breeding season (01.06–09.07) and autumn migration (04.08–29.09).

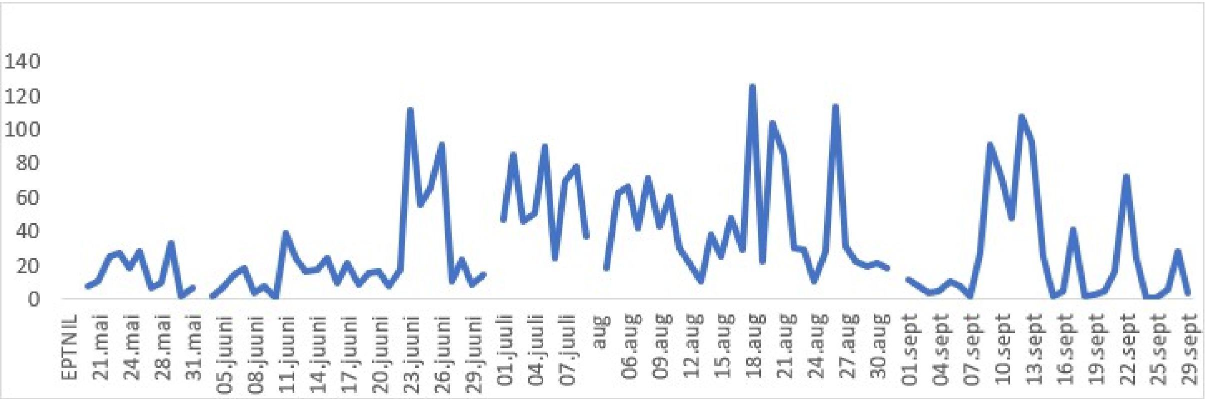

Figure 24. Activity cycle of the northern bat, which was most prevalent in study area 2. The peaks indicate higher activity cycles during the breeding season (20–26 June) and autumn migration (18–26 August and 7–13 September).

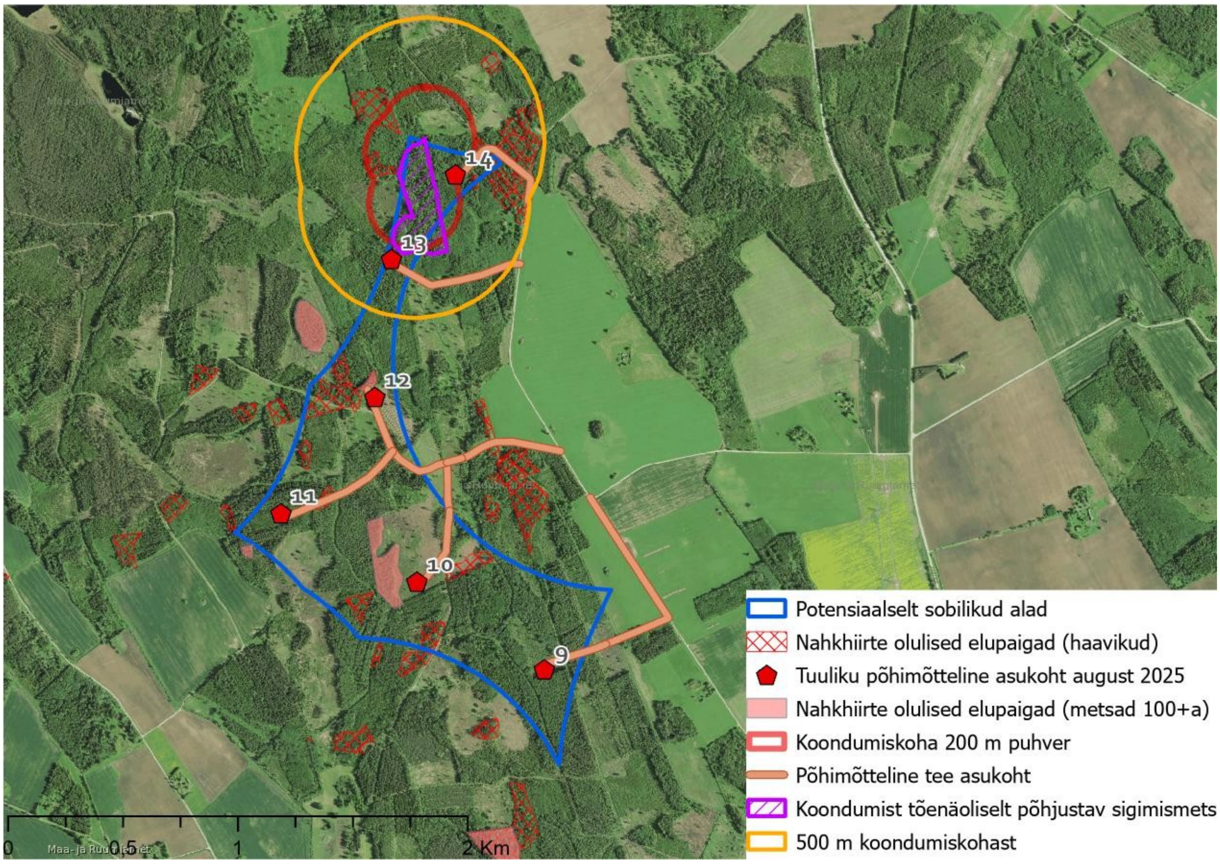

Figure 25. Old (100+ years) forests in study area 2 in Valga – likely habitats and feeding grounds for bats, together with forests aged 55+ years where the proportion of aspen is over 10%. The figure shows the location of forest stands likely to promote concentration (given that high abundance was observed primarily around the northern part of the forest stand). Aspen stands located in the same area may also promote concentration.

In the case of bat concentration sites, the most effective mitigation measure is to establish a buffer zone with a radius of 200 m around the concentration site, where no wind turbines are erected, in order to preserve the bats' breeding site free from disturbance. In addition, weather-dependent restrictions on working hours are an effective mitigation measure to reduce the risk of death. As this is currently a commercial forest, avoiding the construction of wind turbines may not actually guarantee the preservation of a forest area suitable for bat breeding. It can be assumed that when the forest reaches maturity, logging will be carried out in the area and the location of the gathering site will change.

In the case of wind turbine position 14, it is possible to plan construction areas (including access roads) outside areas suitable for bats, including the forest area mapped on the basis of bat surveys as conducive to concentration, However, due to other restrictions, it is not possible to move the wind turbine location completely outside the 200 m buffer zone. The construction of wind turbine position 14 will therefore avoid habitat loss, but its construction will be accompanied by possible disturbance to the bat concentration area (the wind turbines are planned to overlap with the 200 m buffer zone of the concentration area, but the forest community causing the concentration will be preserved) and a risk of death. As this is a potentially significant negative impact, additional mitigation measures must be found.

The gathering place is created by a forest community suitable for bats, where there are suitable hiding places for bats. A forest bat community needs at least 25-30 tree hollows, or 7-10 hollow trees per hectare ([82]) .Considering the possible disturbance of the identified gathering place, but at the same time

[82] Meschede, A., 2001. Bats in forests – information and recommendations for forest managers. Meschede, A., Güther, W., Boye, P. (Eds.), Landschaft als Lebensraum 4, 4–18.

the possibility of damage to the forest community at the roosting site due to logging, logging conditions that take into account the habitat requirements of bats (see section 4.1.4.3 for details) must be provided for in order to preserve the forest community (forest area marked with purple stripes in Figure 25). Compliance with these logging conditions throughout the lifetime of the wind farm will allow the forest community necessary for the bats' habitat to be preserved.

In order to mitigate the risk of death and reduce the disturbance caused by the operation of wind turbines during the most active periods for bats, wind turbines must be shut down at night during the bat breeding season within a 500 m radius of the breeding forest under weather conditions that favour bat activity: average wind speed is <5 m/s, temperature is ≥0 degrees and there is no precipitation (0 mm).

4.1.4.2.3 Fieldwork results for study area 3

Based on the distribution of land use, study area 3 consisted of wooded areas (91%), wetlands (4%), farmland (3%) and open areas (2%).

The stands in study area 3 are dominated by older (81 years) pine forests, which make up 47% of the total stand. Older birch forests (average age 55 years) account for 25% of the forest stands in the area. The most suitable forests for bats, where the age of birch trees is at least 55 years and their share in the stand is at least 10%, cover 56 ha.

Bat detectors recorded data at six different points (Figure 26), divided equally between two observation points in the northern, central and southern parts of the study area. In the northern part of the area, the detector recorded at point 1 at tree canopy height on 18 August–29 September, and at point 2 at a height of *approx. 2* m on 17 May–12 June.

In the central part of the area, detector 3 recorded at tree canopy height on 21 August–29 September, and at point 4, the detector recorded at a height of *approx*. 2 m on 17 May–11 June.

In the southern part of the area, the detector recorded at a height of *approximately* 1.8 m from 18 May to 8 July, and at point 6, the detector recorded at tree canopy height from 18 August to 29 September.

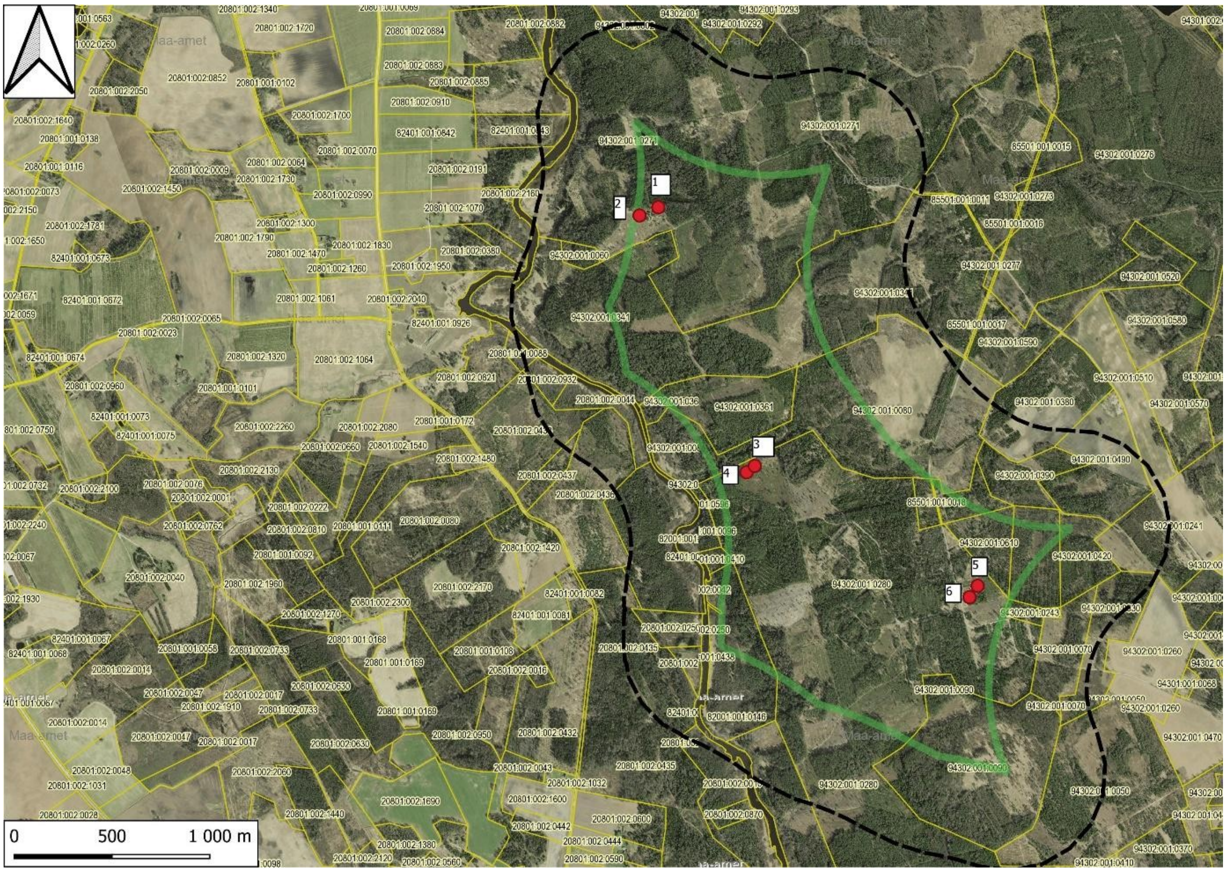

Figure 26. Recording locations 1–6 of bat detectors in study area 3.

A total of 2328 bat vocalisations were recorded in the study area. *Approximately* 40% (767/2328) of the bats were recorded in the northern part of the area, 31.3% (729/2328) in the central part, and 35.7% (832/2328) in the southern part.

During the spring migration (17.05–31.05), a total of 324 bats were recorded, with the largest groups being
the northern bat (197 records) and the greater mouse-eared bat (70 records, Figure 27).

During the breeding season (1 June–8 July), 463 bat recordings were made in the study area, the vast majority of which were northern bats (367 recordings), followed by greater mouse-eared bats (56 recordings, Figure 27).

During autumn migration (18 August–29 September), a total of 1,541 bat vocalisations were recorded, 68% of which were northern bats (1,053 recordings), followed by the silver bat (177 recordings) and the greater mouse-eared bat (172 recordings), but a total of 80 recordings were also made of species of the genus *Pipistrellus* during migration (Figure 27).

The distribution of bats was rather similar and representative across the entire study area. The highest number of bats was recorded in the northern part of the area, but bats were found fairly evenly across the entire study area. In the southern part of the study area, at monitoring points 5 and 6, a military bunker was recorded that was inaccessible (the entrance was located *approximately* 5–6 m above the floor of the bunker), but it may be a suitable shelter for bats.

Based on the activity cycles of bats, an increase in bat activity can be seen in the study area in the last half of May, from 21.05 to 26.05. During the breeding season, there were also increases in activity in the second half of the month, from 22.06 to 29.06, when a northernbat breeding colony originating from nearby older breeding roosts with older bats, as evidenced by the ultrasound pulse activity map.

During the migration period, higher activity remained f r o m 21 August to 13 September, but more active migration was also observed on 27–28 September
(Figure 28).

In study area 3, the Väike Emajõgi River and its 200 m buffer zone (200 m on both banks) must be taken into account as an important feeding area for bats, as it contains both older forest communities on the banks and forests with old aspen trees (min. 55 years old), which are important roosting and breeding sites for bats.

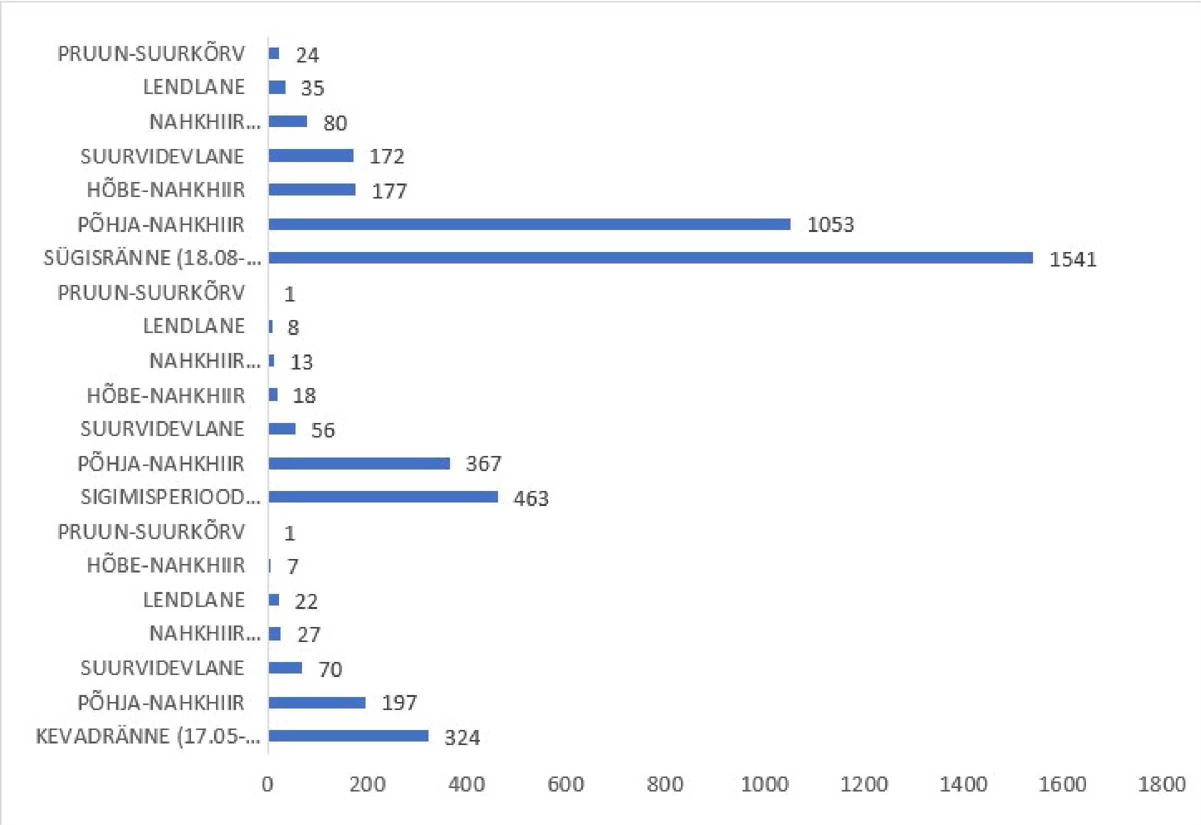

Figure 27. Results of fieldwork on bats in study area 3 during spring migration (17.05–31.05), the breeding season (01.06–08.07) and autumn migration (18.08–29.09).

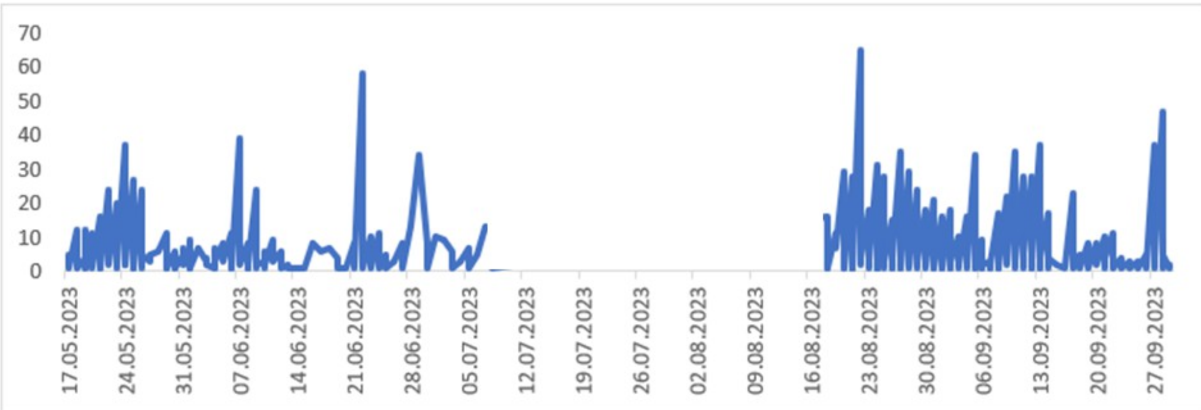

Figure 28. Activity cycles of bats in study area 3.

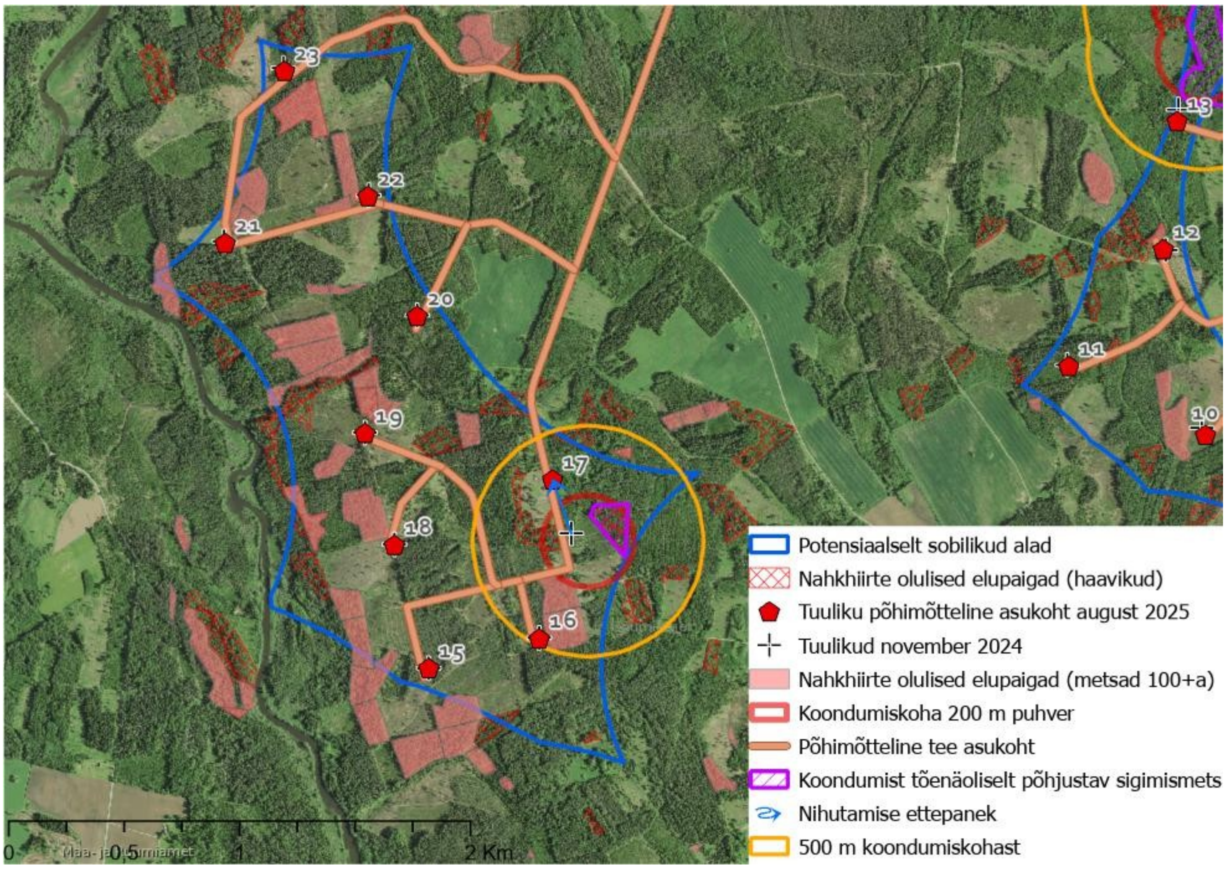

Figure 29. Old (100+ years) forests in study area 3 in Valga – likely habitats and feeding grounds for bats, together with forests where the age of aspen trees is at least 55+ years and their share in the stand is 10%.

In the case of bat roosts, the most effective mitigation measure is to establish a buffer zone with a radius of 200 m around the roost, where no wind turbines will be erected, in order to preserve the bats' breeding site free from disturbance. In this area, it is possible to plan the positions of the wind turbines outside the 200 m buffer zone around the gathering site (position 17 must be moved from its original location to the location shown in Figure 29 outside the buffer zone). This is a location between an existing forest road and bay racks, where the impact of the wind turbine on bat habitats is minimal.

In order to mitigate the risk of death and reduce the disturbance caused by the operation of wind turbines during the most active periods for bats, wind turbines must be shut down at night during the bat breeding season within a 500 m radius of the breeding forest under weather conditions that favour bat activity: average wind speed is <5 m/s, temperature is ≥0 degrees and there is no precipitation (0 mm).

4.1.4.2.4 Fieldwork results for study area 4

Based on the distribution of land use, study area 4 consisted of wooded areas (90%), farmland (5%), open areas (4%) and wetlands (1%).

The stands in study area 4 are dominated by coniferous forests – older (72 years) pine forests (44%) and spruce forests (56 years, 23%), which together make up 67% of the stands. The most common deciduous trees are older (55 years old) birch forests (21% of the stands in the area). The most suitable forests for bats, where birch forests are at least 55 years old (at least 10% of the area), cover a total of 37 ha.

In study area 4, bat detectors recorded at the northern point 1 at a height of 17.08–28.09.2023. The southern detectors recorded at point 2 at a height of *approx.* 2 m on 12.05–01.06.2023,
at points 3–4 at canopy height from 17 August to 19 September, at point 5 at a height of *approximately* 2 m from 12 May to 1 June 2023, and at point 6 at canopy height from 17 August to 10 September (Figure 35). The detectors were installed

mainly in the north-western part of the study area to assess the possible impact of the proximity of a water body (Väike Emajõgi) on the presence of bats.

In total, the detectors recorded 2,949 bats at four points in the study area. Of these, 9.4% of bats (277/2949, Figure 35) were recorded in the northern part (point 1, at tree canopy height, 17.08–28.09.23).

At the southern point 2 (at a height of *approx.* 2 m, 12.05–01.06.2023), 14% (417/2949) of bats were recorded, at points 3–4 (at a height of 17.08–19.09), 50% (1478/2949) of bats were recorded, at point 5 (at a height of *approx.* 2 m between 12 May and 1 June 2023) 12% (365/2949) of vocalisations, and at point 6, at a height of 17.08–10.09) *approx.* 14% (412/2949) of bats.

A total of 782 vocalisations were recorded in study area 4 during spring migration (12 May–1 June), the vast majority of which belonged to northern bats (524 vocalisations) and greater mouse-eared bats (Figure 30; 189 vocalisations).

During autumn migration (17 August–20 September), 2,167 bat vocalisations were recorded, most of which belonged to northern bats (1,458 vocalisations), the silver bat (468 vocalisations) and the greater mouse-eared bat (94 vocalisations, Figure 30).

The vast majority of bat calls (64%, 1895/2949) were recorded at monitoring points 2–4 during autumn and spring migration. This is an important migration and feeding area for bats, which probably runs along the Väike Emajõgi River.

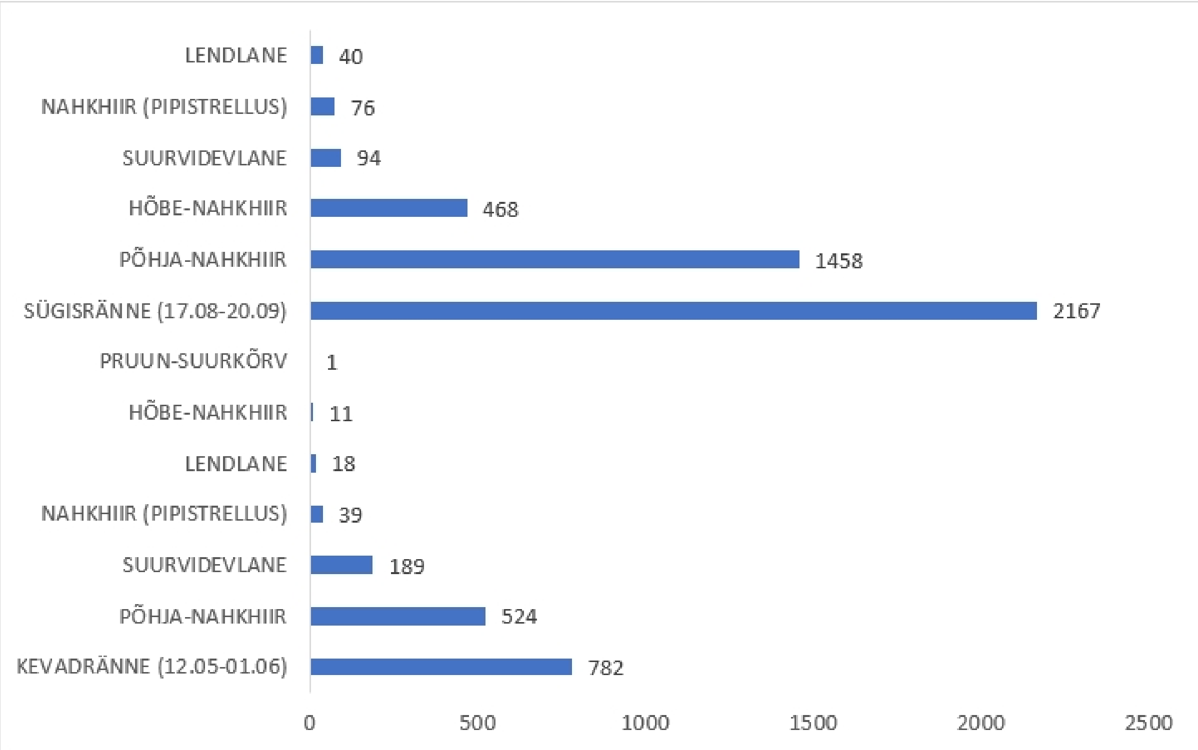

Figure 30. Results of fieldwork on bats in the study area during four different phenophases.

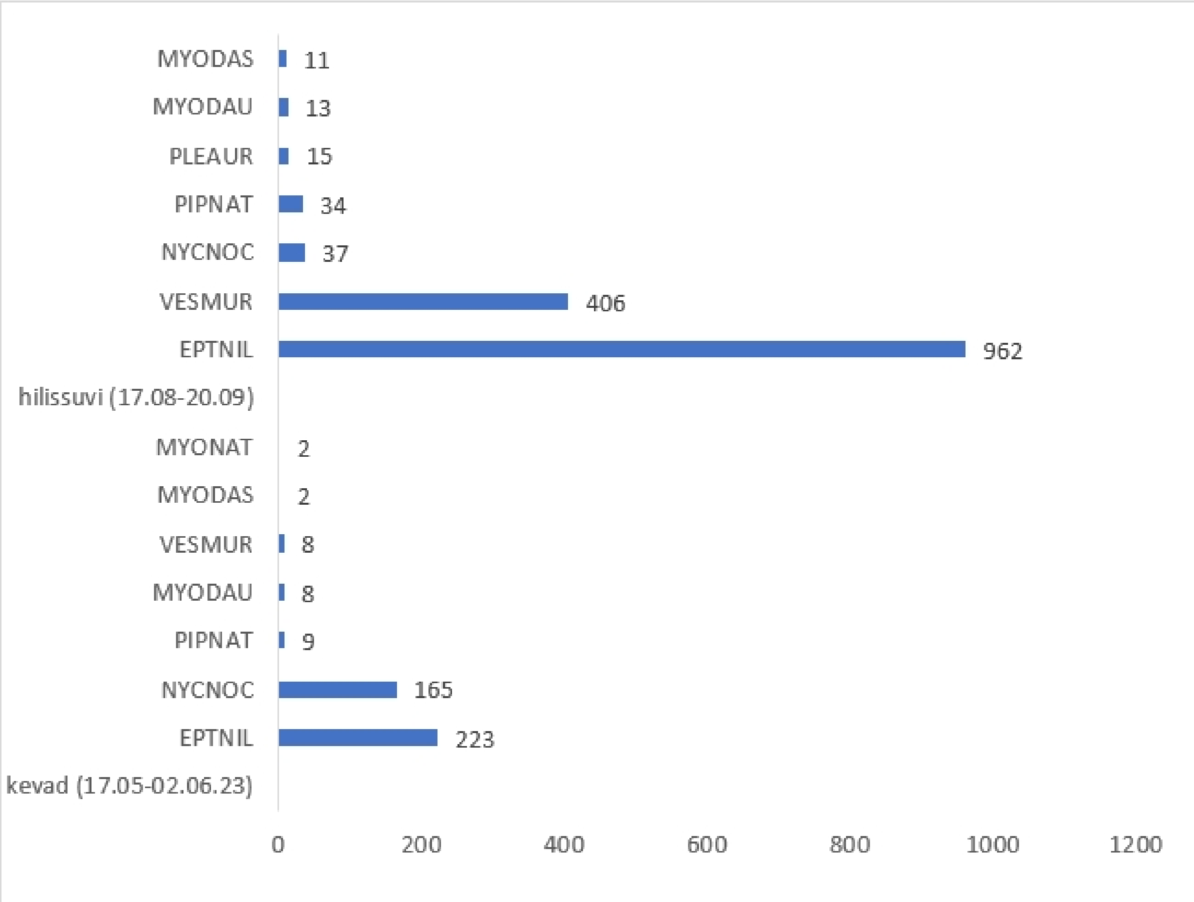

Figure 31. Results of fieldwork on bats in the study area in four different phenophases in the part closest to the river (Väike Emajõgi River, *approx.* 70 m).

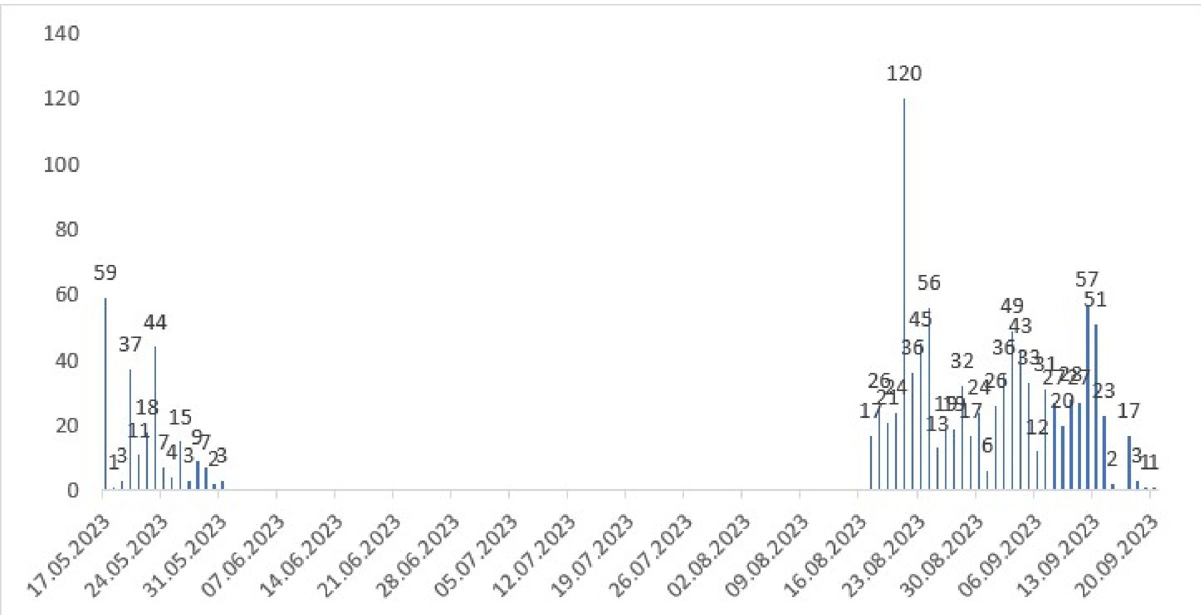

Figure 32. Activity periods of the northern bat (*Eptesicus nilssonii*) in spring and late summer at points 2-6 along the Väike Emajõgi River.

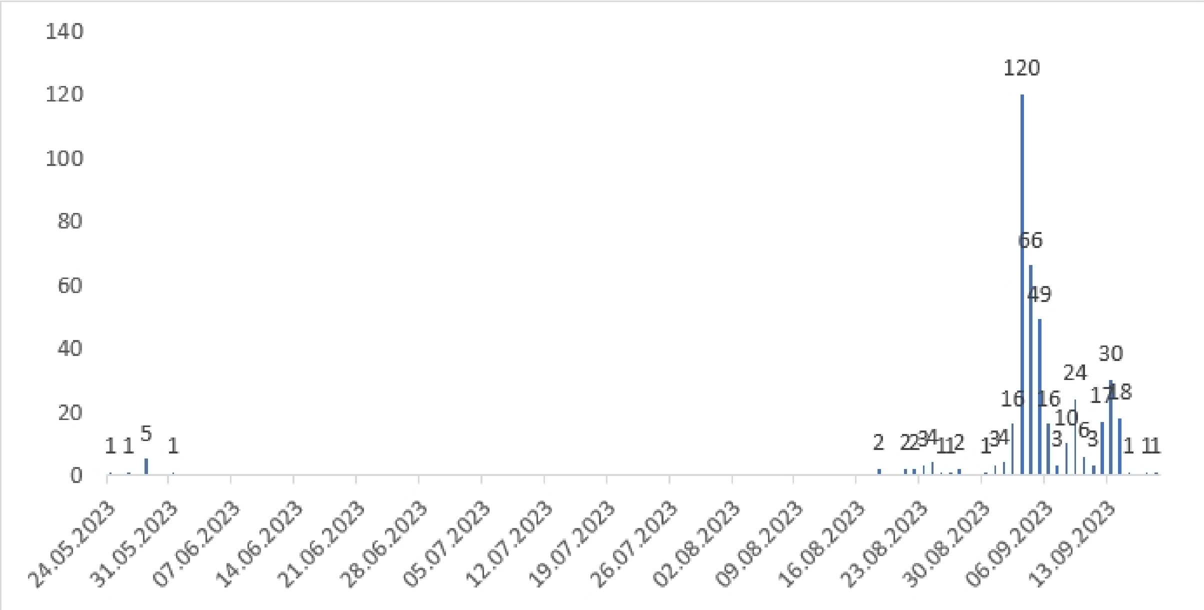

Figure 33. Activity periods of the common pipistrelle (*Vespertilio murinus*) in spring and late summer near the Väike Emajõgi River (at points 2-6).

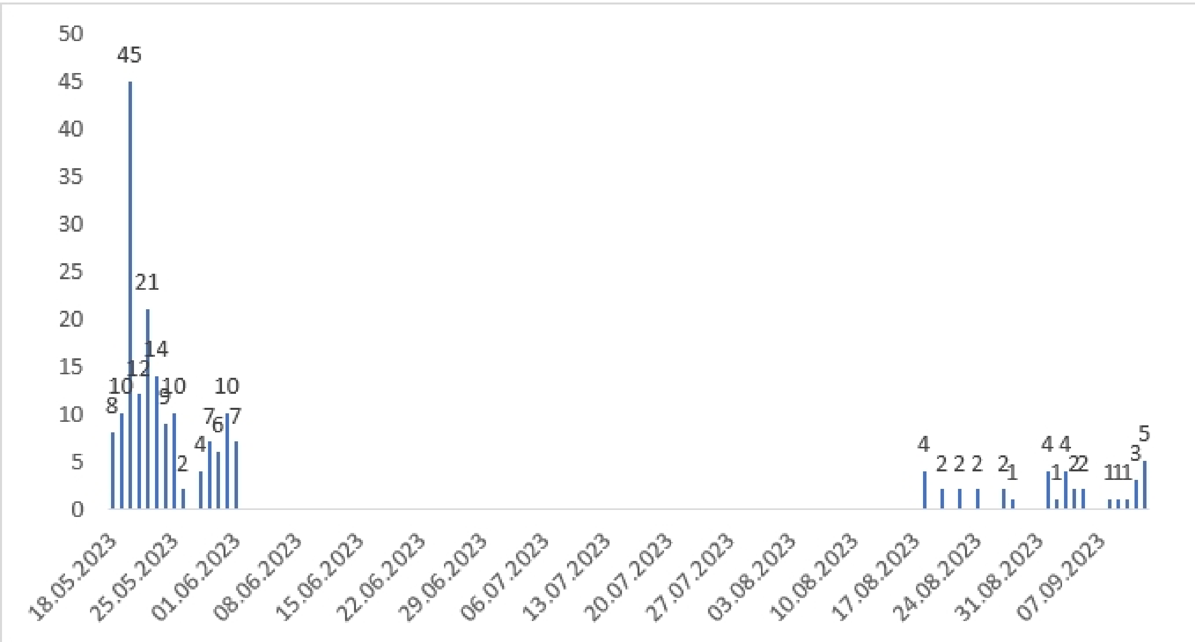

Figure 34. Activity periods of the common noctule (*Nyctalus noctula*) in spring and late summer near the Väike Emajõgi River at points 2-6.

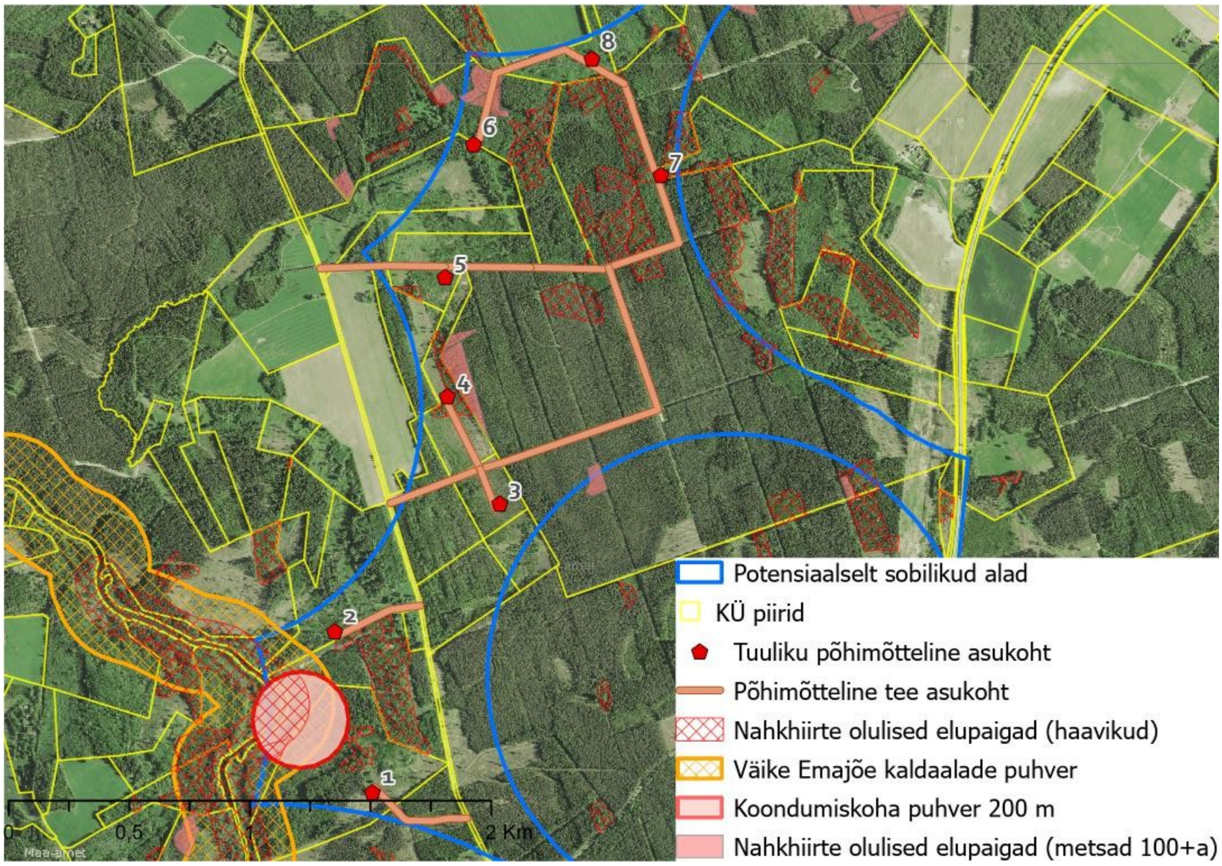

Figure 35. Old (100+ years) forests in the Valga study area 4 – probable habitats and feeding grounds for bats, together with forests where the age of aspen trees is at least 55 years and their share of the forest area is at least 10%.

In area 4, bat roosts are primarily associated with the Väike Emajõe riverside forest. Therefore, the 200 m buffer zone required along the river banks largely overlaps with the 200 m buffer zone required to protect the roosts. Within a 500 m radius of the river, wind turbines must be stopped at night during the bat breeding season when weather conditions are favourable for bat activity: average wind speed is <5 m/s, temperature
≥0 degrees and no precipitation (0 mm). In this area, it is possible to plan the positions of the wind turbines outside the river and the necessary 200 m buffer zone on its banks. However, mitigation measures must be implemented when operating the wind turbines (section 4.1.4.3).

Measures, need for further studies and assessment

Measures at the site selection stage for wind farm planning:

- Potential bat colonies were found in potentially suitable areas 2, 3 and 4. According to EUROBATS recommendations, wind turbines should not be planned closer than 200 m to colony locations in order to avoid damaging and abandoning bat roosts. Within a radius of

  a radius of 500 m from the colonies, wind turbines must be shut down during periods of high bat activity

  .

  - Due to other restrictions, it is not possible to move the location of the wind turbine at position 14 outside the buffer zone of the gathering place. Considering the possible disturbance of the identified gathering place but also the possibility of damage to the forest community at the concentration site due to normal forest management, logging conditions that take into account the habitat requirements of bats must be provided for in order to preserve the forest community (forest area marked with purple stripes in Figure 25). Logging in the breeding forest area is prohibited from 1 May to 15 August. Clear-cutting is prohibited in the area. Regeneration cutting may be carried out in the form of selective cutting and selective thinning.

At least 15 cubic metres of stemwood per hectare or at least 20 trees per hectare must be left standing during logging. When leaving trees standing, follow the RMK guidelines for leaving trees standing [83] or other relevant and up-to-date guidelines. If available, preserve hollow trees, dead standing trees and stumps during logging. Preferably leave linden, ash, oak, alder, aspen and old birch trees as retention trees, as they most often develop hollows suitable for bats. Compliance with these logging conditions throughout the lifetime of the wind farm will help preserve the forest community necessary for bat habitats.

- The location of wind turbine 17 must be moved outside the 200 m buffer zone of the forest stand that promotes the concentration of bats to an area of forest roads and clear-cut areas that are unsuitable as bat habitats.

Prefer locations for wind turbines that are outside the areas of old forests (>100 years) and older forests (>55 years) with at least 10% aspen. Habitats important for these bats should be preserved as much as possible and their fragmentation by wind farm infrastructure should be avoided.

- Where possible, avoid locating wind turbines less than 200 m from edge areas (areas where the forest clearly transitions into grassland or farmland). If necessary, wind turbines may be installed in a buffer zone, provided that their operation is restricted during the breeding season (1 June to 15 July) and autumn migration period (16 July to 15 September).
- Where possible, avoid locating wind turbines less than 200 m from small standing water bodies and ditch extensions (firefighting water ponds) in forest landscapes. Also avoid creating new standing water bodies closer than 200 m to wind turbines when establishing a wind farm.

Do not plan wind turbine infrastructure objects (access roads, routes, etc.) in the habitats listed above and use existing roads as much as possible when constructing roads.

- When installing wind turbines on forest land ( ), the corresponding cables/lines must be installed as underground cables in order to reduce forest loss and habitat fragmentation.
- the positions of wind turbines should be selected based on existing access roads.
- In study areas 3 and 4, avoid installing wind turbines less than 200 m from the Väike Emajõgi River, which is an important feeding area and migration corridor for bats and whose banks are home to bat roosts.

Measures for the wind farm's operating period:

- Avoid logging and clearing of forest stands older than 60 years during the period 15 April to 15 September to prevent the death of bats in their summer roosts.
- All study areas are forest landscapes where there is an increased risk of bat mortality. The optimal mitigation measure to reduce bat mortality is to shut down the wind turbines during the dark hours when bats are active (generally from the beginning of May to the end of September). Taking into account the seasonality of bat migration (if migration is seasonal), precipitation and wind speed at which bats fly, it is possible to minimise the loss of wind farm productivity. In order to avoid significant bat mortality, wind turbines should be stopped at night during the bats' active period when weather conditions are favourable for bat activity: wind speed is below 5 m/s, there is no precipitation and the air temperature is above + 5 °C. The effectiveness of mitigation measures based on limiting the operating hours of wind turbines has been repeatedly proven in studies, for example, a recent study shows that

[83] Tõnisson, K., Kohv, K., Laigu, R., Andres, O. 2021. Guide to conservation trees. Available at: https://rmk.ee/wp-content/uploads/2024/10/RMK_sailikpuude_juhend_2021.pdf

that location-based mitigation measures succeeded in reducing the number of bats killed by 78%.[84] Considering the results of the study, it is appropriate to stop wind turbines in the following periods in each area:

- in the northern part of location selection area 2 (wind turbine positions 13 and 14), it is important to stop wind turbines during the breeding season (1 June–15 July) and autumn migration (15 August–15 September);
- in location selection area 3, bat activity was consistently high across the entire area, which is why all wind turbines in the area must be shut down for the entire bat activity period from 1 May to 15 September;
- In location selection area 4, wind turbines (positions 1 and 2) located within 500 m of the Väike Emajõgi River must be shut down for the entire bat activity period from 1 May to 15 September. Restrictions apply in the rest of the area during the breeding season (1 June to 14 July).
- To reduce the risk of death, instead of a direct time restriction, it is possible to use, for example, Wildlife Acoustics' SMART System, which operates the wind turbine in real time according to bat activity and allows the wind turbine to be stopped if necessary.
- The previously recommended time restrictions may be replaced by operating restrictions based on a corresponding monitoring system, if this is technically and economically feasible. In the case of time restrictions, the restriction period and weather conditions may also be specified on the basis of follow-up monitoring.

Follow-up monitoring proposal:

- As there is uncertainty in the assessment of the risk of bat mortality based on preliminary bat surveys conducted prior to the construction of the wind farm [85] , follow-up monitoring of bats is necessary. Follow-up monitoring should clarify the risk of bat mortality and the avoidance rate of wind turbines (spring migration 01.05–31.05; breeding season 01.06–14.07; autumn migration 01.08–15.09);
    - During follow-up monitoring, bats must be recorded at the working radius of the wind turbine rotors using automatic bat recorders. Based on the data, it is possible to optimise the operating time restrictions of wind turbines and, if possible, reduce the time during which wind turbines are not allowed to start up or, if necessary, increase the restrictions to avoid significant adverse environmental impacts;
    - as the flight altitude of bats is mostly species-specific, it is also necessary to clarify the activity of bats near tree crowns and the ground, as well as at different distances from wind turbines (e.g. up to 100 m, 500 m, 1000 m), taking into account weather conditions (wind direction, temperature, precipitation), which will allow for further analysis of the possible effects of wind turbines on bats;
    - if possible (recommended measure), use trained dogs to detect dead bats under wind turbines.

4.1.5 Impact on the state of ecosystems and biological diversity

In addition to directly inventoried high-value communities, environmental protection is increasingly focusing on the preservation of ecosystems and the benefits they provide, i.e. ecosystem services. The more functioning and biodiverse ecosystems we have, the better equipped we are with food, natural resources, clean water and air, and the better we are able to withstand and mitigate environmental pollution and adapt to climate change.

[84] Rnjak, Dina, Magdalena Janeš, Josip Križan, and Oleg Antonić. 2023. 'Reducing bat mortality at wind farms using site-specific mitigation measures: a case study in the Mediterranean region, Croatia'. Mammalia, February. https://doi.org/10.1515/mammalia-2022-0100

[85] Preliminary studies cannot clarify the flight activity of bats at the height of wind turbine blades, nor is it possible to accurately predict the flight activity of bats after the construction of wind turbines, as for some species, the wind turbines themselves may encourage the concentration of bats.

The land required for the development of the wind farm and related facilities will be taken from existing ecosystems. Therefore, the construction of the wind farm will have an adverse impact on ecosystems in their natural state and, consequently, on biological diversity. When planning a wind farm, the primary measure to avoid significant adverse effects is to select locations for the wind farm where the condition of ecosystems is already poor and to avoid establishing wind farms in locations where their establishment would damage ecosystems and biodiversity in good condition.

4.1.5.1 Assessment methodology

The assessment of ecosystem status and biodiversity was based on the ecosystem mapping compiled within the framework of the ELME2 project as of July 2023 [86] . The analysis used the nationwide ecosystem services base map compiled as part of the ELME project (www.keskkonnaagentuur.ee/elme), which classified different ecosystems (grassland, forest, field, bog) into condition classes. The aim of the assessment was to identify known ecosystems in good condition in potentially suitable areas that are necessary for the preservation of biodiversity. By avoiding such areas as construction sites, it is possible to prevent significant adverse effects on ecosystems and biodiversity.

4.1.5.2 Impact on the condition of ecosystems

To simplify the use of the ecosystem condition map compiled as part of the ELME project, the results were generalised into four condition classes: 'good' (meadow A, bog A1 and A2, forest A, field A), 'average' (meadow B and C, bog B1 and B2, forest B, A–B, C, A–C, field B), 'poor' (meadow D1–D3, bog C1, C2, D and E, forest D, E, F, field D) and 'undetermined'. According to this map, only 11% of Estonia's terrestrial ecosystems are in good condition, 33% are in average condition, 47% are in poor condition and 9% are undetermined. The location of potentially suitable areas in relation to the ecosystem status map compiled as part of the ELME2 project is shown in Figure 36. Ecosystems in good condition are predominantly those with less human impact, which therefore provide habitats for rarer species.

[86] Helm, A., Kull, A., Kiisel, M., Poltimäe, H., Rosenvald, R., Veromann, E., Reitalu, T., Kmoch, A., Virro, H., Mõisja, K., Nurm, H-I., Prangel, E., Vain, K, Sepp, K., Lõhmus, A., Linder, M., Otsus, M., Uuemaa, E. (2023). Nationwide assessment and mapping of the economic value of the benefits (ecosystem services) of Estonian terrestrial ecosystems. Technical final report. Public procurement "Nationwide financial assessment of terrestrial ecosystem services, including the development of methodology" (reference number 235366, Environmental Agency). University of Tartu. Estonian University of Life Sciences.

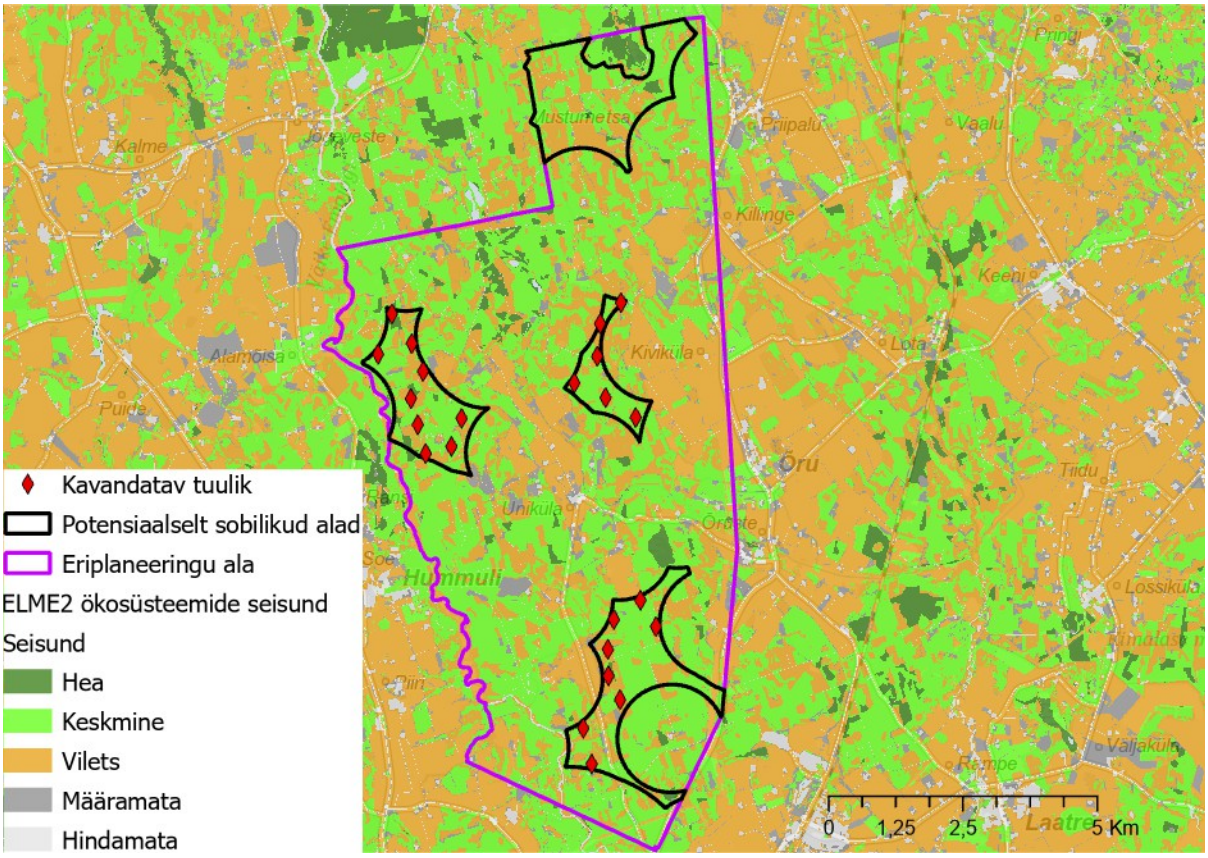

Figure 36. Status of ecosystems in potentially suitable areas in the Valga municipality special planning area. Source: Environmental Agency ELME2 project.

The overlap between potentially suitable areas and ecosystems in good condition is small. At the same time, it should be noted that there are few ecosystems in good condition in Estonia. Small communities in good condition are found in all four potentially suitable areas. The largest ecosystem in good condition is located in potentially suitable areas 1 and 3. Considering the scattered location of the communities, it is possible **to avoid planning wind turbines and related infrastructure in parts of ecosystems in good condition** when planning the wind farm in more detail**.** In the immediate vicinity of ecosystems in good condition, the construction of drainage ditches and other structures that alter the water regime and significantly change the light regime should be avoided.

The location of wind turbines and related infrastructure, as determined in the special plan, does not overlap
overlap with areas of ecosystems in good condition and no adverse impact on them is expected.

Measures and need for further studies and assessment

Measures for planning the wind farm:

- **Ecosystems in good condition** according to the ELME project's ecosystem status assessments **must be preserved**. In the immediate vicinity of ecosystems in good condition, the construction of drainage ditches and other structures that alter the water regime and significantly change the light regime must be avoided. At the same time, there are situations where a logical road or cable corridor that is appropriate for orthophotos and/or actually exists in nature passes through an ecosystem in good condition. During the design phase, the current condition of the ecosystem must be specified and a final solution must be decided based on the nature of the planned facility.

When further specifying the locations of wind turbines and routes, ensure that changing the locations does not cause a greater adverse impact on the condition of ecosystems than the assessed solution. The relevant assessment must be presented in the preliminary EIA assessment of the building permit application.

4.1.6 Impact on the green network, including the connectivity of animal habitats

4.1.6.1 Assessment methodology

The assessment of the impact on the green network is based on the conditions of the Valga County Plan 2030+ and the Valga Municipality Comprehensive Plan currently being prepared, as well as the location of the designated green network. The assessment is provided as an expert opinion based on map analysis. The expert assessment is based on studies on the impact of wind turbines on fauna found in scientific literature.

In order to reduce the adverse impact on the green network and to compensate for the impacts, data on the status of ecosystems from the ELME project[87] and data on road sections that are dangerous to wildlife[88] have been used in making recommendations for strengthening the green network.

4.1.6.2 Location of the green network and general impacts on fauna

A green network (hereinafter referred to as *GN*) is a system of natural and semi-natural communities that ensures the preservation of different types of ecosystems and landscapes and balances the impacts of settlement and economic activity, consisting of core areas and green corridors connecting them[89].

The main objectives of the green network are[90] :

- protecting and preserving biodiversity;
- mitigating and adapting to climate change;
- promoting the green economy, including the leisure industry.

Core areas are mostly areas of natural or environmental value (protected areas, conservation areas, valuable habitats or VEPs, habitats under the Habitats Directive, etc.) and/or areas with high biodiversity and/or areas that provide ecosystem services that are important from a green infrastructure perspective.

(Green) corridors, or strip structures, are elements of the ecological network that connect core areas with the aim of ensuring the coherence of the ecological network, contributing to the preservation of high biodiversity in core areas, and reducing the impact of habitat destruction and fragmentation on biota. Corridors are less massive and compact than core areas and change or are changed more quickly over time.

In order for the RV to fulfil its functions, its structures must be planned in a coherent manner, i.e. the core areas must be connected to the corridors to form a unified whole. Even more important is to ensure ecological coherence, i.e. that the structures of the green network function as a coherent network of habitats and movement routes for species and populations.

The green network is divided into hierarchical levels or value classes – national, county and local support areas. Planning activities that affect the green network in a support area of national importance requires more thorough consideration than activities in a support area of local importance.

Potentially suitable areas largely overlap with the green network areas designated[in]the Valga County Plan 2030+[91](Figure 37). The county plan does not distinguish between the elements of the green network. However, the Valga municipality comprehensive plan currently being prepared includes plans to specify the green network in the area and to distinguish its elements. In compiling the comprehensive plan, the previous county plan (Valga County Thematic Plan, 2002), which dealt with the elements and hierarchies of the green network in more detail, was also taken into account when specifying the elements of the green network.

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[87] https://arcg.is/1z1iO10

[88] https://dge.ee/maps/Loomaohtlikkus/

[89] Planning Act https://www.riigiteataja.ee/akt/119032019104

[90] OÜ Hendrikson & Ko. 2018. Green network planning guide.

[91] This SEA analyses the overlap with the county plan green network, as the new comprehensive plan for Valga Municipality has not been adopted. The county plan green network is a more recent definition than the green network in accordance with the comprehensive plans of the municipalities in the area.

Potentially suitable area 1 and part of area 3 overlap with the large Soontaga-Purtsi support area in the county (the proportion of natural areas in the part of the support area located in Valga Municipality is currently 99.7%). Potentially suitable area 4 overlaps with the small Uniküla support area in the county (the proportion of natural areas is currently 94.3%). Area 2 overlaps with the Uniküla-Soontaga corridor and area 3 with the Väike Emajõe corridor.

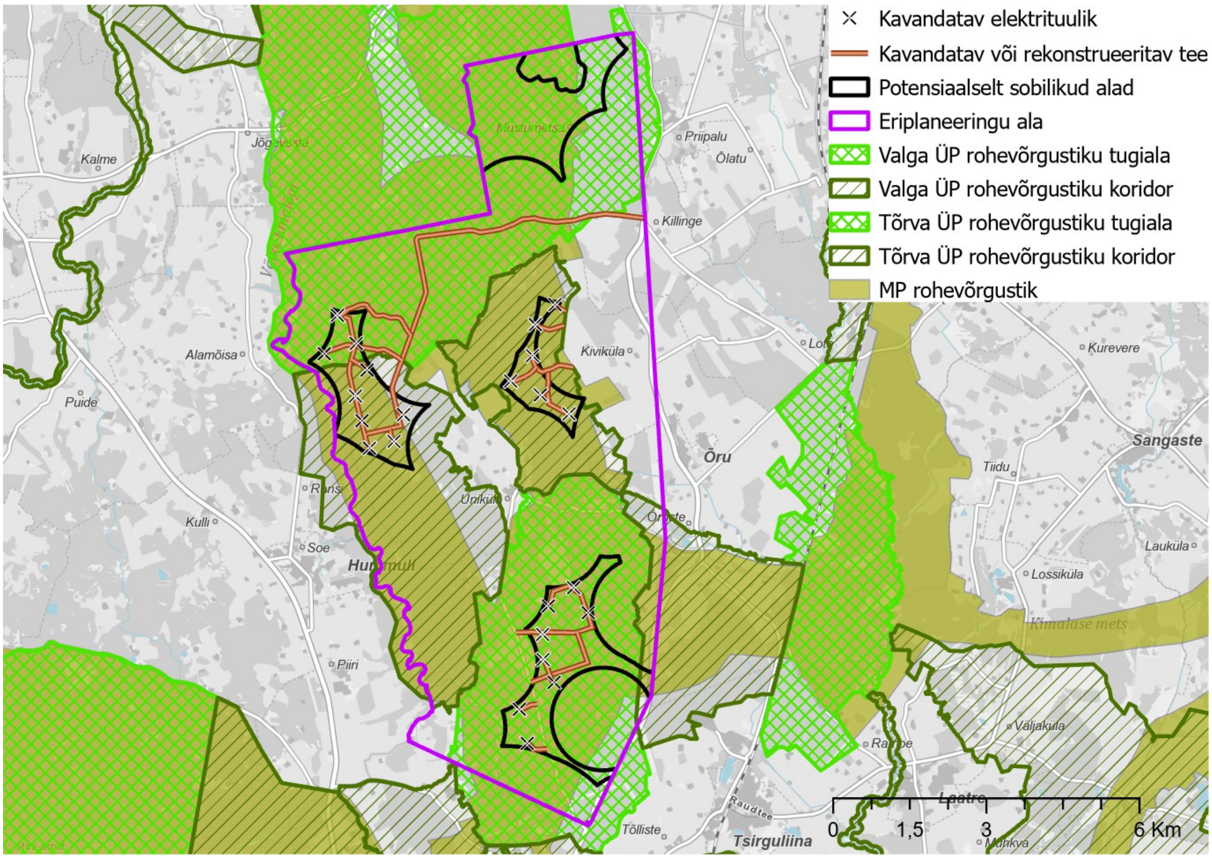

Figure 37. Location of potentially suitable areas in relation to the green network according to the Valga County Plan 2030+ and the comprehensive plan currently being prepared for Valga Municipality. The comprehensive plan of Valga Municipality provides for the specification of the green network of the county plan in the given area in a manner that helps mitigate the impact of the wind farm on the green network.

4.1.6.3 Impact on the protection and preservation of biodiversity

According to the Valga County Plan 2030+, economic activities may be developed in core areas and corridors where the forest category is commercial forest. For the network to function, the proportion of natural areas in the support area must not fall below 90%. As the county plan does not distinguish between the elements of the green network, the green network layer specified in the draft general plan of Valga Municipality, in which core areas and corridors are distinguished, was used for the following analysis.

The analysis was carried out within the boundaries of Valga Municipality (not across the entire green network area of the county plan), as the object of the SEA is the local government's special plan. The local government cannot control changes to the green network outside its administrative territory, and the special plan cannot impose conditions outside the area covered by the special plan. The results of the analysis are presented in Table 12.

Table 12. Overlap of the developed planning solution with green network support areas and changes in naturalness.

Wind area	Name of overlapping green network, value class	Total area of the green network within the boundaries of Valga Municipality, ha	Natural and semi-natural areas [92] in the green network area, ha	Proportion of natural and semi-natural areas of green network area, %	In the case of the developed planning solution wind farm artificial areas Maximum area RV area, ha[93]	Proportion of natural areas in the implementation of the plan, %
1	Soontaga-Purtsi support area, large county	2181.50	2178.73	99.87		99.87
2	Uniküla-Soontaga corridor	831.61	830.98	99.92	8.81	98.86
3	Small Emajõe corridor	1347.56	1345.45	99.84	9.34	98.78
3	Soontaga-Purtsi support area, county large	2181.50	2178.73	99.87	13.20	99.26
4	Uniküla support area, small county	2171.36	2159.49	99.45	12.83	98.86
4	Some corridor	1021.52	1000.57	97.95		97.95

[92] Natural areas are treated as Estonian Topographic Database ETAK land types E_306_margala_a, E_305_puittaimestik_a, E_304_lage_a, E_303_haritav_maa_a, E_202_seisuveekogu_a and E_203_vooluveekogu_a as of 17 September 2024. There are different opinions on whether arable land should be considered a natural area. In this case, arable land has been included in natural areas because it does not hinder the movement of wild animals and a significant part of the fields are used as permanent grassland.

[93] As the exact location of roads and assembly sites is not specified in the plan, a conservative estimate is used as the basis for calculation, assuming that a maximum of 3 ha per wind turbine will be converted into artificial land. The calculation takes into account the basic positions of wind turbines overlapping with the RV area.

All support areas currently have a very high proportion of natural areas. Therefore, it is possible to ensure that 90% of natural areas are preserved when establishing the wind farm (see Table 12).

In addition, when placing wind turbines and related infrastructure in the green network, minimal fragmentation of the green network must be ensured. In the case of corridors, the edges of the corridors should be preferred as locations for wind turbines and fragmentation of the corridors by new roads should be minimised. In the case of support areas, wind turbines should preferably be placed in groups, preserving areas in their natural state between the groups. Below, the impact on the green network and the measures necessary to maintain the coherence of the green network are examined for each potentially suitable area.

According to the green network planning guidelines [94], planning changes in land use in areas of national importance requires careful consideration. According to the guidelines prepared by the Environmental Board ([95]), the planning of a large number of wind farms in core areas of national importance within the green network should be avoided, as wind farms may, in addition to their adverse impact on the wind farm area and its immediate surroundings, also damage the coherence of various protected areas and habitats of endangered species. **In the case of Valga EP, there is no overlap with core areas of national importance, but there is overlap with core areas of county importance (Table 12).**

Potentially suitable area 1 overlaps with the county-level Soontaga-Purtsi green network support area. As no wind turbines or related cable lines or infrastructure are planned for area 1, there will be no impact on the green network support area in area 1.

Potentially suitable area 2 overlaps with the Uniküla-Soontaga green network corridor, but the potential wind farm construction area does not intersect with it (Figure 38).

[94] OÜ Hendrikson & Ko. 2018. Green network planning guide.
[95] Impact of onshore wind farms on biota and recommendations of the Environmental Board for their planning in local government comprehensive plans (as of 10 November 2021).

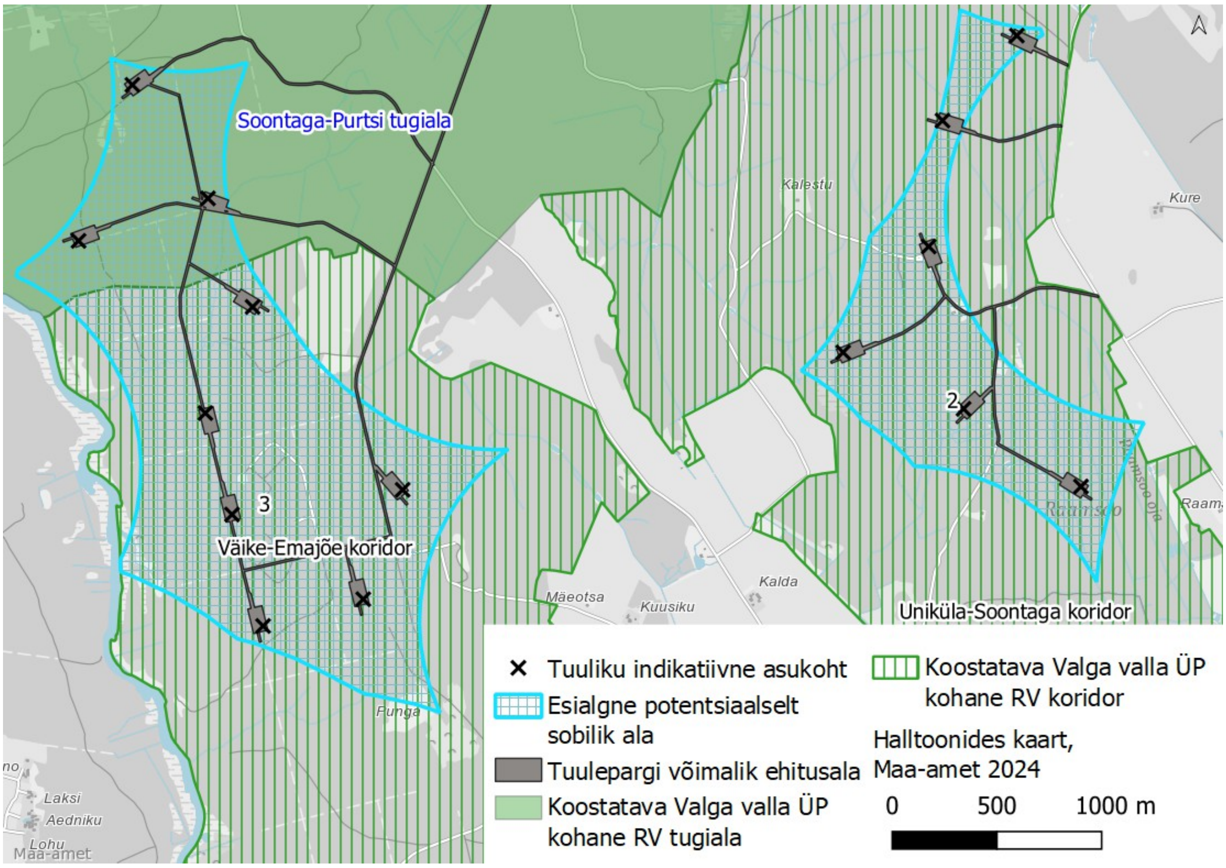

Figure 38. Overlap of potentially suitable areas 2 and 3 with the green network support area and corridors in the comprehensive plan being prepared for Valga Municipality
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In the case of **potentially suitable area 3,** there is an overlap with the large Soontaga-Purtsi green network support area and the Väike Emajõe green network corridor at the county level (Figure 38). Area 3 covers the edge of the green network support area. The proportion of natural areas in the support area will not decrease below 90% during the construction of the wind farm. Area 3 overlaps with the Väike Emajõe green network corridor in the northern part of the corridor, but the possible wind farm construction area does not cut through the corridor. The corridor along the Väike Emajõe River will remain unbroken.

Potentially suitable area 4 overlaps with the small Uniküla green network support area and the Mõneku green network corridor at the county level. In this case, there is no impact on the green network corridor, as the potential construction area of the wind farm is not planned to overlap with the green network corridor. Area 4 is located in the centre of the green network support area (Figure 39). According to Table 12, the proportion of natural areas in the area will not fall below 90% if the wind farm is built.

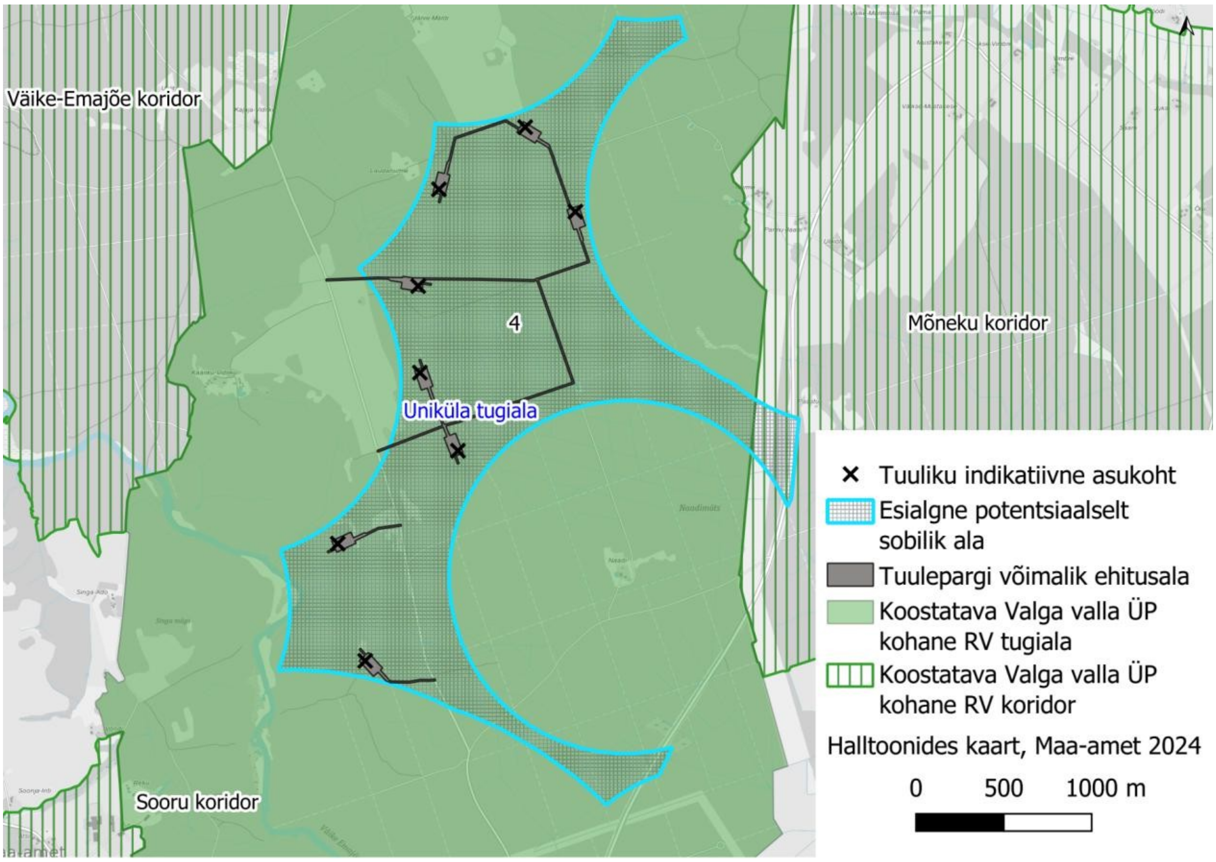

Figure 39. Overlap of the potentially suitable area 4 with the green network support area and corridor according to the Valga municipality comprehensive plan currently being prepared.

As the wind turbines are located at relatively large distances from each other (the distance between the planned large wind turbines is at least 450 m) and the gaps created by the construction of roads and wind turbine assembly sites are relatively small in the forest landscape, the compactness of the natural landscape will be largely preserved even with the establishment of the wind farm in the green network. The construction of the wind farm will not create any significant barriers to the movement or spread of species. Unlike solar parks, wind farms are not enclosed by fences.

In terms of the impact on forest animals, there may be positive effects for some species (the creation of new so-called edge areas, which are usually richer in biodiversity), but also negative effects (new roads and other infrastructure fragment habitats, and the use of infrastructure causes disturbance to more shy species). During the construction period, wild animals avoid construction sites e([96]) ,which cannot be considered a specific impact of wind turbine construction. Any construction activity is inherently disruptive, and when construction takes place in previously natural areas, it is often accompanied by the avoidance of the construction area by the fauna present in the area.

The animal groups most affected by wind turbines are considered to be bats and birds. A significant negative impact on these species has been observed, and therefore these species groups have been assessed in more detail in the planning of wind turbines (see sections 4.1.3 and 4.1.4).

No lasting or significant changes in animal behaviour have been observed in mammals as a result of the noise and shadow effects associated with wind turbine operation[96].However, it should be noted that this topic has been relatively little researched. According to data from specialist literature, studies have been conducted, for example

[96] Helldin, J.O., Jung, J., Neumann, W., Olsson, M., Skarin, A., Widemo, F. 2012. The impacts of wind power on terrestrial mammals. Swedish Environmental Protection Agency Report 6510.

the impact of audible noise from wind turbines on squirrels, and it has been found that individuals are able to cope with the noise generated by wind turbines by changing their behaviour. [97]

Studies have not identified any impact on small mammals associated with the operation of wind turbines. For example, shrews and rodents have been studied in Poland both in wind farm areas and in control areas, and no significant differences in species composition, abundance or population parameters have been found.([98])

The movement of larger mammals in wind farms and nearby open landscapes has been studied, and it has been found that **some mammals (especially herbivores) may use areas close to wind turbines less intensively**. For example, the use of movement routes by roe deer and grey hares within wind farms has been found to be less intensive than in the areas surrounding wind farms. **The impact was observed within a radius of 700 m from the wind turbines.** The study did not identify any effect on foxes ([99]. The study linked the decrease in the intensity of use of areas near wind turbines primarily to the hypothesis that it is more difficult for prey animals to hear predators approaching in areas near wind turbines. It is therefore likely that the impact may be smaller in the case of predators and in forest landscapes. At the same time, the study, which was conducted during both the construction and operation of the wind farm, did not show any measurable change in the behaviour of radio-tagged red deer (Cervus elaphus or North American red deer) ([100]) .

In summary, it can be said that, based on the scientific literature, it is not possible to draw a single conclusion about the impact of wind turbines on the habitats of terrestrial mammals and their connectivity.[101] **The impact on wild animals can be considered particularly negative and significant in cases where facilities are located in an area that is considered important for a particular population and whose loss would limit the abundance of the species. In this case, there is no reason to assume that potentially suitable areas would be important habitats for any species, which would affect the abundance of the species.**

A significant impact may also occur if the wind farm were to affect critical movement corridors. It is therefore very important to avoid significant fragmentation of green network corridors. In this case, the Valga comprehensive plan already specifies the location of the green network corridors in the county plan, expanding them. The planned expansion of the green corridors will ensure that they continue to function better even after the wind farm is built. The wind turbine layout developed during the planning process is not expected to disrupt the functioning of the green corridors. The most important green corridor for the region is the one covering the banks of the Väike Emajõgi River. The distance of the wind turbines from the water body is planned to be at least 300 m. Most of the wind turbines are not planned for the river valley. The exceptions are wind turbines 1 and 2, which are located on the edge of the valley. Given the more complex location, the future design and construction of these wind turbines must take into account the need to minimise damage to the riverbank (measures presented in section 4.1.10.7). However, considering that a corridor allowing free movement will be preserved on the banks of the Väike Emajõgi River and that the wind turbines located in the green network are planned to be spaced more than 450 m apart, no significant deterioration in the connectivity of the green network in the area is expected.

4.1.6.4 Impact on climate change mitigation and adaptation

By adaptation to the effects of climate change, we mean the reduction of risks caused by climate change and a framework for action to increase the preparedness of both society and ecosystems and

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[97] The Wildlife Society. 2007. Impacts of Wind Energy Facilities on Wildlife and Wildlife Habitat. The Wildlife Society Technical Review 07-2.

[98] Lopucki, R., Mroz, I. 2016. An assessment of non-volant terrestrial vertebrates response to wind farms – a study of small mammals. Environmental Monitoring and Assessment- 2016; 188: 122.

[99] Lopucki, R., Klich, D., Gielarek, S. 2017. Do terrestrial animals avoid areas close to turbines in functioning wind farms in agricultural landscapes? Environmental Monitoring and Assessment. 2017; 189(7): 343.

[100] Walter WD, Leslie Jr DM, and Jenks JA. 2006. Response of Rocky Mountain elk (Cervus elaphus) to windpower development. The American Midland Naturalist 156:363-375.

[101] American Wind Wildlife Institute (AWWI). 2021. Wind Turbine Interactions with Wildlife and Their Habitats: A Summary of Research Results and Priority Questions. Washington, DC. Available at www.awwi.org

resilience to climate change. Many of the phenomena associated with climate change – more frequent storms, floods, increased precipitation, extreme temperatures and other extreme weather events – can be mitigated, at least in part, through the planning of green areas. At the same time, it must be taken into account that wind farms are planned to reduce CO2 emissions from the burning of fossil fuels and thus slow down climate change. The impact of the planned activity on climate change, including the impact of land use change, is assessed in section 4.8.

4.1.6.5 Impact on the promotion of the green economy, including the leisure industry

The recreational function of the green network is particularly important in urban areas, in their immediate vicinity and in traditional, established recreational areas with well-developed recreational infrastructure.

Based on expert assessments created as part of the ELME2 project's nationwide assessment and mapping of the status of terrestrial ecosystems and baseline levels of nature benefits, a raster layer [102]of the recreational values (on a scale of 1 to 10) of different types and naturalness of ecosystems as of September 2023 shows areas with high recreational value among potentially suitable areas (Figure 40). Area TU3 in particular has a high recreational value. The establishment of a wind farm would therefore have an adverse impact on the recreational value of the green network. When determining the locations of wind turbines, areas with lower recreational value should be preferred where possible. The developed wind turbine layout solution is expected to have an unfavourable impact on areas with high recreational value. Seven wind turbine locations overlap with areas of high recreational value (rating 8-10), 13 with areas of medium recreational value (4-7) and three with areas of low recreational value (rating 1-3). At the same time, according to ELME2, there are no recreational facilities or other objects that increase the recreational value of the green network in areas with high recreational value in this case. The recreational value of this area is primarily related to the Väike Emajõgi River, and no wind turbines will be built in the Väike Emajõgi River valley. Due to the relief of the primeval valley and the forest cover on the banks of the Väike Emajõgi River, the views from the Väike Emajõgi River will not change significantly. Based on the above, no significant adverse impact on the recreational value of the green network is expected as a result of the construction of the wind farm.

[102] https://www.arcgis.com/home/item.html?id=fda2ab5868204eeb8eb2427db86ee440

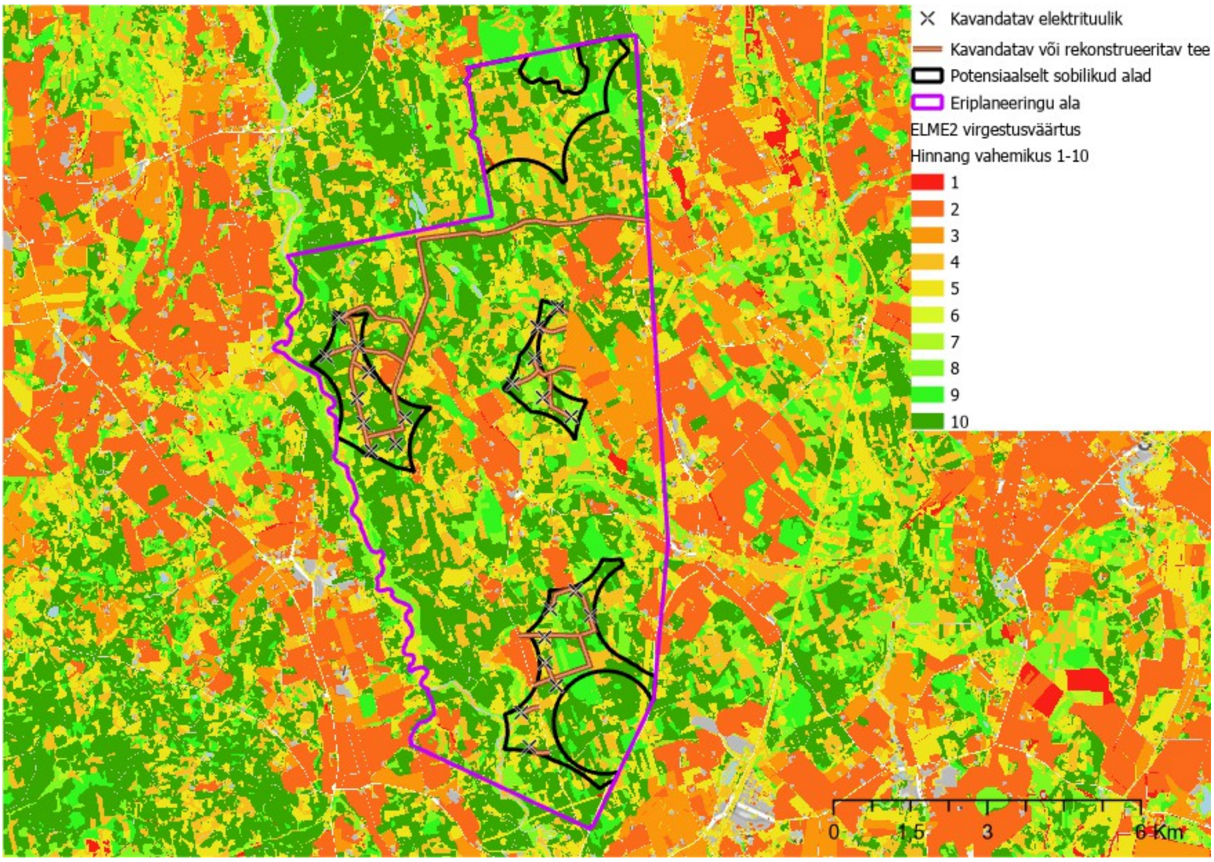

Figure 40. Overlap of potentially suitable areas with the recreational value of terrestrial ecosystems. Map base: Recreation value map of the ELME2 project of the Environmental Agency.

Measures and need for further research and assessment

Measures for wind farm planning:

− When planning wind farm construction areas, **the proportion of natural areas in any green network element must not fall below 90**%. In addition, when placing wind turbines and related infrastructure in the green network, minimal fragmentation of the green network must be ensured. In the case of corridors, the edges of the corridors should be preferred as locations for wind turbines and fragmentation of the corridors by new roads should be minimised.

− The comprehensive plan of Valga Municipality provides for the specification of the county plan green network in the wind farm area in a manner that helps mitigate the impact of the wind farm on the green network. The comprehensive plan must specify the county plan's green network in the area as shown in Figure 37.

A green network corridor with a minimum width of 500 m must be preserved on the banks of the Small Emajõgi River (taking into account both banks).

− Clearing of forest land should generally be avoided in green network areas. As this is not entirely possible when establishing a wind farm, the extent of the forest area to be cleared must be minimised. Existing roads must also be used as access roads as much as possible, including considering options for reducing the distance restrictions on public roads by means of anti-icing measures. When designing wind turbine assembly sites, solutions that minimise the area to be cleared should be preferred (e.g. using access roads as part of the sites).

When designing wind farms, the destruction or significant impact on amphibian breeding sites must be avoided. If this is unavoidable, replacement water bodies suitable for amphibian breeding must be created. If water bodies (e.g. ditches or fire water reservoirs) are planned as part of the wind farm, they should be designed in such a way that they can also function as as breeding water bodies for amphibians. At the same time, such water bodies suitable for amphibians must not be be established closer than 200 m from wind turbines in order to avoid attracting bats to the wind turbines.

- In green network support areas, further drainage of forest areas that have not yet been drained or have been drained to a lesser extent should be avoided, as this would reduce the biodiversity of the area and the ecological and climate change mitigation value of the support area.
- The measure presented in section 4.1.3.3 for maintaining connectivity between capercaillie habitats also serves as a measure to ensure the connectivity of the green network. In order to preserve the relatively natural forest area of Murakasoo/Naadimõtsa as a stepping stone supporting connectivity, the planning of wind turbines 3, 4, 6 and 8 in area TU4 should be abandoned and wind turbine 5 should be moved as far away as possible from the centre of the capercaillie's breeding area.

4.1.7 Impact on forest animals (except birds and bats)

The impact on forest animals is discussed in the assessment of the impact on the green network in section 4.1.7.

During the public consultation on the SEA programme, the possible impact on flying squirrels was raised. Flying squirrels belong to protection category I in Estonia. According to the assessment criteria of the Estonian Red List of Threatened Species, the flying squirrel belongs to the category ‘critically endangered’ based on the assessment carried out in 2018. The flying squirrel is listed in Annexes II and IV of the Habitats Directive. The survival and population size of flying squirrels are linked to the destruction of their habitats, mainly as a result of forestry. The preferred habitat of flying squirrels is old aspen and spruce forests in fertile growing areas. The most common habitat of the flying squirrel is 80–100-year-old stands. The flying squirrel is at the western edge of its range in Estonia, a locally distributed species which, according to current data, is only found in the Alutaguse region in north-eastern Estonia([103]).

Flying squirrel expert Uudo Timm was also consulted regarding the possible occurrence of flying squirrel habitats in the region. In his opinion, the probability of flying squirrels occurring in Valga County is quite low, but cannot be completely ruled out. There have been occasional reports of flying squirrels in south-eastern Estonia, but none of these have been confirmed. In this case, it was not possible to confirm the presence of flying squirrels in the region. It can therefore be concluded that a significant impact on flying squirrels is unlikely.

4.1.8 Impact on domestic animals

There is no scientific literature indicating that wind turbines could have a significant impact on domestic animals (including animals used in agriculture). At the same time, there are only a few scientific articles dealing with the impact of wind turbines on domestic animals.

In general, agricultural production (including sheep and goat farming) coexists with wind farms in many parts of the world. A study conducted in Poland on the impact of wind turbines on the stress parameters and weight gain of young geese found that geese placed in the immediate vicinity of a wind turbine (50 m) gained less weight over a 12-week period and had higher levels of stress hormones in their blood compared to another group of geese placed 500 m away from the wind turbine([104]). A similar study has also been conducted with pigs. It was found that raising pigs in the immediate vicinity of a wind turbine (50 m) caused a decrease in muscle pH, haem pigments and haem iron, and a decrease in C18:3n-3 fatty acid content in the rumen. ([105]) Therefore, based on the available data, it cannot be ruled out that being in the immediate vicinity of a wind turbine causes stress, which may affect their growth and thus the quality of agricultural production.

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[103] Action plan for the protection of the flying squirrel (Pteromys volans). APPROVED by order no. 1-3/23/2 of the Environmental Board on 4 January 2023.

[104] Mikołajczak, J., Borowski, S., Marć-Pieńkowska, J., Odrowąż-Sypniewska, G., Bernacki, Z., Siódmiak, J., Szterk, P., 2013. Preliminary studies on the reaction of growing geese (Anser anser f. domestica) to the proximity of wind turbines. Polish Journal of Veterinary Sciences Vol. 16, No. 4 (2013), 679–686.

[105] Karwowska, M., Mikołajczak, J., Dolatowski, Z.J., Borowski, S., 2015. The effect of varying distances from the wind turbine on meat quality of growing-finishing pigs. Ann. Anim. Sci., Vol. 15, No. 4 (2015) 1043–1054.

According to the PRIA animal register, there are no livestock buildings (except apiaries) within a 1 km radius of the planned wind turbines. Therefore, the construction of the wind farm is not expected to have a significant impact on livestock. However, there are apiaries in the planning area and also in potentially suitable areas. As far as is known, modern wind turbines do not have an impact on bees([106]) .

4.1.9 Impact on protected areas

4.1.9.1 Assessment methodology

The assessment of the impact on areas protected under the Nature Conservation Act is based on the conservation objectives for the area, which are specified in the conservation rules (or other conservation documents) for the area. If there is a protection management plan for the area, the protection objective is also based on the protection management plan, which specifies the protection objective. The principle is that the planned activity must not harm the protection objectives of the area.

4.1.9.2 Assessment results

The initial map analysis has excluded areas that are protected areas, conservation areas and permanent habitats under the Nature Conservation Act as potentially suitable areas. Based on this, the planned activity is not expected to have a direct significant adverse impact on protected areas, conservation areas, permanent habitats and their conservation objectives.

In the case of areas established for the protection of vegetation, the impact can generally be considered to be excluded within a distance of 100 m from the area[107]. In the case of particularly sensitive wetlands, the possible impact area can be estimated at up to 250 m. Based on this**,** an impact on **the Sauniku orchid permanent conservation area (KLO3001211),** which is located 100 m from the potentially suitable area 1, cannot be ruled out. The permanent conservation area has been established to protect plant species growing in wetlands. As the conservation objectives of the permanent conservation area largely overlap with those of the Sauniku nature reserve, the impact on conservation values has been assessed within the framework of the Natura assessment (section 4.1.1). The same measures applied to the Sauniku nature reserve are relevant for the conservation objectives of the permanent conservation area. The assessment will not be repeated here.

According to the analysis of the mainland bird fauna [108], the most sensitive species in terms of bird fauna is the black stork, for which the potential impact area (zone 3 area) may extend up to 14 kilometres. For the lesser spotted eagle, the potential impact area is 3.5 km from the nest, for the osprey 9 km and for the forest eagle 1 km from the habitat, as well as the connecting corridors between habitats.

Based on the above**,** an impact cannot be ruled out on **the permanent habitats of the black stork (KLO3002099), the permanent habitat of the black stork in Mõnu (KLO3000519) and** the conservation objectives of **the Soontaga Nature Reserve (KLO1000264)**. Both permanent habitats and the nature reserve remain within the potential impact area of the black stork (up to 14 km based on the EIA analysis) in the potential wind farm areas. **The Supa lesser spotted eagle permanent habitat (KLO3001727)** also falls within the potential impact area of the potentially suitable area TU4**.**

Of the permanent habitats, **the permanent habitat of the Virna capercaillie (KLO3000076)**, which is located between three potentially suitable areas, may also be affected. There may be an impact on the connectivity between the habitats of the species for which the permanent habitat is intended to provide protection (discussed in more detail in 4.1.3.2.5).

[106] Fourrier, J.; Fontaine, O.; Peter, M.; Vallon, J.; Allier, F.; Basso, B.; Decourtye, A. (2023). Is it safe for honey bee colonies to locate apiaries near wind turbines? Entomologia Generalis, 43(4), 799–809. https://www.researchgate.net/publication/374184316_Is_it_safe_for_honey_bee_colonies_to_locate_apiaries_near_wind_turbines

[107] The impact of onshore wind farms on wildlife and the recommendations of the Environmental Board for their planning in local government comprehensive plans (as of 10 November 2021)

[108] https://kliimaministeerium.ee/elurikkus-keskkonnakaitse/looduskaitse/uuringud-projektid-ja-analuusid#analuus-ja-lisad

The impacts on birdlife are discussed in section 4.1.3 of the SEA report. The following table summarises the impact assessment and measures in relation to the conservation objectives of the protected area.

Table 13. Impact on protected areas.

Protected area	Distance from potential pre-selection area	Conservation objective of the protected area objective	Impact on the protected area and its conserva tion objectives	Measures
Ramp Black stork PEP	TU4 2.4 km from the border	Black stork Habitat KLO9128282 has has not been inhabited for over 10 years and the nest has been destroyed.	During fieldwork, the species was not encountered in any potentially suitable areas, and both permanent habitats hav e been uninhabited for a very long time. Based on GPS , there are feeding waters [109]in the TU4 area and the vicinity of the TU2 area. The main reason for the decline in the black stork population is considered to be the degradation of feeding areas and the resulting low productivity due to reduced food availability (110) (111) . low productivity resulting from the degradation of feeding areasand reduced food availability110111 .	Implement the possibility of re-establishing permanent habitats for the preservation of habitats for habitats listed in the black stork register 3 km buffer zone (considering that these are habitats that have been uninhabited for a very long time). Implement GPS data to important feeding waters 500 m buffer where wind turbines will not be built. When implementing the measures it is possible avoid significant adverse impact on PEPs.
Some black stork PEPs	TU4 3.7 km	Black stork Habitat KLO9133649 has uninhabited for over 10 years and the nests hav e collapsed.		
Soontaga Nature Reserve	TU1 1.8 km, area the habitats of the osprey, black stork and capercaillie are located within 3 km.	1) Council Directive 92/43/EEC on the conservation of natural habitats and the conservation of wild fauna and plants Annex Annex	Impact may affect the black stork, osprey and capercaillie. The black stork habitat KLO9128283 located in the area has been uninhabited for 24 years. Therefore, there is no direct real	For black storks the same measure as in the case of Mõneku and Rampe PEP. For ospreys, avoid the construction of wind turbines in Small

[109] Eagle Club. 2022. Acquisition of information on eagles and black storks equipped with satellite and GSM transmitters and analysis of nesting season data and supplementary feeding of black storks.
[110] Rosenvald R, Lõhmus A. 2003. Nesting of the black stork (*Ciconia nigra*) and white-tailed eagle (*Haliaeetus albicilla*) in relation to forest management. Forest Ecology and Management 185: 217–223.
[111] Väli Ü, Nellis R, Kaldma K, Vainu O, Sellis U. 2021. Black stork abundance, breeding success and survival in Estonia in 1991–2020. Hirundo 2: 20–39.

		habitat types – fen meadows (6450), old natural forests (9010*), spruce forests rich in herbs (9050), bog woodlands and bog woodlands (9080*) and transitional mires and bog woodlands (91D0*); 2) Council Directive 79/409/EEC on the conservation of wild birds Annex I , which are also listed in Annexes I and II , (**black stork, osprey and capercaillie**); 3) typical of the area II protected plant species typical of the area – the pasque flower (*Pulsatilla patens*); 4) protection of the common pine genetic resource .	Impact on the establishment of a wind farm may occur. The establishment of a wind farm may indirectly affect indirectly affect the repopulation of the habitat. The osprey habitat KLO9129625 has been inhabited for the last 5 years. The osprey habitat is is guaranteed a Zone 1 area in accordance with the MLA. Zone 3 includes TU1, but considering the main feeding areas are likely to be probably Lake Võrtsjärv and the Väike-Emajõgi River, TU1 does not fall within the expected flight corridor. The fish eagle have been spotted feeding on the Emajõgi River. There may be a risk of collision when constructing wind turbines in the immediate vicinity of the water body. Capercaillie and other waterfowl , , that the impact of wind turbines extends up to 1 km (distance)[112, 113, 114] (.) In this case, this distance is is guaranteed. Similarly not remain only one of the potentially suitable areas, Soontaga and other nearby capercaillie	Emajõe primeval valley. Ensure that the has at least 300 m of wind turbine-free area on the banks of the river.

[112] Kämmerle, J.-L., Taubmann, J., Andrén, H., Fiedler, W., Coppes, J. (2021). Environmental and seasonal correlates of capercaillie movement traits in a Swedish wind farm. Ecology and Evolution, 11: 11762–11773. doi: 10.1002/ece3.7922.
[113] Taubmann, J., Kämmerle, J.-L., Andrén, H., Braunisch, V., Storch, I., Fiedler, W., Suchant, R., Coppes, J. (2021). Wind energy facilities affect resource selection of capercaillie Tetrao urogallus. Wildlife Biology. doi: 10.2981/wlb.00737.
[114] Impact of onshore wind farms on wildlife and recommendations of the Environmental Board for their planning in local government comprehensive plans (as of 10 November 2021). Environmental Board.

			between habitats. Thus the connectivity of capercaillie habitats is not affected. There is no impact and no measures need to be planned.	
Supa Lesser spotted eagle PEP	TU4 2.9 km from the border	Lesser spotted eagle	The extent of the usual home range (2 km) is guaranteed. Considering TU4 area (forest area), there are no important feeding areas for the species in the area. . There is no impact on this PEP.	
Virna capercaillie PEP	TU1, TU2 and TU3 1 km	Capercaillie habitat and mating area	In the case of capercaillie and other birds of prey, it has been found that the impact of wind turbines extends up to 1 km distance [115, 116, 117]. Therefore, in the initial map analysis , a 1 km impact area from the PEP has been excluded as a location for a wind farm. In a situation where wind farms would begin PEP from three sides , there would be an impact on the connectivity of the capercaillie habitat with other habitats. The possible access road to the wind farm is adjacent to the capercaillie PEP. Wind farm construction activities (especially transport) may cause disturbances.	The best measure to reduce potential disturbances to the PEP and to ensure consistency with other capercaillie habitats is to abandon the construction of a wind farm in the TU1 area. This would ensure coherence between the Virna PEP and capercaillie habitat KLO9131764, which in turn is connected to the Soontaga LKA . PEP adjacent to the PEP construction and use must must

[115] Kämmerle, J.-L., Taubmann, J., Andrén, H., Fiedler, W., Coppes, J. (2021). Environmental and seasonal correlates of capercaillie movement traits in a Swedish wind farm. Ecology and Evolution, 11: 11762–11773. doi: 10.1002/ece3.7922.

[116] Taubmann, J., Kämmerle, J.-L., Andrén, H., Braunisch, V., Storch, I., Fiedler, W., Suchant, R., Coppes, J. (2021). Wind energy facilities affect resource selection of capercaillie Tetrao urogallus. Wildlife Biology. doi: 10.2981/wlb.00737.

[117] Impact of onshore wind farms on wildlife and recommendations of the Environmental Board for their planning in local government comprehensive plans (as of 10 November 2021). Environmental Board.

				mitigate the impact by limiting the duration restrictions.

4.1.9.3 Measures, need for further research and assessment

Measures for planning wind farms:

- Implement a 3 km buffer zone around habitats listed in the black stork register in order to preserve the possibility of repopulation (considering that these are habitats that have been uninhabited for a very long time). Implement a 500 m buffer zone based on GPS data for important feeding waters where wind turbines will not be built.
- Refrain from constructing a wind farm in the TU1 area.
  : implement a 300 m buffer zone on the Väike Emajõgi River where wind turbines will not be built.
- When planning connections to the main grid, the location of permanent habitats and protected areas must be avoided as the route for underground cables.
- When rebuilding the road adjacent to the permanent habitat of the capercaillie in Virna, the need to preserve the water regime of the permanent habitat must be taken into account. Activities that may cause permanent drainage in the permanent habitat are not permitted.
- Construction activities, noisy transport and subsequent noisy maintenance work on wind turbines in the vicinity of the permanent habitat of the capercaillie in Virna must be restricted in late winter and spring, when the birds are mating. Mating mainly takes place in the morning at sunrise. In order to reduce construction noise and other disturbances, all construction activities and related activities (including soil transport, logging, etc.) within 500 m of the mating area during the period from 1 March to 15 May, from 1.5 hours before sunset until 10:00 in the morning.
- In order to ensure the connectivity of the capercaillie habitat with the southern habitats, the planning of wind turbines 3, 4, 6 and 8 in area TU4 must be abandoned and wind turbine 5 must be moved as far away as possible from the centre of the capercaillie mating area in order to preserve the function of the Murakasoo habitat as a stepping stone.

4.1.10 Impact on water bodies

4.1.10.1 Assessment methodology

The impact on water bodies was assessed in potentially suitable areas mapped in the special plan areas. To this end, existing data on surface water bodies, land improvement systems, wetlands and groundwater protection were analysed. The aim of the assessment was to identify areas of known importance for water protection in potentially suitable areas, the avoidance of which as construction areas would prevent significant adverse impacts on water bodies.

4.1.10.2 Impact on surface water

The construction of a wind farm may potentially have an impact on water bodies during the construction phase if construction activities are planned on water bodies (e.g. access road bridges or culverts) or their shore areas. The main risk during construction is the entry of sediment and petroleum products into water bodies. During the operational phase of the wind farm, the potential impact on water bodies may mainly occur in emergency situations (e.g. oil spills).

It should be noted that construction restriction zones apply to water bodies under the Nature Conservation Act. As the area is predominantly forest land, it must be taken into account that, within the meaning of § 3(2) of the Forest Act, the construction restriction zone on forest land on the banks of a river extends to the boundary of the beach or shore restriction zone. When planning infrastructure related to the wind farm, the restrictions applicable to water body shore areas under the Nature Conservation Act must also be taken into account.

According to EELIS data (as of 25 September 2024), there are no standing water bodies in potentially suitable areas. According to ETAK data, there are several standing water bodies in potentially suitable areas that are not linked to the EELIS database **(** these are small water bodies such as forest firefighting water intakes water intake points, etc.). However, there is overlap with watercourses, for which data is presented in Table 14.

Table 14. Overlap of watercourses with potentially suitable areas. Source: EELIS 25.09.2024.

Code	Name	Construction restriction zone extent, m	Length of watercourse within the area within the area, km
	Potentially suitable area 1		
VEE1012800	Sauniku stream	50	0.55
VEE1012700	Soontaga Stream	25	0.80
	TOTAL Potentially suitable area 1		**1.35**
	Potentially suitable area 2		
VEE1011800	Raamsoo stream	2	0.09
	TOTAL Potentially suitable area 2		**0.09**
	Potentially suitable area 3		
VEE1008219	Kalda ditch	0	1.41
	TOTAL Potentially suitable area 3		**1.41**
	Potentially suitable area 4		
VEE1011902	Naadimõtsa ditch	0	2.17
VEE1008200	Small Emajõgi River	5	0.26
	TOTAL Potentially suitable area 4		**2.43**

Potentially suitable areas 1 and 3 can be considered fragmented by water bodies in terms of their location (Figure 41). Potentially suitable area 1 is crossed by the Sauniku stream (construction restriction zone 50 m) and potentially suitable area 3 is crossed by the Kalda ditch (construction restriction zone 0 m). In addition, potentially suitable area 1 is crossed by the Soontaga stream (construction restriction zone 25 m), potentially suitable area 2 by the Raamsoo stream (construction restriction zone 25 m) and potentially suitable area 4 by the Naadimõtsa ditch (construction restriction zone 0 m) and the Väike Emajõgi river (construction restriction zone 50 m). Greater fragmentation with water bodies is expected to result in a greater need to cross watercourses when constructing routes and roads, which may have a potentially greater impact on them (risk of damage to the banks of water bodies).

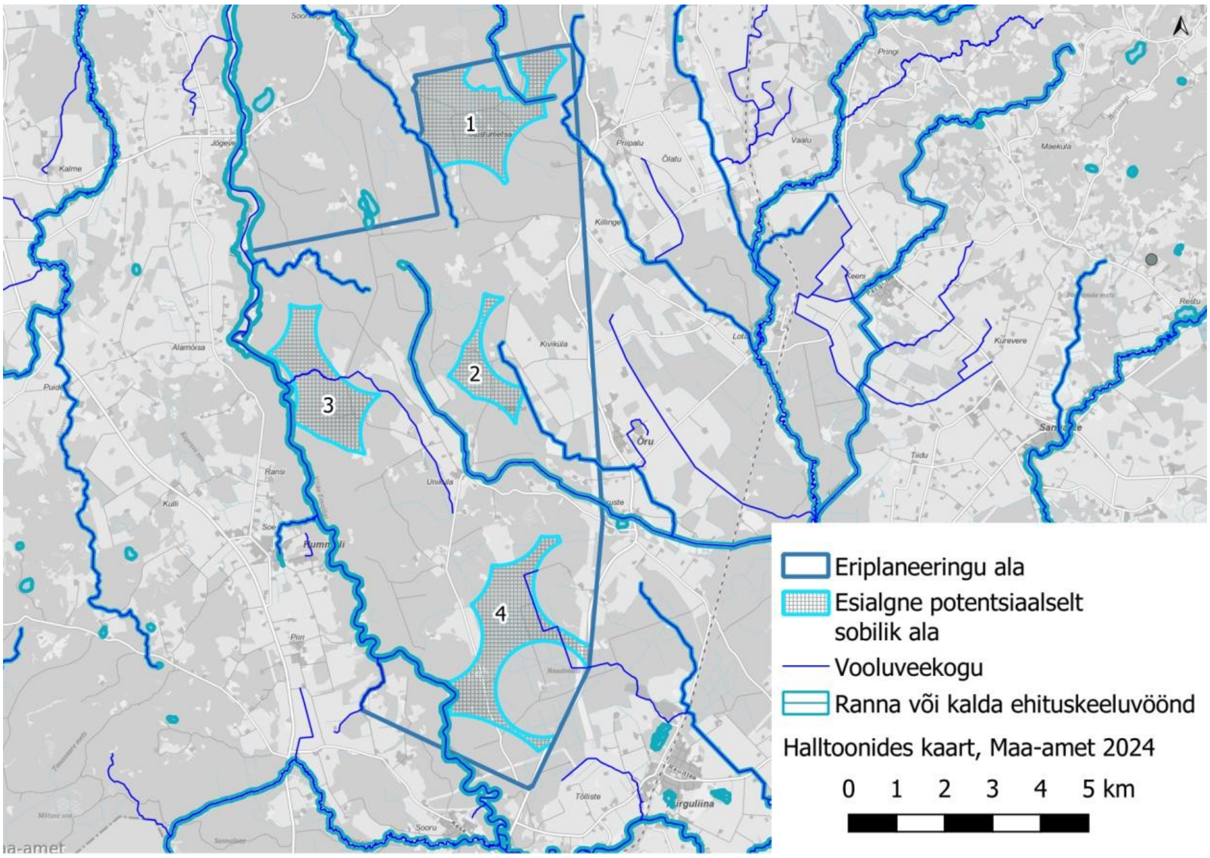

Figure 41. Location of watercourses and springs in relation to the special planning area. Data as of 25 September 2024.

An analysis of the overlap with watercourses revealed that significant water protection restrictions exist in the case of potentially suitable area 1. Considering that no wind turbines are planned for the area due to bird protection considerations (section 4.1.3), the impact from watercourses is insignificant.

The purpose of the construction prohibition zone (CPZ) is to ensure the preservation of natural communities located on the shore, to limit the harmful impact of human activity, to guide settlement in a manner that takes into account the specific characteristics of the shore, and to ensure free movement and access to the shore. Reducing the CZA is an exception under the law and is only permitted in justified cases. Considering the abundance of areas in Valga municipality that are suitable for the development of wind farms, the need to reduce the CZA cannot be considered justified on the basis of the available information. In order to protect water bodies and their banks and to avoid significant environmental impact, it is appropriate to comply with the construction restriction zones for water bodies. As wind turbines involve relatively large-scale construction work, it is appropriate to follow the interpretation that the construction area of a wind turbine is the projection of the rotor on the ground in order to avoid significant impact on water bodies. This ensures that there is an additional buffer between the actual construction area and the construction restriction zone, which helps to protect water bodies.

In order to avoid significant adverse effects on surface water bodies, the extent of the construction restriction zones for water bodies should therefore be observed on the basis of the above, and areas within the construction restriction zone for water bodies that are located on the periphery of potentially suitable areas should be excluded from the site selection areas.

The developed planning solution complies with the protection zones of water bodies. No significant adverse impact on water bodies is expected as a result of the activity. Measures to prevent possible impacts during construction are set out in section 4.1.10.7.

From the point of view of surface water protection, the positions of wind turbines 1 and 2 may be considered somewhat problematic. Both positions are planned for an area where the slope of the Väike Emajõe primeval valley rises. The basic locations for both positions are planned for the gentler part of the slope, but these are more complex locations in terms of construction geology than the other wind turbine positions. Due to the distance buffer applicable to public roads, it is not possible to plan the positions of these wind turbines further away from the river or closer to the road. Wind turbines are also built on mountain slopes in other parts of the world, and in the opinion of the interested party, it is technically possible to build wind turbines at this location. Due to the complexity of the location, there is a risk of damage to the slope and, in the event of heavy rainfall during the construction period, of sediment and possible pollution entering the river. Measures to minimise risks are presented in section 4.1.10.7.

4.1.10.3 Impact on land improvement systems

Land improvement involves draining and irrigating land and regulating the water regime on both sides in order to increase the agricultural value of the land and protect the environment. Some potentially suitable areas (2 and 4, Figure 42) overlap significantly with existing land improvement structures – these are areas where the water regime has already been altered. Potentially suitable areas 1 and 3 (Figure 42) have only a small overlap with land improvement structures. From an environmental perspective, it is appropriate to build wind farms (and other artificial environments) in areas that have already been affected by human activity.

The proportion of land improvement systems (based on the Land Board's spatial data as of 1 September 2024) in potentially suitable areas is as follows:

- area 1 6.2% (27.61 ha);
- area 2 58.1% (74.57 ha);
- area 3 2.3% (7.02 ha);
- area 4 50.8% (203.44 ha).

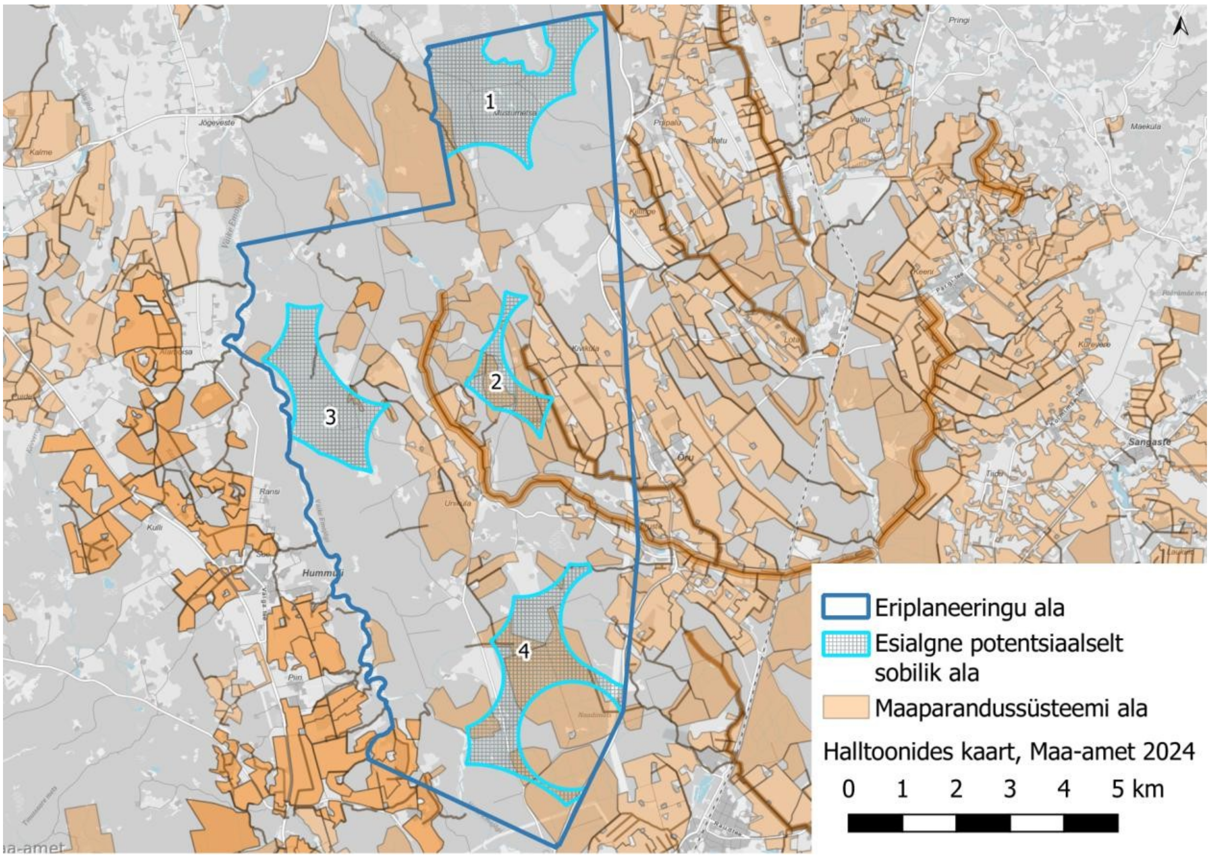

Figure 42. Land improvement systems special planning area. Source: Land Board spatial data (land improvement systems impact areas) 01.09.2024.

Planned activity not may deteriorate the land improvement structures .

Damage to land improvement structures may cause flooding in areas related to the land improvement object in question

. This, in turn, may cause damage to people's property or the natural environment. The functioning of land improvement structures can also be ensured from a construction engineering perspective by building in their area of occurrence, but it is necessary to take land improvement structures into account in the design, including, if necessary, planning their relocation, supplementation, etc. **Planning and construction projects in the land improvement network area must be coordinated with the Agricultural and Food Board in accordance with § 47(1) of the Land Improvement Act.**

It is undesirable to construct new land improvement structures in connection with the establishment of wind farms in areas where there are currently no drainage systems. The construction of land improvement systems reduces the naturalness of areas and is known to have a negative impact on carbon sequestration. Therefore, areas already covered by land improvement systems should be preferred as locations for wind farms. This applies in particular to areas where the land improvement system is still functioning.

4.1.10.4 Impact on wetlands

The overlap with wetlands was analysed on the basis of the EELIS (Estonian Nature Information System) database layer 'sood' (wetlands). The EELIS layer "sood" was used because it contains mainly inventoried natural bogs, whereas the ETAK layer "märgalad" has a somewhat broader scope. Potentially suitable area 1 and the northern part of potentially suitable area 3 overlap with the so-called national potential wind energy EELIS development areas, where nature studies have been commissioned by the Environmental Agency. As regards vegetation, a study on bog habitats had been completed by the time this SEA report was compiled. The SEA report uses the relevant study results ([118]).

Most of the wetlands are located in potentially suitable area 1 (Figure 43). Only potentially suitable area 4 does not contain any wetlands according to the EELIS database.

Potentially suitable area 1 overlaps with the lowland between Mustumetsa and Vaardi, the lowland northeast of Mustumetsa and the Soontaga Pulga floodplain. Potentially suitable area 2 overlaps with the preserved north-western part of Raamsoo. Potentially suitable area 3 overlaps with the transitional bog near Uniküla Sõgelsepa and the lowland bog near Uniküla Sõgelsepa.

Wetlands are ecologically valuable and highly sensitive to changes in the water regime. Wetlands play an important role in both preserving biodiversity and regulating climate change. When establishing a wind farm in their vicinity, damage to wetlands must be avoided. In Estonia, there are no specific recommendations for planning wind farms (or other large-scale construction projects) near wetlands. The relevant guidance material in Ireland recommends planning wind farms at a distance of 250 m from important wetlands([119]) to avoid changes in the water regime in wetlands. In Canada, a 100 m buffer zone is used for all wetlands([120]). This SEA recommends that wetlands be kept free of wind turbines. Wetlands are important both from the perspective of preserving biodiversity and from the perspective of climate impact. As wetlands that overlap with potentially suitable areas are generally of lesser importance in terms of nature conservation (in some places already affected by drainage), it is appropriate to apply a 100 m buffer zone to preserve them. It is not advisable to establish a wind farm in the buffer zone of a wetland necessary to prevent changes in the water regime, as the impact on the wetland may be highly negative. Construction activity in or in the immediate vicinity of a wetland will damage the wetland's water regime, which is likely to lead to the destruction of the wetland. Figure 43 shows the location of wetlands in the area of potentially suitable sites.

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[118] Estonian Nature Fund. 2023. Study of wetland habitats and plant species in potential wind energy development areas. Public procurement "Study of vegetation to identify priority areas for wind energy development for the Environment Agency" Part 3 Contract No. 4–5/23/3.

[119] Northern Ireland Environmental Agency. 2015. Wind farms and groundwater impacts. A guide to EIA and Planning considerations. Version 1.1/April 2015.

[120] Wildlife Directive for Alberta Wind Energy Projects: https://open.alberta.ca/dataset/2d992aec-2437-4269-9545-cd433ee0d19a/resource/11d33fdc-5971-42e7-8cb4-947d2f226804/download/wildlifewindenergydirective-apr07-2017.pdf

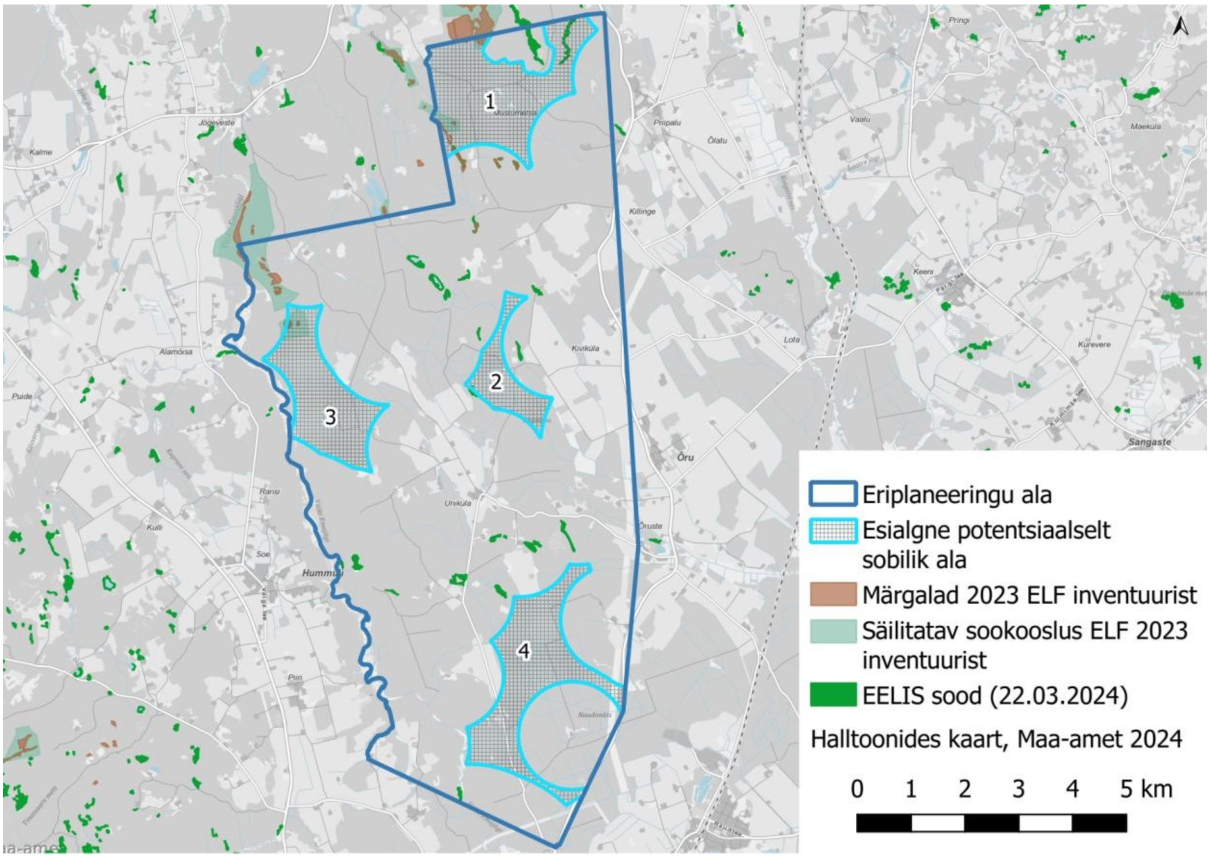

Figure 43. Wetlands in the special planning area. Source: EELIS database, 22 March 20234.

4.1.10.5 Impact on groundwater

The special planning area covers the distribution area of three groundwater bodies:

- Middle Lower Devonian groundwater body in the East Estonian basin (potentially suitable areas 1, 2, 3 and 4);
- Middle Devonian groundwater body in the East Estonian basin (potentially suitable areas 1, 2, 3 and 4);
- Silurian-Ordovician aquifer under the Devonian layers in the East Estonian basin (potentially suitable area 1 partially).

The first groundwater complex on the surface of the potentially suitable areas is relatively well protected, with some parts of the area being protected (Figure 44).

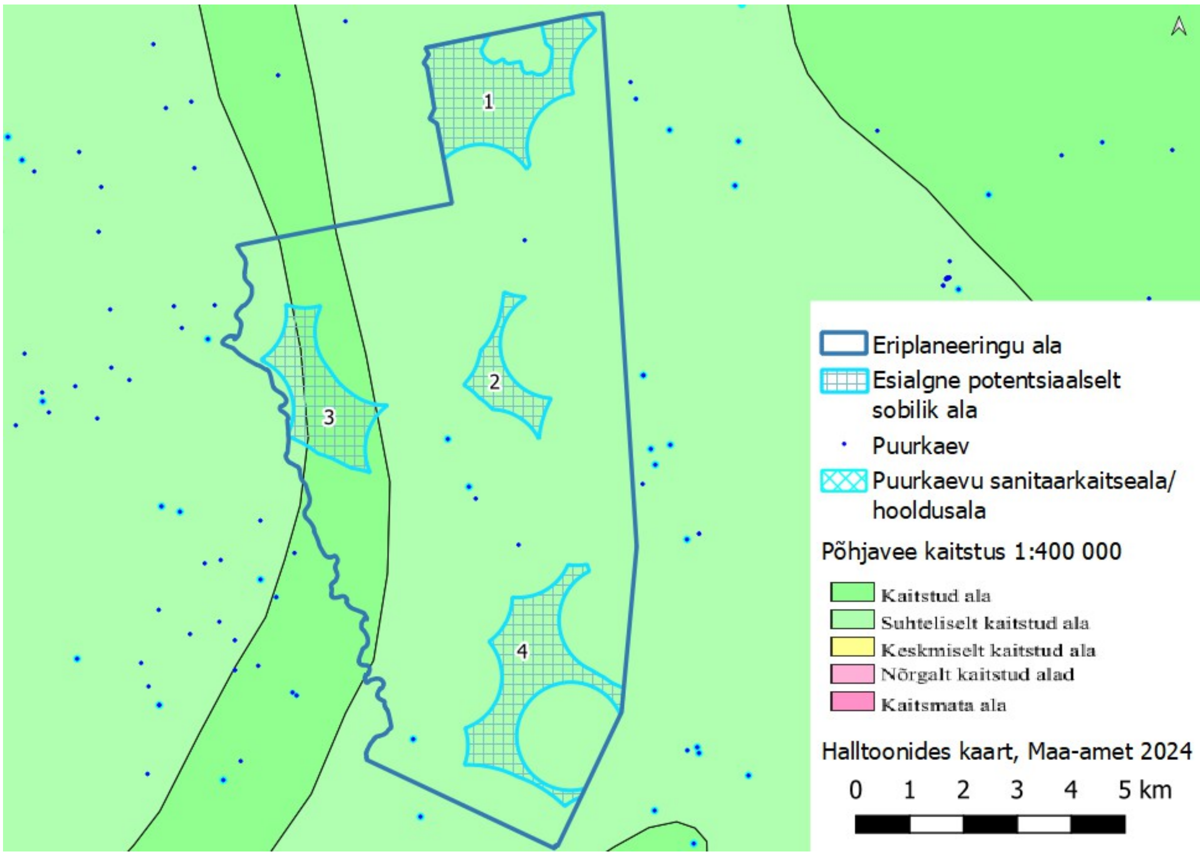

Figure 44. Groundwater protection and location of boreholes in the area of potentially suitable areas within the special planning area. Base: Groundwater protection map 1:400,000.

Given the relative protection of the groundwater, there are no risks associated with the construction of wind turbines, such as possible accidental pollution during the construction or operation of wind turbines. Considering the modern construction solutions used for wind turbines, their construction will not have a significant impact on the distribution of groundwater or groundwater resources.

Wind turbine foundations are large structures, the specific design of which depends on the geological conditions. The foundation must ensure the stability of the wind turbine and is therefore designed for each wind turbine model based on the parameters of the wind turbine itself and the characteristics of the soil. Technical solutions for foundations are discussed in section 2.4.2. Depending on the choice of wind turbine foundation construction, pile foundations can reach depths of up to 30 m in soft soil. Based on the engineering geological conditions in Estonia, the use of gravity foundations is more common, in which case the foundation depth can be up to approximately 6 m.

When using pile foundations, there is a certain risk of mixing groundwater layers (as the piles are drilled or rammed through several groundwater layers). When constructing foundations, the requirements of the Water Act must be followed, which prohibit the mixing of different groundwater layers. The mixing of groundwater layers must be prevented by means of construction techniques. If the need to construct pile foundations arises, the construction project must take into account the need to minimise the risk of mixing groundwater layers when developing a solution.

When using gravity foundations, there is no risk of mixing groundwater layers, as construction work does not involve penetrating multiple groundwater layers. Permanent lowering of the groundwater level is not necessary for the construction of wind turbines. It may be necessary to pump out groundwater near the surface during the construction period to keep the foundation pit dry. After the end of construction, the foundation will not significantly affect the movement or quality of groundwater. Water will flow around the foundation and, given the dimensions of the foundation, this will not be a significant obstacle.

Considering the depth of the boreholes (at least 50 m in the area, mostly between 60 and 100 m) and their location (Table 15) in relation to potentially suitable areas, it is unlikely that they will have a significant negative impact. In the case of dug wells, there could be an impact on the water level if construction work took place in the vicinity of the well, but in this case, the distance between the wind turbines and residential buildings (and thus also the dug wells of the residential buildings) is at least 1 km, which is a sufficient distance. Even the impact area of quarries causing permanent lowering of the groundwater level is generally less than 1 km([121]) .

Shallow dug wells are fed by rainwater seeping through the ground. Therefore, the water level in such wells may also be sensitive to drainage activities close to the ground surface if the drainage is carried out in a way that reduces the amount of water reaching the well. The direction of groundwater flow near the ground surface follows the relief of the ground surface. Analysing the layout of the planned wind farm, taking into account the relief of the ground surface, the location of residential areas and the existing network of drainage ditches (Figure 45), it appears that the most densely populated residential areas closest to the wind farm, in the centre of Uniküla, are located predominantly in higher areas than the planned locations of the wind turbines. Similarly, no roads are planned in the immediate vicinity of residential areas where the activity could alter the movement of groundwater near the surface.

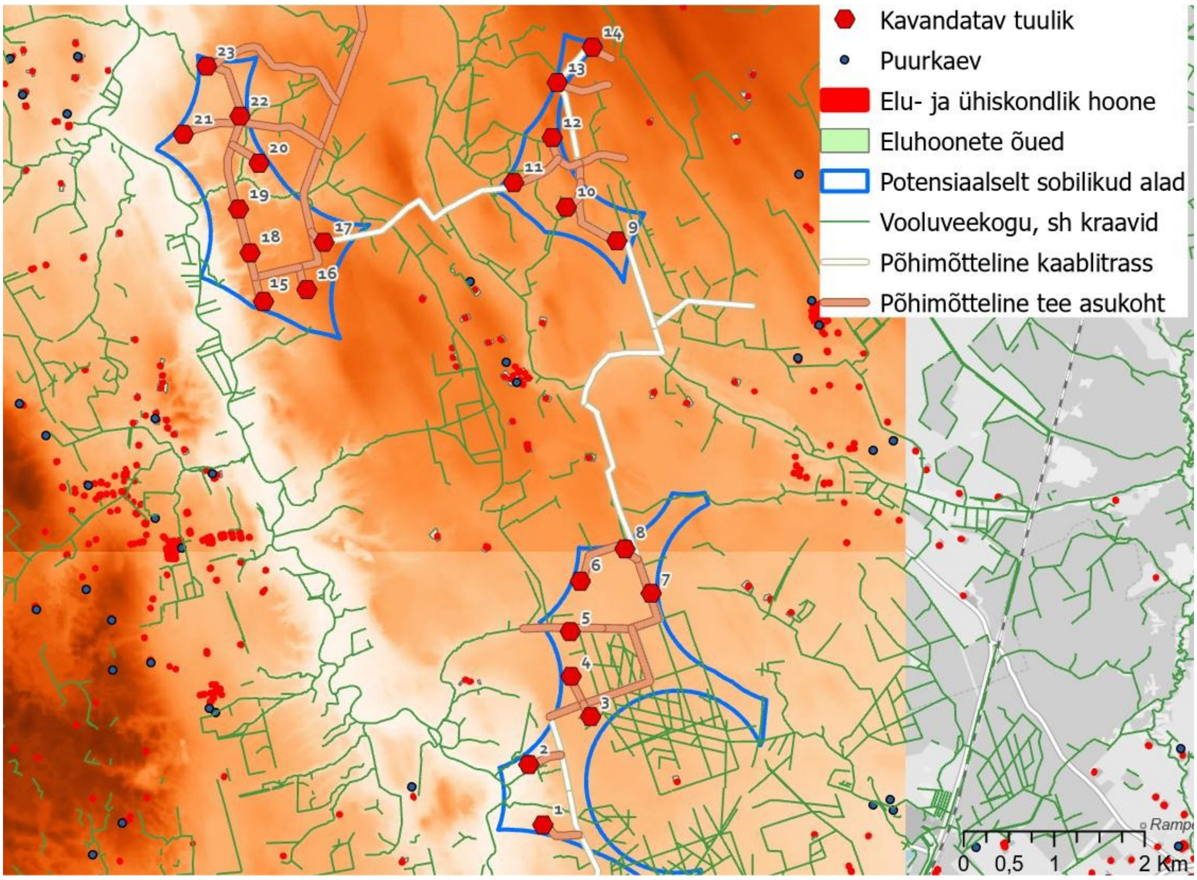

Figure 45. Ground relief (darker areas are higher, lighter areas are lower) in relation to the network of residential areas, boreholes and watercourses. Base map: Land Board 2024

Lowering the groundwater level or causing groundwater pollution can have a significant impact, especially if it threatens the quality of drinking water. Existing dug wells and boreholes are mainly located in populated areas. As the terms of reference for this special plan stipulate that wind turbines shall not generally be erected closer than 1 km to residential areas, most of the region's dug wells and boreholes will remain more than 1 km away from the potential wind farm area. In Estonia, direct recommendations for planning wind farms in relation to wells

[121] Quarry monitoring conditions generally require the condition of wells within a 1 km radius to be monitored.

nearby. The relevant guidance material in Ireland [122] **recommends planning wind farms at a distance of 250 m from wells used as drinking water sources and at least 50 m from other wells.** Table 15 shows boreholes located closer than 1 km to potentially suitable areas. There are no boreholes located closer than 250 m to potentially suitable areas (Table 15). In the developed planning solution, a distance of more than 250 m is also ensured by the planned roads, the construction of which may require the construction of drainage ditches.

Table 15. Drilled wells located closer than 1 km to potentially suitable areas. (Drilled well data – EELIS as of 26 September 2024 and Veka EELIS [123]as of 26 September 2024.

Drilled well code	Related to borehole groundwat er body groundwater body	Borehole water table depth, m	Distance from potentially suitable area, m	Additional
PRK0010962	Middle Devonian groundwater body Eastern Estonian basin	36.5	962 (area 2)	Operating borehole for domestic water supply
PRK0010716	Middle Devonian groundwater body in the East Estonian basin	40	987 (area 4)	Operating borehole for domestic water for domestic water
PRK0071671	Middle Devonian groundwater body in the Eastern Estonian river basin	71	979 (area 4)	Operating borehole for domestic water supply

4.1.10.6 Risk of surface and groundwater pollution

The main source of danger to surface and groundwater associated with wind turbines is the oil used in the gearbox located in the nacelle (up to 500 litres per turbine), which, in the event of a nacelle breakage or incorrect oil change procedure, may enter the soil and, in the worst case, surface or groundwater. Wind turbine technology has been developed in such a way that oil changes are rarely necessary. Modern wind turbine technology also takes into account the minimisation of the risk of leakage. Oil changes are generally carried out using a special tanker truck. The old oil is pumped into the vehicle using hoses and replaced with new oil. Oil changes are carried out by specialised companies and qualified specialists. In the event of an accident, the main measure is the rapid response of the rescue service and their ability to resolve the situation (oil spill clean-up). Modern wind turbines are under constant digital control, which provides operational information on the status of the turbine and thus reduces the risk of accidents.

All potentially suitable areas are either fully or partially covered by relatively protected groundwater, with area 3 also partially covered by protected groundwater. The data comes from a groundwater protection map on a scale of 1:400,000 (this is not a very accurate map, so it should be viewed with a critical eye).

The accident is similar in nature to, for example, a fuel tanker accident on a motorway, and the main remedy is the rapid response of the rescue service and the wind turbine maintenance team and their ability to resolve the situation. In order to prevent accidents, the wind farm owner must ensure continuous monitoring of the condition of the wind turbines and maintenance in accordance with the technical specifications of the specific wind turbines to be installed.

There are no springs in or near potentially suitable areas, so the construction of the wind farm will not have an impact on springs.

[122] Northern Ireland Environmental Agency. 2015. Wind farms and groundwater impacts. A guide to EIA and Planning considerations. Version 1.1/April 2015.
[123] https://veka.eelis.ee/veka.aspx?type=artikkel&id=757660072

4.1.10.7 Measures, need for further studies and assessment

Measures for wind farm planning:

- the further planning of the wind farm must not affect the hydrological regime and quality status of water bodies.
- In order to avoid significant adverse effects on surface water bodies, the extent of water body construction restriction zones must be observed and areas within the construction restriction zone of water bodies that are located on the periphery of potentially suitable areas must be excluded from the selection of locations. Considering the extent of potentially suitable areas, reducing construction restriction zones and diverting watercourses (except for land improvement ditches) for the construction of a wind farm is not justified.

During construction work, especially when crossing watercourses and carrying out work within the construction restriction zone, damage to the banks of watercourses, the risk of erosion and the entry of soil and pollution into watercourses must be avoided. Construction machinery and vehicles are not permitted to drive in watercourses.

- If additional drainage ditches or significant reconstruction of existing drainage ditches and water diversion during construction are planned in wind farm areas, flow stabilisers (settling ponds or purification beds) must be provided on the ditches before they flow into the receiving watercourse or natural water bodies in order to reduce sedimentation.
- Construction activities must not impair the functioning of existing land improvement systems (drainage). If it is unavoidable to affect drainage, the drainage system must be reconstructed as necessary to ensure the continued functioning of the land improvement system.
- Where possible, wind turbines should be located in areas with more suitable geological conditions, which reduce the need for drainage and soil works. For the design of a wind farm, a construction geological survey must be prepared by a competent company, on the basis of which a suitable foundation solution must be determined and the possible impact of the wind farm on surfaceand groundwater, and, if necessary, plan measures to prevent significant adverse effects on surface and groundwater.

For wind turbines 1 and 2, the following additional measures must be taken:

- based on the engineering geological survey, a suitable technical solution for the foundation, assembly site and access road must be found, paying attention to ensuring the stability of the slope.
- solutions with minimal space requirements should be preferred, as they allow for maximum preservation of the existing vegetation cover on the slope. The vegetation cover acts as a buffer system on the slopes of water bodies, reducing the amount of sediment, nutrients and pollution entering the water body.
- The construction project should include both construction and work organisation measures to prevent slope failures and, in the event of heavy rainfall, the transfer of sediment, construction materials, etc. into the water body.

4.1.11 Impact on soil, including valuable agricultural land

4.1.11.1 Assessment methodology

The impact on soil was assessed primarily from the perspective of soil fertility. The overlap of potentially suitable areas mapped in special planning areas with arable land and valuable agricultural land was assessed. The aim of the assessment was to identify known agriculturally important areas in potentially suitable areas, the preservation of which would prevent significant adverse effects on valuable agricultural land.

4.1.11.2 Impact on soil

The construction of a wind farm has an impact on soil, primarily in connection with soil removal. The construction of a wind farm involves the removal of soil from construction sites. Direct soil works (removal of soil and replacement with fill material) are to be expected within the construction areas. The

the greater the number of wind turbines to be constructed, the greater the amount of soil to be removed. The impact on the soil is local and limited to the direct construction areas. The impact on the soil can therefore be considered insignificant. This is particularly true if standard environmental measures applicable to construction activities are implemented (as described in section 4.1.11.4).

4.1.11.3 Impact on valuable agricultural land

Based on ETAK data (as of 17 September 2024), the overlap of arable land with potentially suitable areas is presented in Table 8. In all potentially suitable areas, the proportion of arable land remains at 0%. Potentially suitable area 1 has 0 ha of arable land, potentially suitable area 2 has 0.26 ha, potentially suitable area 3 has 0.12 ha and potentially suitable area 4 has 1.39 ha. Therefore, the possibility of valuable agricultural land occurring in potentially suitable areas is low.

According to the Valga County Plan 2030+, valuable agricultural land is arable land, permanent grassland and agricultural land under permanent crops, whose productivity rating or bonitet is equal to or higher than the weighted average soil fertility bonitet of Estonian agricultural land (40 points). If the average bonitet of the county is lower than the Estonian average bonitet, areas with a bonitet equal to or higher than the county average are defined as valuable agricultural land. The average bonitet of agricultural land in Valga County is 40 points, which is why the county plan considers bonitet 40 and above to be valuable. The Valga County Plan 2030+ sets out measures to ensure the preservation of valuable agricultural land. The map layer of valuable agricultural land in the county plan is informative. **The Valga County Plan 2030+ stipulates that in the case of distributed energy, where it is necessary to use agricultural land for energy production, less valuable areas (outside the green network, valuable landscapes and valuable agricultural land).**

As of now (November 2024), the draft of the new Valga municipality comprehensive plan has not been completed, so the data on valuable agricultural land in the comprehensive plan cannot be considered. Therefore, the overlap of valuable agricultural land is analysed based on data from the Valga County Plan 2030+ (Figure 46). According to the local government, the comprehensive plan does not propose the designation of additional valuable agricultural land, but rather seeks to clarify the data in the comprehensive plan and not to designate less productive agricultural land as valuable.

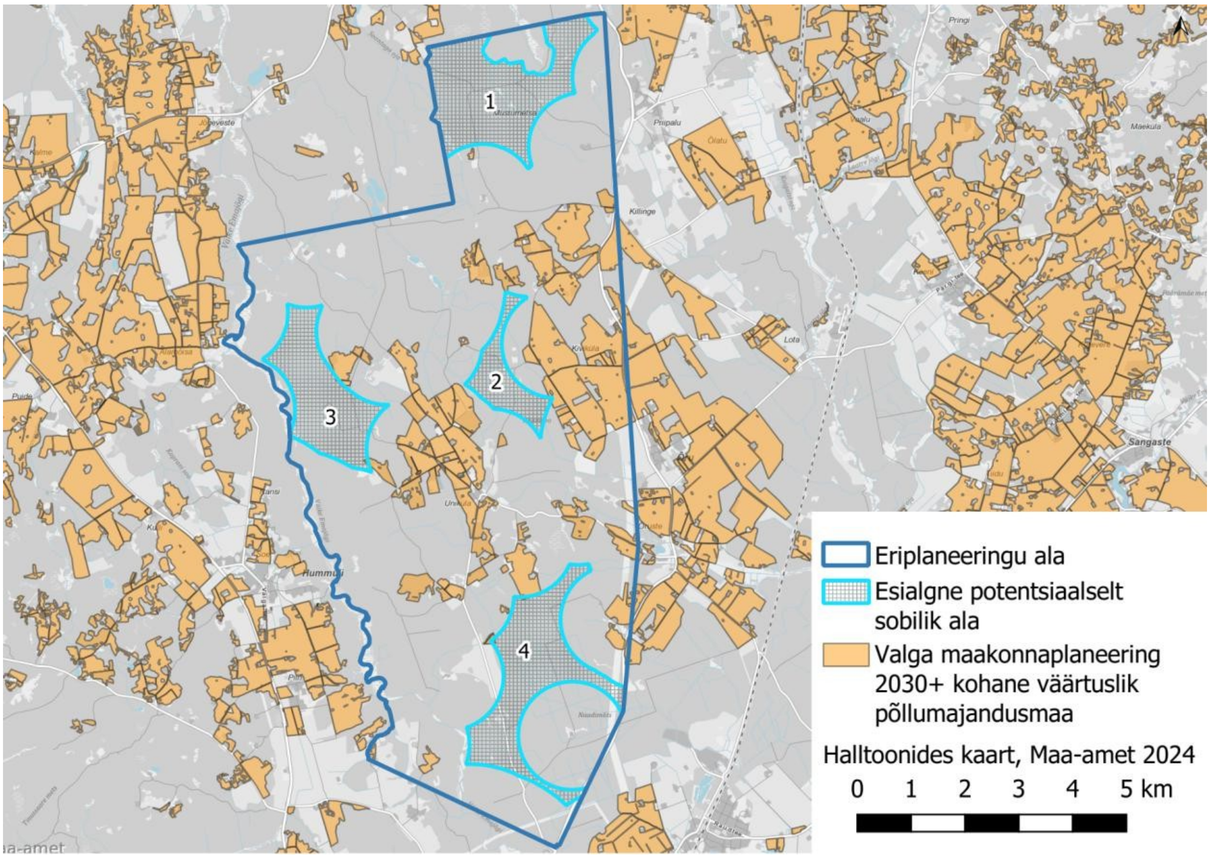

Figure 46 Special plan area are Valga county plan 2030+ valuable agricultural land.

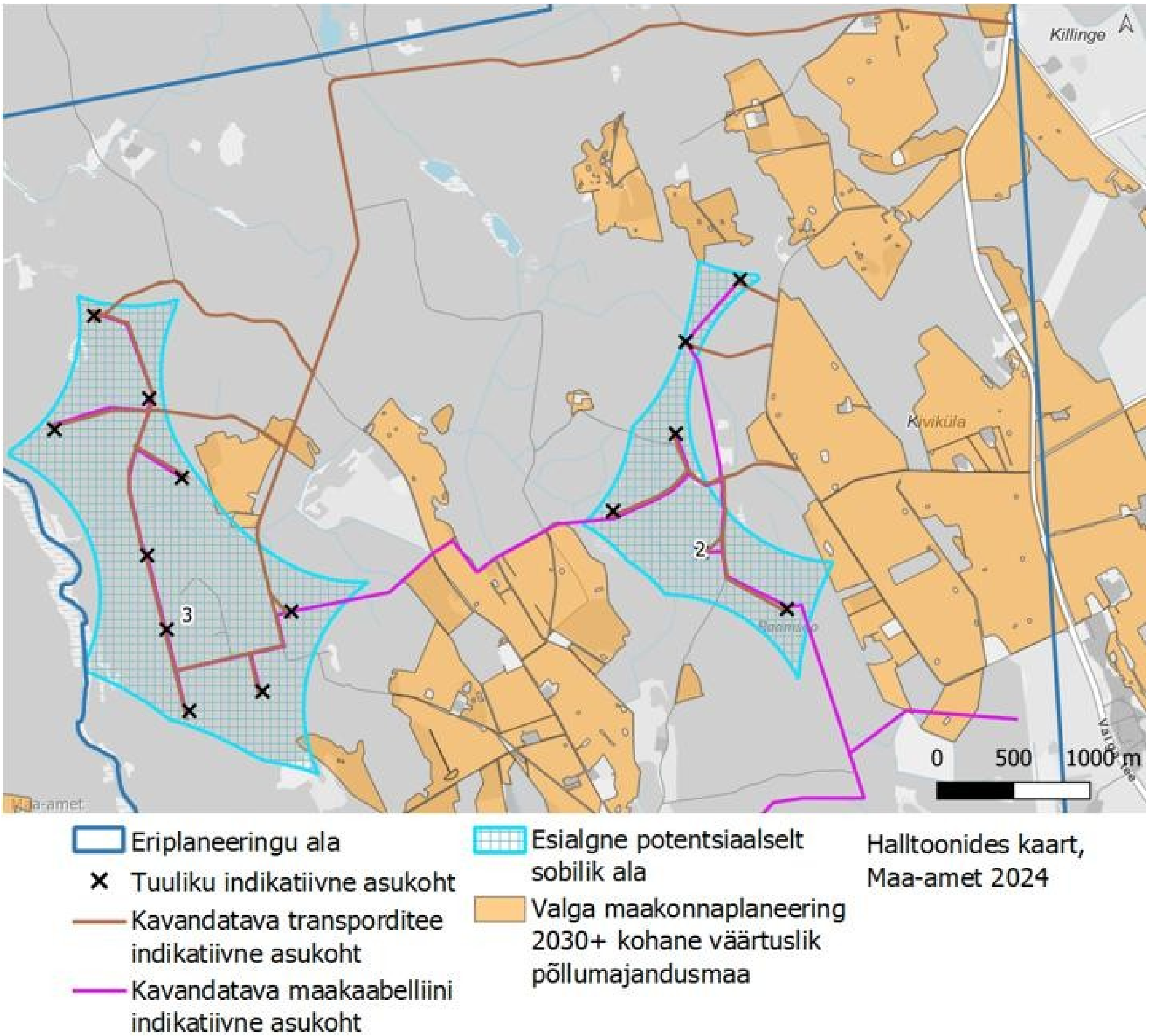

Figure 47. Overlap of the potential suitable areas 2 and 3, wind turbines, planned underground cable line and planned transport route with valuable agricultural land according to the Valga County Plan 2030+.

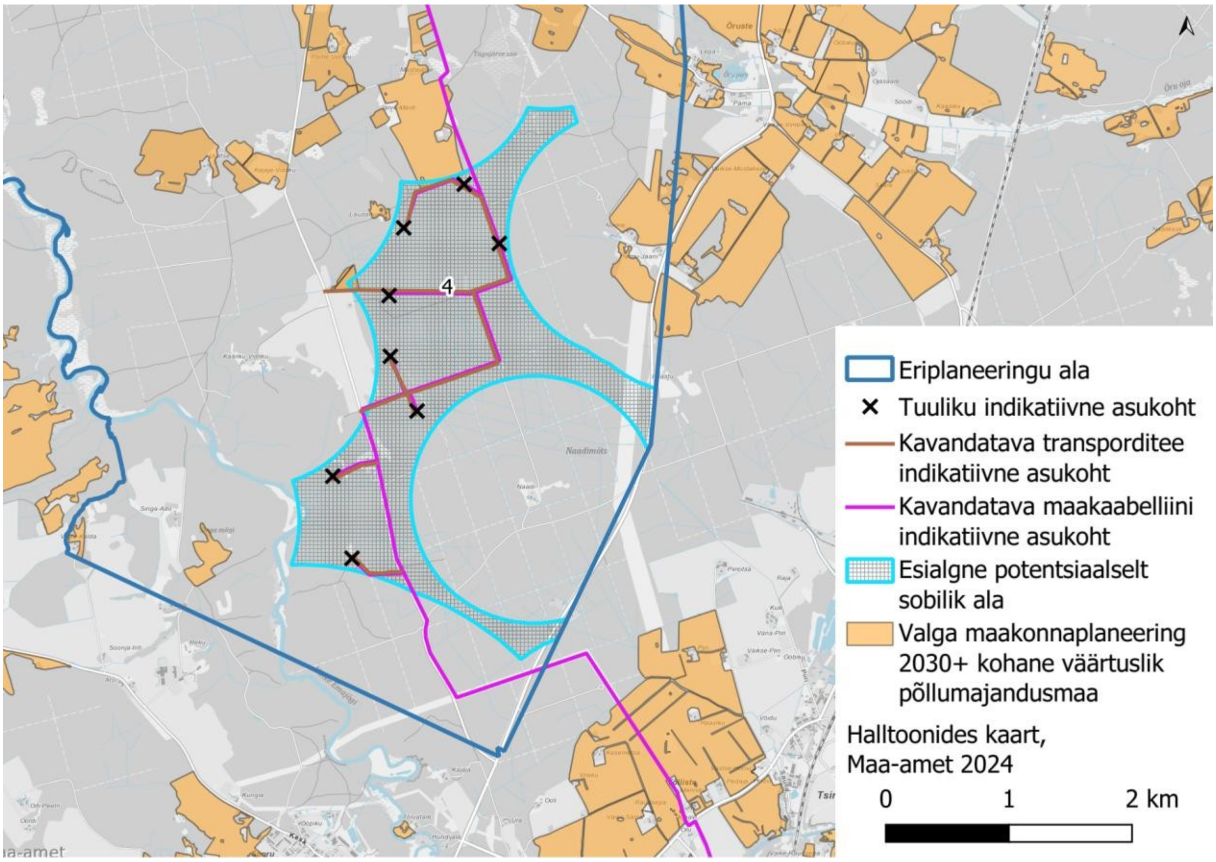

Figure 48. Overlap between potentially suitable area 4, wind turbines, the planned underground cable line and the planned transport route with valuable agricultural land according to the Valga County Plan 2030+.

The locations of the wind turbines developed in the special plan do not overlap with the locations of valuable agricultural land according to the Valga County Plan 2030+. However, the approximate locations of underground cables and transport routes do overlap with valuable agricultural land in some places (Figure 47 and Figure 48). However, their fragmenting effect is small and no significant impact on valuable agricultural land is expected.

4.1.11.4 Measures, need for further studies and assessment

Measures for wind farm planning:

- Where possible, avoid constructing wind turbines and other structures necessary for the wind farm on valuable agricultural land. However, as from an environmental protection perspective, it may be preferable to plan wind turbines on arable land (rather than in forests and wetlands), the planning of wind turbines on valuable agricultural land is not ruled out. In the case of valuable agricultural land, buildings should be located on the edge of the array to ensure its efficient use. The wind farm must not significantly impair the intended use of valuable agricultural land.
- Transport and construction machinery in good working order and well maintained must be used for construction work. The leakage of hazardous substances from vehicles and machinery into the environment must be prevented.
- Topsoil that is removed must be reused on site as much as possible. High-quality soil must be spread on the surrounding preserved farmland to ensure its continued agricultural use.

Upon completion of soil works, the area must be cleaned up and landscaped.

4.2 Potential impact on climate and climate resilience

4.2.1 Assessment methodology

The assessment of climate impacts is based on the principles and guidelines described in the European Commission Communication 'Technical Guidelines for Climate Resilient Infrastructure 2021-2027' (2021/C 373/01). Accordingly, climate impacts are addressed in two parts: 1) the impact of activities on the climate/climate change; 2) the climate resilience of activities. The accuracy of the planning has been taken into account in the assessments.

On 12 December 2024, the Valga Municipal Government initiated the preparation of a climate and energy plan for Valga Municipality. As there was no local climate and energy plan at the time of preparing this SEA report, it is not possible to assess its compliance.

4.2.2 Impact on climate change

Global warming affects both the human environment and the natural environment. If the global average temperature increase compared to pre-industrial levels cannot be kept below 1.5°C, this will have serious negative consequences for human living conditions and for many other species and communities. In order to slow down global warming, it is necessary to immediately reduce the emission of anthropogenic greenhouse gases into the atmosphere([124]) .

The main sources of greenhouse gas emissions are the production, processing and combustion of fossil fuels and energy production. The construction of wind farms for electricity generation means increasing the share of electricity production based on renewable energy sources, which creates the conditions for reducing greenhouse gas emissions from the combustion of fossil fuels, **thereby having a potentially positive impact on mitigating climate change.**

The production of wind turbines uses resources and emits greenhouse gases. A wind turbine compensates for the energy and $_{CO2}$ emissions used in its production, operation and dismantling in 7–8 months of operation. For example, in the case of Vestas V150-4.2 MW wind turbines, the payback period is 7.6 months under low wind conditions. **During its lifetime, a wind turbine produces 31 times more energy than it consumes during its entire life cycle.**

The specific $_{CO2}$ emissions of wind turbines depend on the size of the wind turbine (e.g. Vestas V162 7.2 MW wind turbine approx. 7.1 g CO2/kWh[125]), the higher the capacity of the wind turbine, the lower the greenhouse gas emissions per unit of energy produced (kWh)[126] . The Valga special plan envisages the construction of up to 23 wind turbines (18 wind turbines in the case of a planning solution that takes into account bird protection measures). We conservatively estimate that the capacity of the wind turbines to be built will be 7 MW and the annual production of a wind turbine will be at least 23,000 MWh/a. The annual production of the wind farm would therefore be 529,000 MWh/a for 23 wind turbines and 414,000 MWh/a for 18 wind turbines. This means that CO2 emissions from wind turbine production would be 3.7 thousand tonnes of CO2 for 23 wind turbines and 2.9 thousand tonnes of CO2 for 18 wind turbines.

For comparison, oil shale-based electricity production generates 1,000 g CO2/kWh[127] , and Estonian electricity production will generate 715 g CO2/kWh([128]) in 2022. The estimated production of the wind farm is 529,000 MWh/a with 23 wind turbines and 414,000 MWh/a with 18 wind turbines, taking into account measures to reduce the number of wind turbines in the bird area. This means that if this amount of energy replaces the current fossil fuels

[124] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

[125] https://www.vestas.com/en/energy-solutions/onshore-wind-turbines/enventus-platform/v162-7-2-mw

[126] Raadal, H.L., Gagnon, L., Modahl, I.S., Hanssen, O.J. 2011. Life cycle greenhouse gas (GHG) emissions from the generation of wind and hydro power. Renewable and Sustainable Energy Reviews. Elsevier. 15. pp. 3417-3422.

[127] European Environmental Agency. 2022. Greenhouse gas emission intensity of electricity generation by country.

[128] Elering 2023. Electricity mix in 2022.

Based on energy production, the 23 wind turbines will prevent the emission of approximately 375,000 tonnes of CO2 and the 18 wind turbines will prevent the emission of 296,000 tonnes of CO2.

Therefore, the construction of a wind farm has a significant positive impact on reducing Estonia's greenhouse gas emissions and thus slowing down climate change.

The carbon footprint assessment of wind turbines also takes into account the SF6 used in wind turbine-related equipment, which is a powerful greenhouse gas (1 SF6 = 23,500 CO2). SF6 is used as an electrical insulator in medium and high voltage applications in switchgear. The gas acts as an electrical insulator in the operation of switchgear. Each wind turbine uses switchgear, and switchgear is also used to connect wind turbines to substations and in substations. 0.1% of the SF6 associated with wind turbines leaks annually, and over the lifetime of a wind turbine, it is estimated that gas leakage can total 2% of the gas used([129]) .Gas leakage accounts for a significant portion of the carbon footprint of wind turbines. However, even taking this into account, the carbon footprint of wind turbines remains significantly smaller than that of fossil fuel-fired power plants. With regard to the use of SF6, it should also be noted that the European Union has introduced a phased ban on the use of this chemical. Depending on the voltage of the equipment, SF6 will be banned in distribution equipment between 2026 and 2032([130]) .Considering the possible implementation schedule of the Valga special plan, it is unlikely that equipment containing SF6 will be installed in this area.

The establishment of a wind farm in potentially suitable areas will be accompanied by changes in land use, including the clearing of forest land and the drainage of wetlands. Deforestation and drainage of wetlands cause irreversible changes to the environment and **affect carbon storage and sequestration**. The establishment of wind farms in potentially suitable areas is accompanied by deforestation and drainage of wetlands. Deforestation and drainage of wetlands cause irreversible changes to the environment, which **affect carbon storage and sequestration.**

The establishment of wind farms involves the clearing of forest land in areas covered by wind turbines. The clearing of forest land causes irreversible changes to the environment and affects carbon storage and sequestration. The total carbon stock (t/ha) of forest woody biomass (coarse roots, trunks, branches) has been estimated for the whole of Estonia in the course of the ELME2 project. All wind turbine locations overlapping with forest areas are planned for areas with low carbon stock woody biomass (Figure 49). The carbon stock stored in woody biomass overlapping with the planned wind farm construction area (23 wind turbines) is calculated to be 1.6 thousand tonnes of CO2 based on ELME project data.

[129] Vestas. 2023. Life Cycle Assessment of Electricity Production from an onshore EnVentus V162-6.2 MW Wind Plant.
[130] https://eur-lex.europa.eu/eli/reg/2024/573/oj

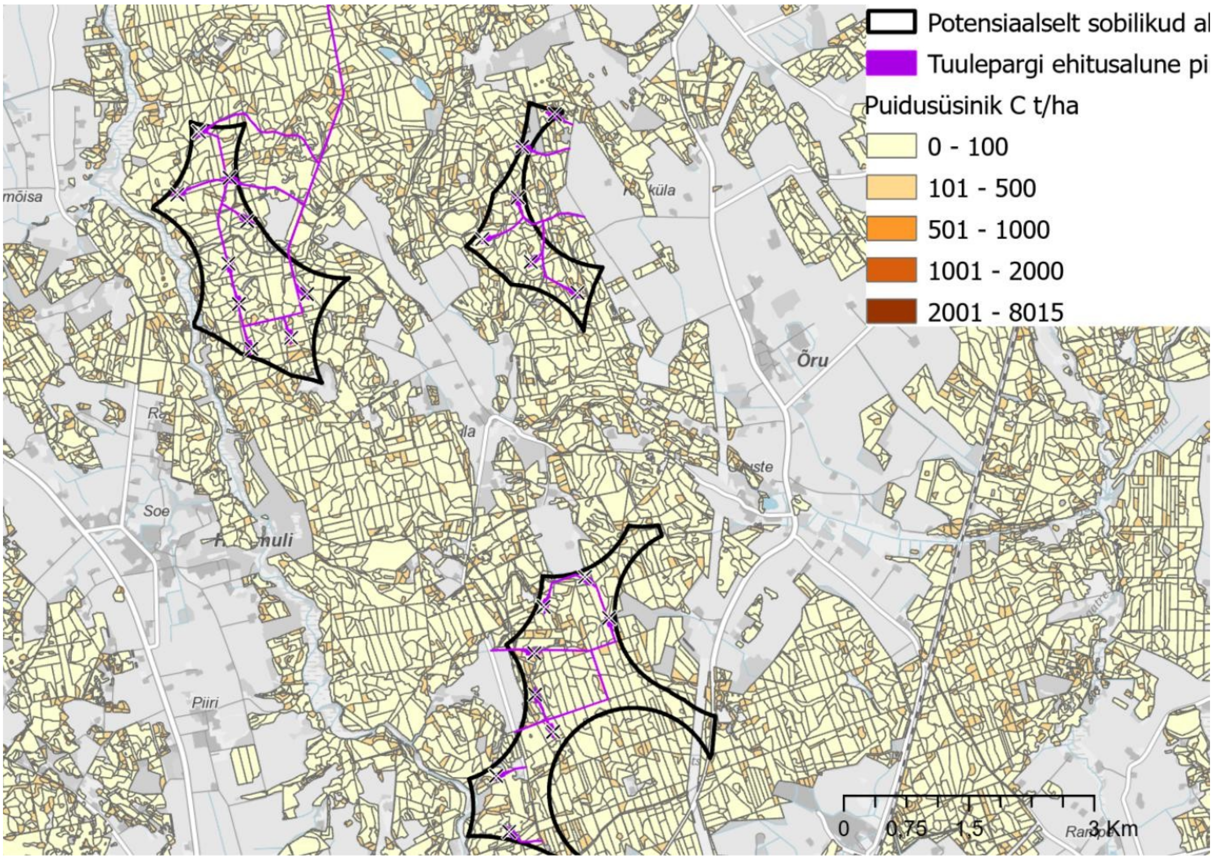

Figure 49. Overlap of wind turbine positions with forest carbon stocks. Source: www.keskkonnaagentuur.ee/elme

At the same time, soil carbon stocks in the area are higher than average. Wind turbines overlap with soils with average and above-average carbon stocks (Figure 50). The approximate construction area of the planned wind farm (23 wind turbines) overlaps with soil carbon stocks of approximately 30.6 thousand tonnes of CO_2. A conservative estimate is that all soil carbon stocks will be released during construction. In the case of 18 wind turbines, the amount of carbon released is estimated to be approximately 20% less.

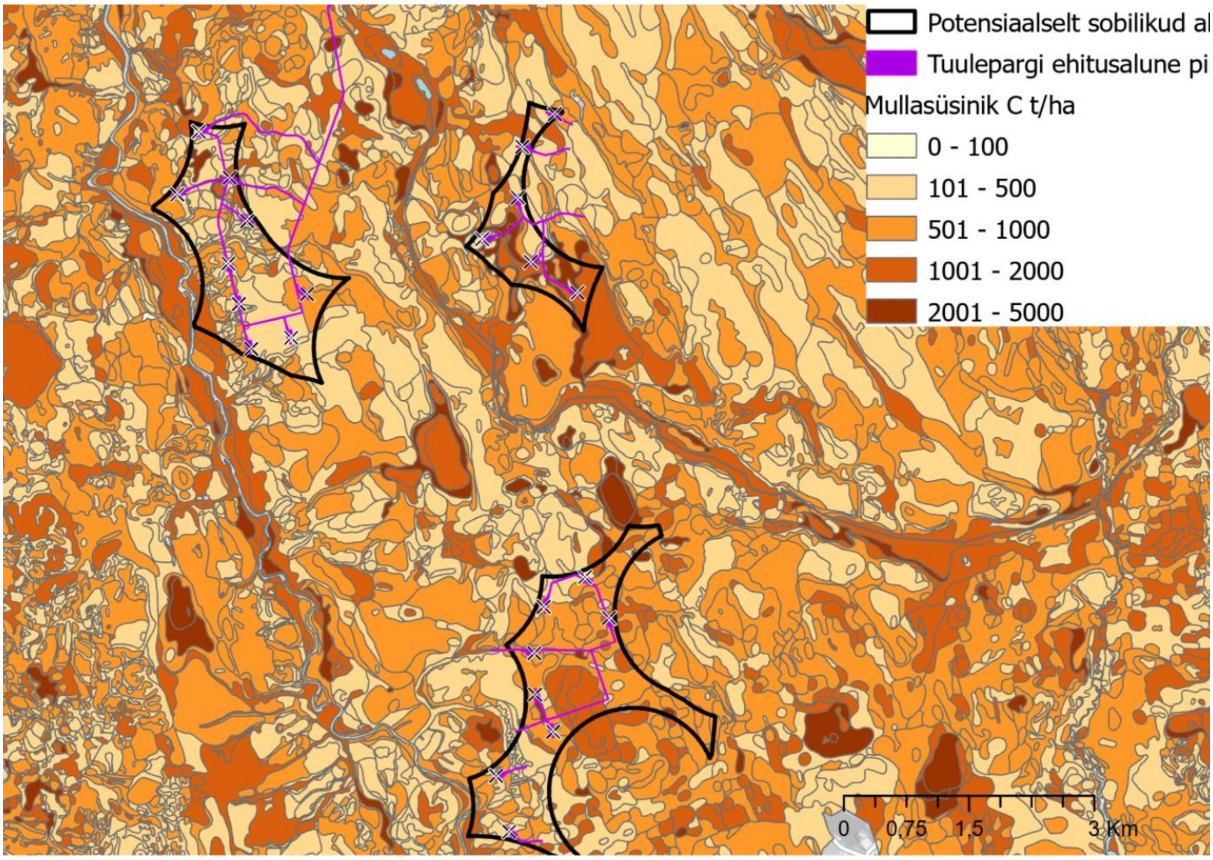

Figure 50 Wind turbine positions overlap soil carbon reserve. Basis: www.keskkonnaagentuur.ee/elme

Considering the CO_2 emission reduction effect of the wind farm, it significantly exceeds the reduction in carbon sequestration resulting from forest clearing and soil removal. Therefore, the construction of a wind farm has a strong positive impact in terms of reducing climate impact. At the same time, however, the construction of a wind farm is accompanied by damage to the carbon sequestration targets of the **land** use sector. **The impact of deforestation is subject to compensation in accordance with the Forest Act and the Environmental Charges Act.**

4.2.3 Climate resilience

Valga County has not prepared a climate and energy plan whose objectives could be used in this SEA report.

Wind energy resources and their use have a direct impact on the following factors in the case of onshore wind farms factors:[132]

- average wind speed in 2015;
- extreme weather conditions (storms, ice and lightning);
- microclimatic conditions (wind turbulence).

Of all renewable energy sources, wind energy benefits most from climate change, as wind speeds have shown a clear upward trend during the cold half of the year, when energy demand is highest[131] . When establishing a wind farm, it is also important to consider possible changes in prevailing wind directions so as not to lose potential energy due to shadowing between wind turbines caused by incorrect placement.

[131] Kallis, A., Kull, A. Roose, A., Järvet, A., Kriis, E., Abroi, E-L., Põdersalu, H., Laas, I., Võrno, I., Jaagus, J., Kriiska, K., Eerme, K., Lember, K., Rannik, K., Aidla, K., Kaar, K., Kaare, K., Sakkeus, L., Kaasik, M., Mandel, M., Viisimaa, M., Möls, M., Kabral, N., Roots, O., Talkop, R., Laasma, T., Kallaste, T., Anis, T., Räim, T., Adermann, V., & Suursaar, Ü. 2013. Estonia's Sixth Climate Report.

Due to the possible intensification of extreme wind gusts, there may be a higher risk of wind farms being shut down, as wind turbines are switched off during stormy weather for safety reasons. For the most common commercial wind turbines, the wind speed range for shutdown is 20–25 m/s. If wind turbines are shut down en masse, this jeopardises the stability of the energy system and requires additional rapid compensation capacities. In addition to the impact of more frequent extreme wind speeds and protective mechanisms, increased precipitation can also hinder maintenance crews' access to onshore wind turbines. This requires the reinforcement of access roads . ([132]) Wind turbine manufacturers are working to increase the resilience of wind turbines in the face of increasingly frequent extreme weather conditions. The climate resilience of wind farm roads, routes and foundation solutions must be addressed during the construction design process.

The increasing frequency of extreme weather conditions resulting from climate change may increase the frequency of ice formation in Estonia. The risk of wind turbine icing occurs at temperatures close to 0 degrees in conditions of high air humidity. For ice to pose a danger, it must fall at the same time as a person is in the place where it falls. As ice formation is a random phenomenon, the risk also occurs randomly. When it does occur, the risk is high, but for most of the year, the turbine is ice-free. The risk of ice formation in Estonia is less than 2% of the year. There are no known cases of serious injuries caused by ice flying from wind turbines in global practice. The risk of ice formation on wind turbines can be minimised, and various technological solutions have been developed for this purpose, such as anti-icing systems. Anti-icing systems are generally solutions that allow hot air to circulate inside the wind turbine blades to melt the ice after it has formed. In addition, modern wind turbines can be equipped with sensors that stop the turbines when ice forms, allowing maintenance technicians to safely remove the ice from the blades. When selecting wind turbines, the climatic conditions in Estonia must be taken into account and suitable technical solutions must be used.

If wind turbines are not equipped with an anti-icing heating system, they must be located at a sufficient distance from sensitive objects (residential buildings, roads). The maximum impact area of ice fragments can be calculated using the formula 1.5×(tower height + rotor diameter)([133]) .This is a simplified distance formula that has been used in several guidance materials. If necessary, it is possible to calculate the danger zone and the magnitude of the risk more accurately, but this is only relevant if sensitive objects are located within the initial assessment danger zone ([134]) .In this case, the danger zone for ice fragments extends up to 540 m. The risk of ice falling is significantly higher under the wind turbine and decreases with distance. The wind turbines are planned to be located at least 1 km away from residential buildings. **Therefore, in this case, no significant risk to residential areas due to icing is expected. At the same time, several wind farm areas are crossed by forest roads used for forest management and public roads. On icy days, there is a risk of ice falling on the roads.**

Of the potentially suitable areas, 3 (Figure 51) and 4 (Figure 52) are located in areas at risk of flooding associated with the Väike Emajõgi River and Kalda ditch. The other areas do not overlap with potential flood areas ([135]) .All wind turbine locations are planned outside the flood risk area.

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[132] Estonian infrastructure and energy sector to climate change adaptation strategy final report – https://www.sei.org/wp-content/uploads/2017/12/enfra-a-uuringuaruanne-01-04-2016.pdf

[133] Deutscher Naturschutzring Grundlagenarbeit for an information campaign "Environmental and environmentally friendly wind energy use in Germany (onshore). 2005.

[134] IEA Wind TCP. 2022. Technical Report International Recommendations for Ice Fall and Ice Throw Risk Assessments.

[135] Piirimäe, K., Raidla, M., Uuemaa, E., Peetersoo, A., Kiiker, K., Reitalu,T. 2021. List of inland water bodies prone to major flooding and high water levels. Report. Public procurement no: 223733.

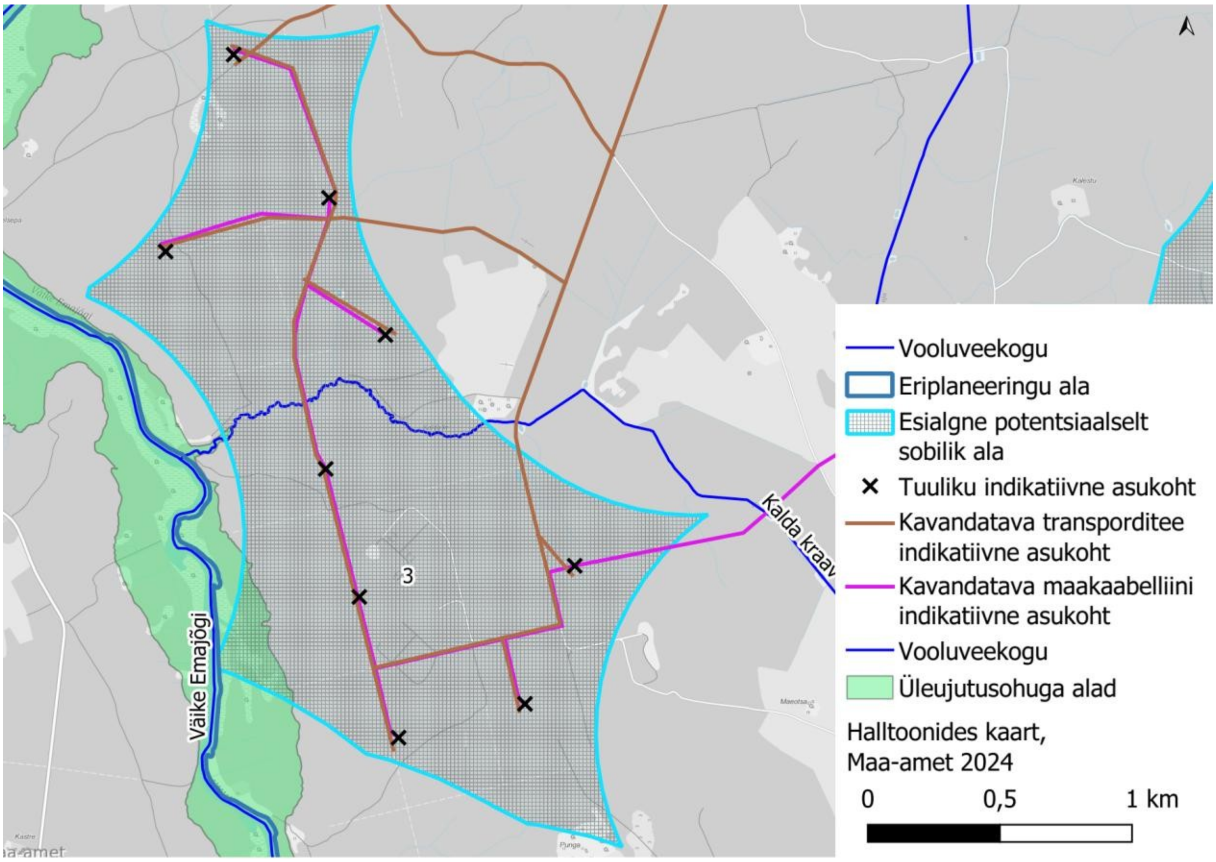

Figure 51. Location of flood-prone areas in potentially suitable area 3 and its vicinity.

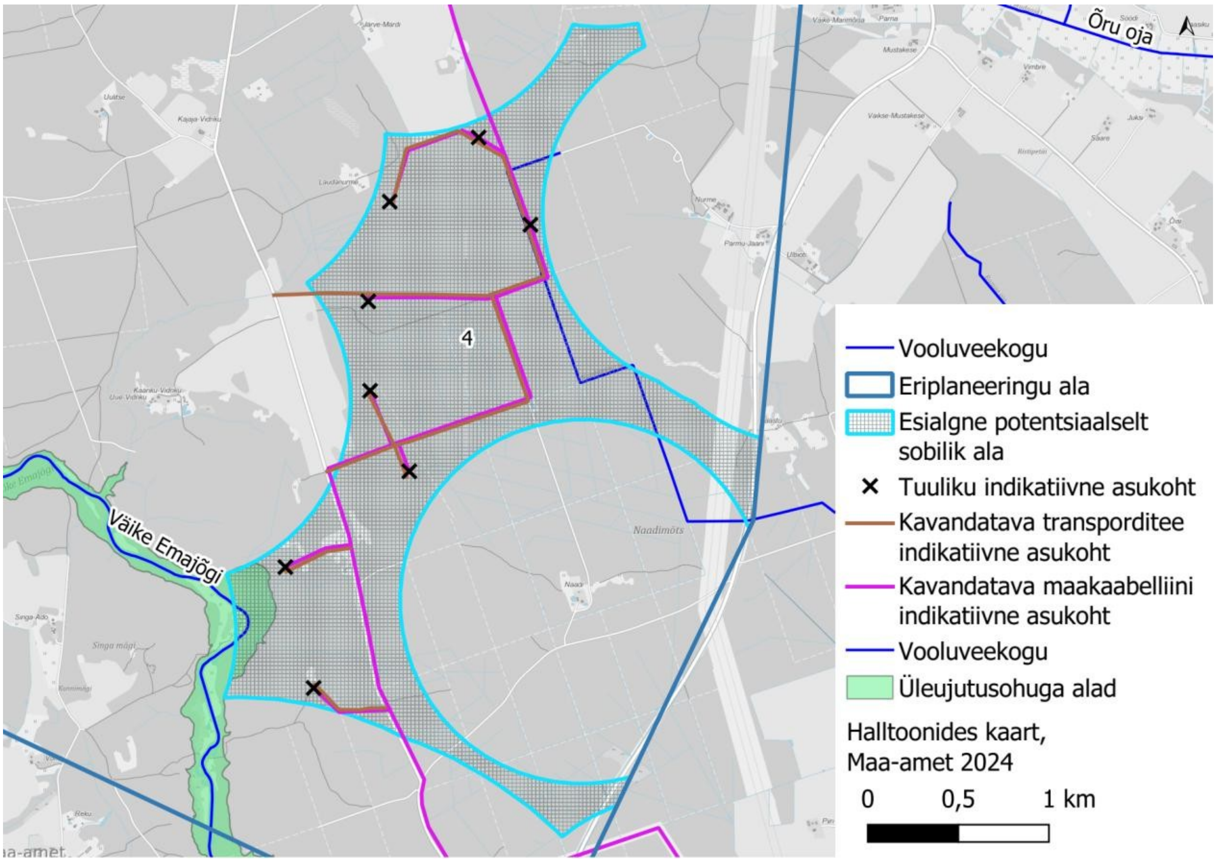

Figure 52. Location of flood-prone areas in potentially suitable area 4 and its vicinity.

In the further design of wind farms in potentially suitable areas 3 and 4, the risk of flooding must be taken into account and appropriate measures must be implemented in the design of wind farm infrastructure to ensure access to wind turbines even in flood conditions and the stability of roads. In the developed planning solution, the risk of flooding has been taken into account when determining the location of the wind turbines, and the locations of the wind turbines have been planned outside the flood risk area.

4.2.4 Measures, need for further studies and assessment

Measures for planning the wind farm:

- A reduction in carbon sequestration due to land use change would occur primarily if wind farms were built on areas with protective soil. An effective measure to reduce this impact would be to avoid building wind farms on wetlands. In the further design of the wind farm, attention must also be paid to ensuring that the construction of the wind farm does not result in the drainage of wetlands in the surrounding areas.
- To reduce emissions from deforestation, as many wind turbines as possible should be located in open areas of wind farm sites. Due to conflicting conditions (it is necessary to preserve semi-natural communities, valuable agricultural land and wetlands, and to ensure adequate distances between wind turbines and infrastructure), it is not always possible to avoid deforestation. However, efforts should be made to avoid deforestation by using underground cables instead of overhead lines for electrical connections and, where possible, by using existing roads and route corridors. When planning assembly sites, preference should be given to solutions that require less deforestation.
- The national regulation on offsetting greenhouse gas emissions associated with land use change must be complied with.
- In the further design of wind farms in potentially suitable areas 3 and 4, the risk of flooding must be taken into account and appropriate measures must be implemented in the design of the wind farm infrastructure to ensure access to the wind turbines even in flood conditions and the stability of the roads. It is recommended not to plan wind turbines and infrastructure in areas at risk of flooding.
- This SEA considers the distance of 1.5× (tower height + rotor diameter) from the wind turbine to be the danger zone for ice throw, which is the maximum extent of the hazard. As the danger zone has been determined in general terms, the wind farm owner may reduce the extent of the danger zone on the basis of a more precise risk assessment. In order to reduce the risks associated with icing, it is recommended to use an anti-icing system on wind turbines located in the danger zone of roads. If this is not done, instructions for action in the event of icing must be drawn up for the wind farm and compliance with them must be ensured. In the event of a risk of icing, it may be necessary to temporarily close roads within the danger zone and/or mark them with appropriate warning signs.

4.3 Potential impact on cultural heritage

4.3.1 Assessment methodology

The impact on cultural values was assessed on the basis of databases containing information on cultural heritage (the Register of Cultural Monuments, the EELIS database of heritage sites, and data on archaeologically sensitive areas compiled by the National Heritage Board). The aim of the assessment was to identify areas of potential cultural heritage significance in potentially suitable areas, the preservation of which would prevent significant adverse effects on cultural heritage.

4.3.2 Location and impact of cultural values

There are no cultural monuments in the potentially suitable areas, so **it is unlikely that** they **will be** directly **affected. Indirect impact may occur through changes in views. The visual impact is discussed in section 4.6.4. The location of cultural monuments has been taken into account.**

There are no inventoried natural sacred sites in potentially suitable areas. **Therefore, an impact on them is ruled out.**

There are heritage culture objects [136]in potentially suitable areas 1, 3 and 4 . Only potentially suitable area 2 does not have any heritage culture objects. Heritage culture is one form of cultural heritage, which refers to man-made cultural heritage objects in the landscape. Heritage culture objects are not protected, but as they are part of cultural heritage, it is advisable to preserve them and restore them where possible. The overlap of potentially suitable areas with heritage culture objects is presented in Table 16 and Figure 53. The condition (preservation) of heritage culture objects and their resulting value vary greatly among objects located in potentially suitable areas. The establishment of a wind farm may have an adverse impact on heritage cultural objects if the construction areas are planned in such a way that the objects are destroyed.

Potentially suitable areas do not overlap with archaeologically sensitive areas. The planned roads and cable corridors in the developed planning solution do not pass through the archaeologically sensitive areas mapped by the National Heritage Board in the region (based on the map layer submitted by the National Heritage Board to the Valga Municipal Government for the preparation of the comprehensive plan).

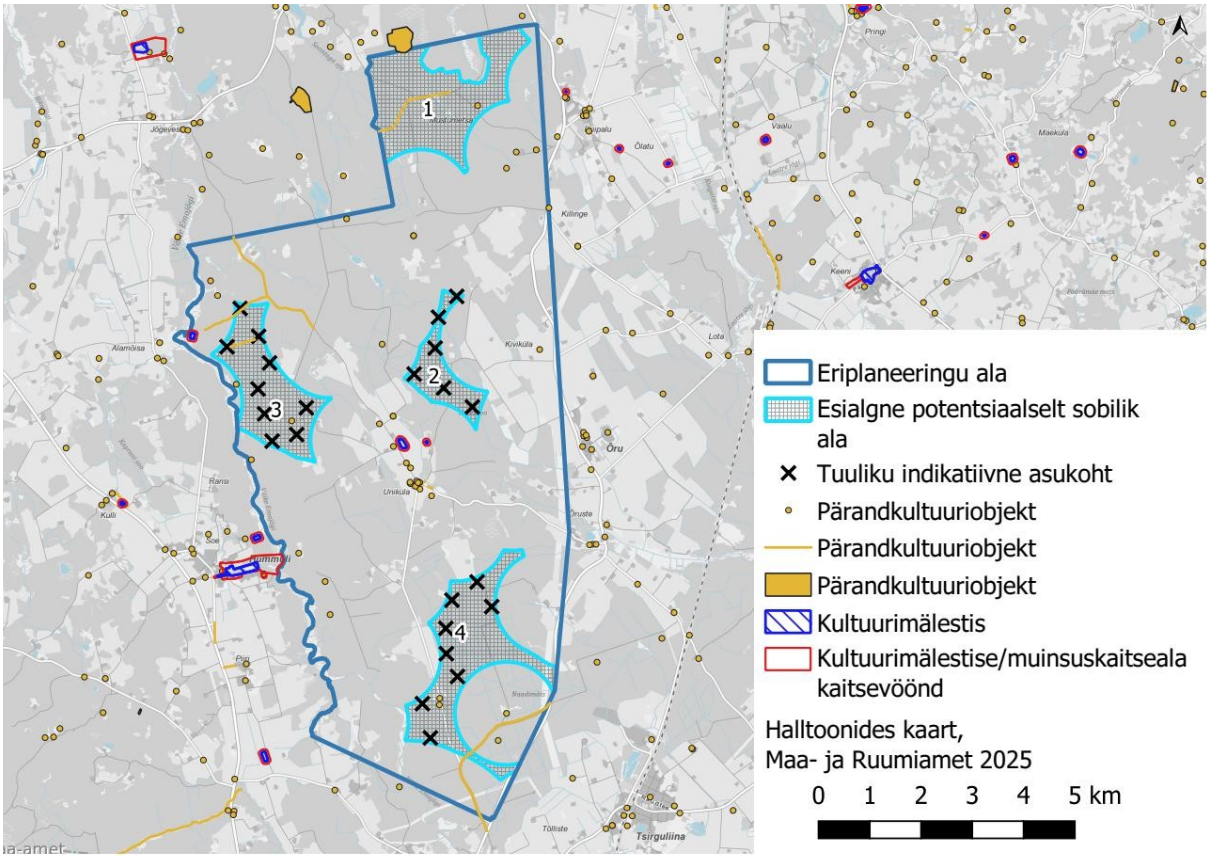

Figure 53. Overlap of potentially suitable areas within the special plan area with cultural values.

In the case of areas where the locations of wind turbines have been developed in principle during the preparation of the special plan, the location of the wind turbines is not planned to be in the locations of well or very well preserved heritage culture objects. Therefore, the planned activity is not expected to significantly damage cultural heritage values.

[136] EELIS (Estonian Nature Information System), Environmental Agency data as of 17 September 2024.

Table 16. Heritage culture objects located in potentially suitable areas. EELIS data as of 26 September 2024.

Name	Code	Type	Status	Comments based on EELIS database information presented in the
Potentially suitable area 1				
Peat pits	608:TVK:001	Peat extraction sites	About the object or its its functionality	
Mustumetsa forest guard station	943:VKK:004	Guard cordons	About the site or its 20–50% of its original functionality	Ernst Kipper, the current forest guard in Konno, has been appointed forest guard for the Mustumetsa guard station in the Aakre forest district, as the previous forest guard, Küla , has retired due to old age retired.
Forest railway	943:RTR:001	Railway structures	Type can be determined, less than 20% of the object or its original functionality has been preserved less than 20%	
Potentially suitable area 3				
Sõgelsepa forest road	943:MET:001	Native forest roads, footpaths, horse trails	Object well or very well preserved	This road was used to reach the church in Sõgelsepa church in Sõgelsepa
Sõgelsepa border post	943:MEK:001	Traces of older forest management Traces	Object well or very well preserved	
Uniküla rocket base	943:OKU:002	Objects from the occupation period	About the object or its 50–90% of its original functionality preserved	Concrete road with a guardhouse at the end. The hangars of the missile base have been demolished. During the Soviet era, they housed strategic medium-range missiles, which carried nuclear warheads (see **table below for details**).
Potentially suitable area 4				
Tõlliste municipal building	820:VAL:002	Town halls	Signs have been preserved in the landscape, but allow for a clear determination of the type	
Magasiait	820:MAG:001	Magasiaidad	Object or its original functionality	
Old Tartu-Valga road	820:MNT:002	Highways	From or its original functionality	

Area 3 contains the former Uniküla missile base. In the 1960s, eight missile bases with above-ground launch complexes were established in Estonia: Piirsalu, Lintsi, Rohu, Kadila, **Uniküla,** Rooni, Nursi and Sänna, as well as one with underground launch silos armed with R-12U missiles, located in Vilaskis. Each base could hold up to
four rockets. By the 1980s, the missile system had become obsolete. Most of the R-12 missile bases located in Estonia were dismantled in the late 1970s and early 1980s, including the Uniküla base [137]. The rockets were taken away when the base was dismantled. Today, only a few ruins of the former buildings, platforms and roads of the missile base remain in Uniküla. All military equipment related to former military activities has been dismantled. There is no radiation hazard in the area.

4.3.3 Measures, need for further research and assessment

Well-preserved and very well-preserved heritage sites must be preserved in the further planning of the wind farm. It is recommended that heritage sites be restored, marked and made accessible to the public.

4.4 Restrictions arising from infrastructure and land use

4.4.1 Roads and traffic safety

Access roads **with high load-bearing capacity and constant access** are necessary for the construction and subsequent maintenance of wind turbines. When using existing roads, they will be repaired before the work is carried out and again after the work is completed. Based on current practice, the use of roads in the wind farm is not restricted, so the roads to be built will also remain in local use (restrictions due to safety requirements on roads within the wind farm are possible, see 4.2.4). However, it should be noted that during the construction of the wind farm, there may be disruptions related to the use of local roads, as the transport of materials, including heavy loads, will cause additional traffic and possible changes in traffic management. **The impact on the local road network and welfare during construction is therefore moderately negative. The impact occurs in all potentially suitable areas. The exact magnitude of the impact depends on the traffic management during construction.**

[137] https://db.esap.ee/object/va-0740

The biggest challenge in establishing a wind farm in relation to roads is the delivery of wind turbine components. Wind turbines are not currently manufactured in Estonia and are mainly delivered to Estonia via the specially adapted port of Paldiski. Therefore, it is necessary to transport the wind turbine components from the Port of Paldiski to the selected locations. The distance is approximately 250 km by the most direct route and involves heavy goods transport. According to information published by the Transport Agency (Figure 55), the existing special transport corridors for the special planning area extend to road no. 3 Jõhvi–Tartu–Valga. Alternatively, it is possible that the wind turbines will be transported via Latvia.

The roads from the special transport routes to the potentially suitable areas will probably need to be rebuilt for transport, which may include straightening curves and widening roads.

Figure 55. Location of special transport corridors.

The Transport Agency has presented its position in various planning procedures, according to which the planning of wind turbines and wind farms must take into account that wind turbines must not be located closer than 1.5×(H+D) to publicly accessible roads (regardless of their function, type, class and permitted speed) than 1.5×(H+D) (where H = the height of the turbine mast and D = the diameter of the rotor blade). In the case of publicly accessible roads with low traffic (less than 100 vehicles per day), wind turbines may, in justified cases, be permitted to be located closer to the road in the plan, based on a risk analysis and with the consent of the road owner, but not closer than the total height of the wind turbine (H+0.5D). The distance requirement is primarily due to the risk of ice fragments being thrown from the blades of the wind turbines in the event of icy conditions (see section 4.2). From 17 November 2023, the distance of wind turbines from roads will be determined by Regulation No. 71 of the Minister of Climate, 'Road Design Standards'. The minimum distance of an electric wind turbine from the edge of the road surface is determined by the formula L = (H + 0.5D), where:

1) L is the minimum distance of the wind turbine from the edge of the road surface in metres;
2) H is the height of the wind turbine mast in metres;
3) D is the diameter of the wind turbine rotor or blade in metres.

The reason for the distance restriction is primarily **the risk** of wind turbines **icing up** in the Estonian climate**, but the distance also helps to reduce the shadowing of roads by wind turbines and to ensure road safety in the event of possible accidents.** The risk of icing and measures to prevent it are discussed in section 4.2.

No significant increase in the risk of traffic accidents has been observed due to wind turbines visible from the road[138]. There are also several wind farms in Estonia located in the immediate vicinity of roads, and traffic accident statistics show no higher than average frequency of traffic accidents in these areas.

4.4.1.1 Measures, need for further research and assessment

Based on the technical requirements of the selected wind turbine, a more detailed analysis of possible access roads must be prepared when drawing up the wind farm project. This requires cooperation with road owners, including the Transport Administration. If necessary, the necessary intersection reconstructions and road widening must be carried out and traffic management measures must be implemented to ensure the safe delivery of wind turbines.

With regard to public roads, the distance restrictions specified in Regulation No. 71 of the Minister of Climate, "Road Design Standards", must be observed.

4.4.2 Mineral resources

Potentially suitable areas overlap with the following mineral resources registered in the mineral resources register[139]as of 26 September 2024 deposits but do notcover the 27 December 2016 No. No. 87 ‘List of peatlands damaged and abandoned by mining and peatlands suitable for mining’ (hereinafter referred to as *Regulation No 87 of the Minister of the Environment*) as suitable for mining.

Potentially suitable areas do not overlap with active or proposed

research areas in their vicinity.

No conflicts with the preservation of mineral resources were identified in this specific plan, and there is no need to plan measures.

4.4.3 Other restrictions and impacts

4.4.3.1 Impact on national defence objects

The determination of potentially suitable areas was based on known information about the location of national defence structures and their restricted areas. The extent of the restricted areas has been treated as areas excluded from the location of the wind farm.

The construction of a wind farm is only possible on condition that it does not affect national defence. The special planning area falls entirely within the sector published by the Ministry of Defence, which includes the compensation area for mainland Estonia from 2025. Preliminary work on the construction of the wind farm can begin before the implementation of the aforementioned compensation measures in 2025. The Ministry of Defence's coordination letter No. 12-1/24/466-2 of 09.12.2024 stipulates that the erection of wind turbines in the pre-selection areas TU2, TU3 and TU4 is permitted after the full implementation of the compensation measures for mainland Estonia.

The location/coordinates of each specific wind turbine must be coordinated with the Ministry of Defence. If the Ministry of Defence deems the location unsuitable for the erection of a wind turbine, the location restriction will remain in force even after the implementation of the compensation measures. If the Ministry of Defence considers the proposed location suitable for the construction of a wind turbine, the national defence height restriction at that location will be lifted after the implementation of the compensation measures. All applications for building permits for wind turbines must be coordinated with the Ministry of Defence.

The area used by the Defence League for explosions is known to be located within the special planning area. The State Defence Investment Agency has announced in the planning procedure[140] that, in accordance with the agreement

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[138] De Ceunynck, T., Pauw, E., Daniels, S., Polders, E., Brijs, T., Hermans, E., Wets, G. 2017. The effect of wind turbines alongside motorways on drivers' behaviour. European Journal of Transport and Infrastructure Research.

17. 477-494. 10.18757/ejtir.2017.17.4.3210.

[139] https://geoportaal.maaamet.ee/est/Ruumiandmed/Geoloogilised-andmed/Maavarade-register-p83.html

[140] 12.02.2025 9-1.3/4816-21

The owner of the immovable property will cease to use the land for demolition training by 2028 at the latest, and the current use will not affect the implementation of the plan in the future, therefore it is not necessary to address this in the special plan.

4.4.3.2 Impact on mobile, radio and television signals

Wind turbines are associated with interference with mobile, radio and television signals. Wind turbines can potentially interfere with electromagnetic waves used in telecommunications, navigation, radar systems, etc.

The occurrence and significance of interference depends on:

- the location of the wind turbine in relation to the transmitter and receiver;
- the characteristics of the wind turbine blades;
- the characteristics of the receiver;
- signal frequencies.

Interference can be caused by the wind turbine tower, rotating blades and generator. The tower and blades can block, reflect or refract electromagnetic waves. The blades of modern wind turbines are generally made of fibreglass, which has a minimal effect on electromagnetic wave radiation. Similarly, the generators of modern wind turbines no longer cause significant interference. Interference may therefore occur in cases where wind turbines are located directly between the transmitter and receiver, and the problem may be significant if the wind turbine is close to the receiver. In this case, the wind turbines are planned *to be located at* least *1* km away from the receivers (residential buildings).

Onshore wind farms are not considered a potential threat to the functioning of maritime navigation systems, but they may have an impact on aviation safety and the operation of weather radars.

The nearest meteorological radars to the planned activity area are the radar operated by the Estonian Environment Agency in Sürgavere and the radar of the Latvian Environment, Geology and Meteorology Centre, which is located on the territory of Riga Airport ([141]) . The World Meteorological Organisation (WMO) and the European Meteorological Services Network (EUMETNET) recommend maintaining certain distances from weather radars, where the construction of wind farms should be avoided (up to 5 km for C-band radars and 10 km for S-band radars) or to coordinate with the radar owner (up to 20 km for C-band radars and 30 km for S-band radars)([142]) .However, some studies suggest that the 20 km limit for C-band radars should be increased, as the impact can be observed at greater distances([143]) .The two radars in Estonia and Latvia are located more than 100 km from the planned wind farm. Given the distance of the weather radars from the planned wind farm, the planned turbines are not expected to significantly affect the performance of the radars.

The European Organisation for the Safety of Air Navigation (EUROCONTROL), taking into account the International Civil Aviation Organisation (ICAO) guidelines for regulating construction in restricted areas of air navigation facilities related to air traffic management, has developed guidelines for air navigation service providers and wind farm developers on the need to assess the impact of wind turbines on navigation systems and the procedures to be followed ([144]) . The guidelines define air traffic

[141] https://www.eumetnet.eu/wp-content/themes/aeron-child/observations-programme/current-activi-ties/opera/database/OPERA_Database/index.html

[142] Finnish Meteorological Institute, EUMETNET OPERA PROGRAMME (2004–2006) – Operational programme for the exchange of weather radar information, Final report, 2007

[143] VINDRAD. Project report v1.0, A tool for calculation of interference from wind power stations to weather radars, 2011

[144] European guidance material on managing building restricted areas: 3rd edition, International Civil Aviation Organisation, 2015

Extent of zones near surveillance radars where the impact of wind turbines should be assessed. The extent of the zones may be up to 15 km from the radar. In the case of this wind farm, there are no air traffic control radars at such a distance. Nor are there any airfields at such a distance whose instrument systems would be relevant for assessing the impact.

The impact on national defence is discussed in section 4.4.3.1 and is largely related to the impact on the operational capability of national defence radars. National defence radars in Estonia are located in Kellavere, Levalõpme and Otepää. The competent authority in Estonia for providing relevant assessments on this issue is the Ministry of Defence, to which the plan will also be submitted for coordination.

The Latvian armed forces use radars in Čalase (approximately 270 km from the planned area of operation), Lielvārde (approximately 150 km from the area of operation) and Audriņi (approximately 160 km from the area of operation) for airspace surveillance [145]. Given the considerable distance, it can be assumed that the planned wind farm will not affect Latvian airspace surveillance functions. Latvia will be involved in the planning process on the basis of the possible cross-border impact, and the competent Latvian authorities will have the opportunity to submit their own assessment on this issue.

Mobile and radio communications: Wind turbines are large structures and, like large buildings, they can create so-called dead zones in mobile communications. Therefore, when placing wind turbines, the direction in which the wind turbine is located from the mobile communications base station should also be taken into account in order to eliminate possible dead zones. In general, wind farms do not have a significant impact on mobile coverage unless the wind turbine is located in the immediate vicinity of a mobile mast (closer than 500 m). In this case, the wind turbines are not located in the immediate vicinity of any known mobile base stations.

There are several communication masts in the area of potentially suitable sites (Figure 56). In order to assess the impact of wind turbines on the operation of communication masts, it is necessary to cooperate with communication companies when preparing the plan.

[145] https://en.wikipedia.org/wiki/Baltic_Air_Surveillance_Network

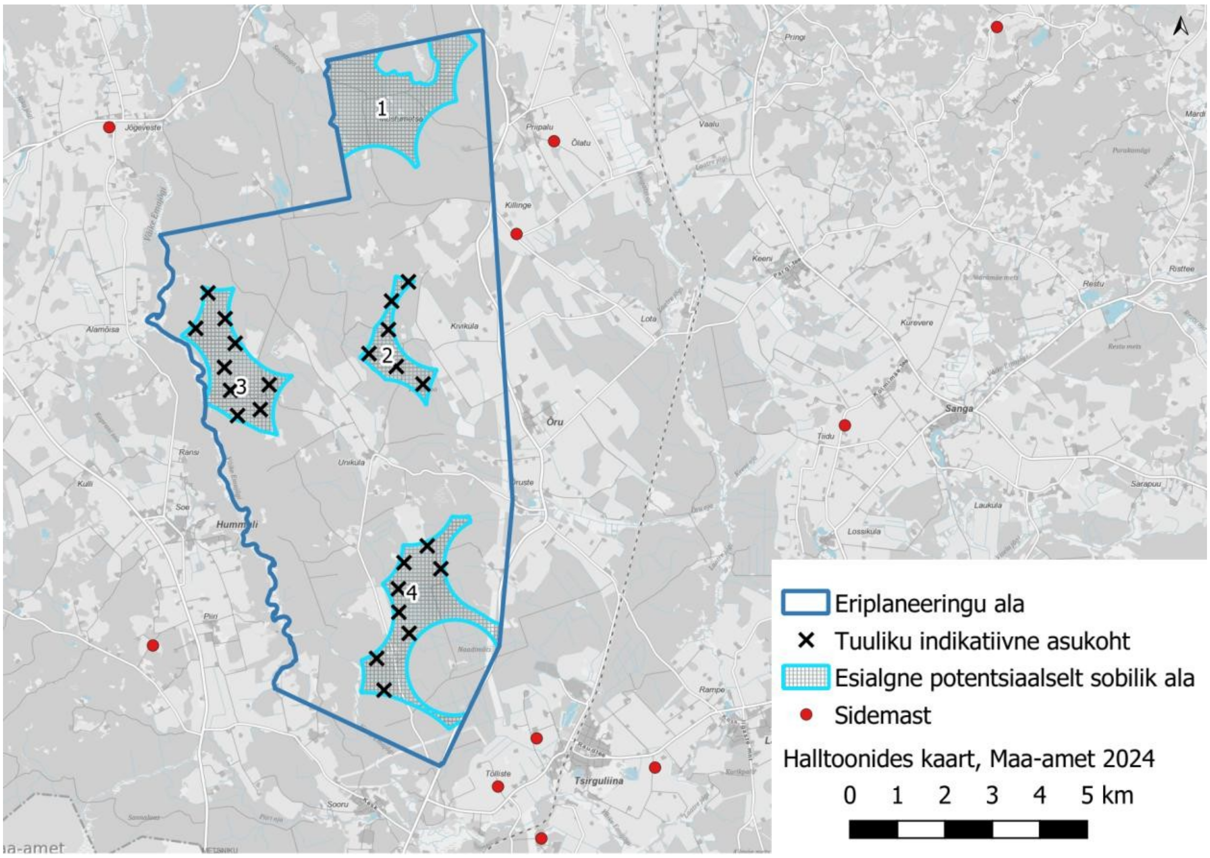

Figure 56. Location of communication masts in relation to potentially suitable areas in the special plan area based on ETAK data as of 29 July 2024.

Unlike mobile communications, the operation of wind turbines can have a significant impact on radio communications. **In order to clarify the significance of the interference and, if necessary, find mitigation measures, cooperation with the authorities responsible for radio communications is required when preparing the plan.**

Impact on television images: In the case of analogue television, the impact of electromagnetic waves on TV signals was a significant factor. The impact mainly consisted of distortions in the TV picture (e.g. flickering in sync with the rotation of the wind turbine blades)([146] (,[147] .In the case of digital and satellite TV, the impact has been found to be negligible.

4.4.3.3 Measures, need for further research and assessment

When drawing up the plan, cooperation is required with the Ministry of Defence, the Transport Administration, the Information Technology and Development Centre of the Ministry of the Interior, the Consumer Protection and Technical Regulatory Authority, and communications network operators in order to clarify the possible effects of the construction of the wind farm on radars and communications services (especially radio communications).

Although communication quality issues are not directly related to environmental impacts, measures should be taken to improve signal quality after the construction of the wind farm if the operation of the wind turbines causes a decline in communication quality. The necessary technical solutions should be determined on a case-by-case basis.

[146] Sengupta, D.l., Senior, T.b.a. 1994. Electromagnetic interference from wind turbines. Wind Turbine Technology. ASME, New York.

[147] Anguloa, I., de la Vega, D., Cascón, I., Cañizo, J., Wu, Y., Guerra, D., Angueira, P. 2014. Impact analysis of wind farms on telecommunication services. Renewable and Sustainable Energy Reviews. Volume 32, April 2014, pages 84-99.

4.5 Waste generation

The waste generated during the construction phase of a wind farm and its management is similar to normal construction waste management. If appropriate measures are taken (correct collection and removal of waste, etc.), the waste is unlikely to have a significant impact on the environment.

The operation of the wind farm will also generate waste, such as various consumables, waste oil, etc. Waste management must comply with the applicable waste legislation. If waste management is organised in accordance with the law, no significant environmental impact is expected.

The service life of wind turbines is 20–30 years. After that, the turbines may be replaced with new ones or the farm may be decommissioned. In both cases, the decommissioning of wind turbines generates waste in the form of metal and (glass) plastic from the foundation and turbine components. Modern wind turbines are relatively easy to dismantle and most of their components are reusable or recyclable (approximately 85% of modern wind turbines). It is somewhat more complicated to dismantle and reuse concrete foundations, but this is also feasible. The biggest problem in terms of waste is the disposal of wind turbine blades. On a small scale, it is possible to recycle blades to produce accessories for outdoor use, such as street furniture, playgrounds, outdoor gyms, etc.([148]) .As the material of wind turbines is exceptionally resistant to weather conditions, there are many possibilities for its reuse. Another option is to mechanically and chemically reprocess wind turbines. During the crushing of wind turbine blades, glass fibres and fine fractions are separated, which can be used as composite fillers. For example, wind turbine blades can be used to make glass fibre pellets and materials needed for cement production ([149]). It is also possible to separate the polymers in wind turbines by chemically dissolving them, but this process consumes a great deal of energy. These polymers can be used in various products, such as insulation materials or boot soles, but the technology is still under development ([150]) .The largest wind turbine manufacturers are also actively engaged in the development of wind turbines that are up to 100% recyclable ([151]) .

The blades of electric wind turbines are made of composite materials and consist of approximately 70% glass fibre and 30% heat-resistant plastic [152,153] .

The approximate composition of a wind turbine in terms of mass percentage is shown in the figure below.

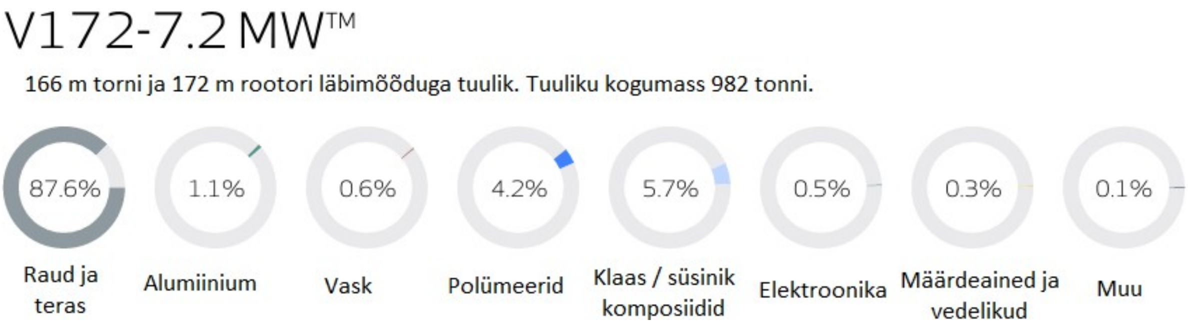

Figure 57. Wind turbine components (without foundation). Source: https://www.vestas.com/en

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148 https://www.superuse-studios.com/projectplus/blade-made/
149 Jensenab, J.P., Skeltonab, K. 2018. Wind turbine blade recycling: Experiences, challenges and possibilities in a circular economy. Renewable and Sustainable Energy Reviews. Volume 97, December 2018, Pages 165-176.
150 https://www.vestas.com/en/media/company-news/2023/vestas-unveils-circularity-solution-to-end-landfill-for-c3710818
151 Clean Energy Brief. 2020. Vestas to produce zero-waste wind turbines by 2040. GO ECO GREEN21.
152 Cooperman et al., (2021), Wind turbine blade material in the United States: Quantities, costs, and end-of-life options, https://www.sciencedirect.com/science/article/abs/pii/S092134492100046X?via%3Dihub
153 Svensk Vindenergi (2021), Vindkraften är Sustainable – economically, ecological, social,https://svenskvindenergi.org/wp-content/uploads/2021/05/Vindkraften-ar-hallbar-ett-faktablad-fran-Svensk-Vindenergi.pdf

No waste volumes that could cause significant environmental impact are expected during the construction and operation of the wind farm. The possibility of recycling waste generated at the end of the wind farm's life will be determined at the appropriate time based on the best available knowledge. The wind farm can be decommissioned on the basis of a demolition project, which also addresses waste quantities and management. Considering the long-term goals of the circular economy, maximum reuse of the wind farm's materials must be ensured at the end of its life.

Wind turbines (regardless of the model chosen) are technological devices that must comply with the requirements in force at a given time and are approved for use in the European Union and, therefore, in Estonia. Therefore, the materials used in wind turbines are not regulated by planning, but by regulations applicable to equipment, which are predominantly pan-European (e.g. the use of SF6, bisphenol A and other chemicals is regulated at the level of substance use, not at the planning level).

Considering the worst-case scenario, where, despite the increasingly established principles of the circular economy and the development of wind turbine blade processing options, the blades of the wind turbines to be built will prove to be unusable at the end of their life cycle, 23 wind turbines would generate 23x10%*982t≈2260 tonnes of waste, and the reduced planning solution with 18 wind turbines would generate 18*x10%*982t≈1768 tonnes. This would be a one-off waste generation. In the context of Valga Municipality, this is a significant amount of waste (for comparison, in 2023, 41,017 tonnes of waste were generated in Valga Municipality), and finding a way to reuse the blades would significantly reduce the need for landfill and the negative impact associated with it.

However, compared to the current waste generation in the Estonian energy sector, this is a relatively modest amount of waste. In 2023, oil shale power plants generated a total of 5,880,796 tonnes of semi-coke, bottom ash and fly ash, of which 5,749,433 tonnes were landfilled. In total, 5,974,559 tonnes of waste were landfilled in Estonia in 2023, with 96% of the landfilled waste coming from oil shale-based electricity production. Therefore, assuming that the construction of a wind farm will help reduce the need for oil shale-based electricity, it can be expected that even if it becomes necessary to landfill wind turbine blades at the end of the wind farm's life, this will reduce the amount of waste generated by electricity production in Estonia.

A newer issue that has been raised in relation to waste generation and wind turbine planning is the possible formation of microplastics [154]during operation. Microplastics can be defined as all water-insoluble plastic particles smaller than 5 mm ([155]).The possible generation of microplastics and their release into the environment is associated with wind turbine blades, which are mainly made of fibreglass and wear down due to precipitation and wind when operating outdoors. There is still little research in this area (as with microplastics in general), but studies to date suggest that wind farms are not significant sources of microplastics. Studies in this field have so far found that microplastics are present in wind farm areas, but their composition is not characteristic of the material used in wind turbine blades. Nor has it been observed that the concentration of microplastics in wind farm areas is higher than in surrounding areas([156]). At the same time, it is clear that wind turbines undergo a certain amount of wear and tear due to precipitation and wind erosion, and, as with other plastics used in human activities, some of the plastic in wind turbines ends up in the natural environment. The blades of wind turbines, which consist exclusively of fibreglass, epoxy resin and, in some cases, carbon fibre, are the part of the wind turbine that is most exposed to wear and tear. According to current knowledge, various studies have found that between 3 g and 14 kg of material, mainly paint covering the blades, is "sanded off" from wind turbine blades each year. More recent studies on this topic have found that the amount of plastic worn away is 240 g per wind turbine per year (the study looked at wind turbines with 117 m long blades, which are significantly larger than those in Valga

[154] For more information on microplastics, see https://kliimaministeerium.ee/elukeskkond-ringmajandus/poliitika-ja-seadusandlus/plastid-ja-plastijaatmed#mikroplast

[155] Frias, J.P.G.L., Nash, R. 2019. Microplastics: Finding a consensus on the definition, Marine Pollution Bulletin, Volume 138, Pages 145-147.

[156] Teng. W., Xinqing, Z., Baojie, L., Yao, Y., Li, J., Hejiu, H., Yu, W., Chenglong, W. 2018. Microplastics in a wind farm area: A case study at the Rudong Offshore Wind Farm, Yellow Sea, China. Marine Pollution Bulletin. 128. 10.1016/j.marpolbul.2018.01.050.

planned with special planning)[157] . Annually, this would mean up to 5.5 kg of microplastics generated by a wind farm with 23 wind turbines (up to 4.3 kg with 18 wind turbines). Wind farms are not considered to be a significant source of microplastics. Significant sources of microplastics are sources that are more characteristic of everyday human activity, such as paints, tyres, textiles, washing capsules, etc. The European Union is actively working to reduce the generation of microplastics by regulating the intentional addition of microplastics to everyday products([158]) .

Microplastics worn off wind turbine blades due to weather conditions may also contain small amounts of chemicals found in the epoxy adhesive used in the blades, including bisphenol A and epichlorohydrin. Studies to date do not consider such emissions to have a significant impact. It should be noted that the surface of a wind turbine blade is primarily made up of paint. The epoxy adhesive layers are located under the paint layers and wear minimally during the lifetime of the wind turbine ([159]) ([,160]) .

4.5.1 Measures, need for further research and assessment

When planning a wind farm, the following must be taken into account:

- − appropriate waste prevention measures must be implemented during the construction, operation and decommissioning of the wind farm, and care must be taken to ensure that the waste generated does not pose an excessive risk to health, property or the environment. The waste generated must be collected separately in containers that are suitable for the type of waste and resistant to its physical and chemical properties. When collecting waste in piles, preference should be given to hard surfaces or, if necessary, the ground and/or waste should be covered with a weatherproof and leak-proof cover to prevent pollutants from entering the environment as a result of waste or leaching and spreading with the wind.
- Long-term storage of waste at the place of generation should be avoided and the waste generated should be transferred to an authorised waste handler for treatment at the earliest opportunity. When selecting a waste handler, it is advisable to apply the principle of proximity in order to reduce the negative impact of waste transport on the environment.
- − When developing waste prevention and waste management measures and handling waste, the waste hierarchy should be followed in order of priority. Waste that can be recycled or reused should be sent for treatment accordingly. When directing waste for reuse, recycling should be given priority.
- Waste that is suitable and permitted for reuse at the place of generation should be reused on site as much as possible. The reuse of waste at the place of generation should be guided by the requirements set out in the relevant legislation.
- − In order to reduce the likelihood of emergency situations, continuous monitoring of waste management must be implemented and, in the event of pollution, its appropriate and rapid elimination must be ensured.
- − At the end of the wind farm's life, the owner of the wind farm is obliged to reconstruct or dismantle the wind farm. In the case of dismantling, this must be carried out in accordance with the dismantling project, including the proper handling of all waste generated during dismantling.

[157]Caboni, M., Schwarz, A. E., Slot, H., and van der Mijle Meijer, H.: Estimating microplastics emissions from offshore wind turbine blades in the Dutch North Sea, Wind Energ. Sci. Discuss. [preprint], https://doi.org/10.5194/wes-2024-175, in review, 2024.

[158] Further information microplastics restrictions can be found https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4581

[159] Epoxy Resin Committee. 2015. EPOXY RESINS IN WIND ENERGY APPLICATIONS ASSESSMENT OF POTENTIAL BPA EMISSIONS. www.epoxy-europe.eu

[160] Norwea. 2021. Klare faktafeil fra motvind om vindkraftsforurensning https://www.fornybarnorge.no/

4.6 Impact on human health, well-being and property

The impact on human health, well-being and property can potentially be caused by wind turbines, so in order to assess this, it is necessary to know the parameters and locations of the wind turbines. The initial selection of potentially suitable areas has been made on the principle that the areas should be located at least 1 km away from residential buildings, unless an agreement has been reached with the owner of the residential building to locate the wind turbines closer. Due to aspects related to the natural environment, infrastructure, land use and cultural heritage, proposals for narrowing down the potentially suitable areas are presented in sections 4.1-4.4 of this SEA report. Based on these proposals, the planning of a wind farm in area TU1 has been abandoned and the areas in other areas have been narrowed down. Based on the known areas with adverse effects, a solution for the potential location of wind turbines has been prepared for the potentially suitable areas. The following assessment of the impact on human health, well-being and property is based on the developed wind turbine locations in the areas. The initial wind turbine location solution was prepared for 27 wind turbines, but the number of wind turbines was reduced to 23 based on the feedback from the visual impact assessment workshop held in Tsirguliina on 25 July 2024 (see section 4.7.1). Preliminary noise modelling was prepared for the 27-turbine layout during the work process, but this is not presented in the SEA report, as it is clearly a worse solution in terms of noise generation than the 23-turbine solution.

With regard to the computational assessment of noise and shadowing, guidance material[161]was prepared in the first quarter of 2025 at the request of the Ministry of Climate. The draft SEA report was prepared before the guidance material was completed, and therefore there were differences in the assessment methodology. During the planning process, it was decided to bring the impact assessments in this area into line with the guidelines. As the number of wind turbines in the planning solution had been reduced to 18 for nature conservation reasons by the time the assessment was updated (August 2025), noise and shadow modelling was carried out for the planning solution with 18 wind turbines when updating this chapter. Methodologically, the previous modelling with 23 wind turbines was not updated, and as the assessments were made on different methodological bases, the SEA report did not present the previous modelling results for comparison with the updated estimates. As of August 2025, the information on residential buildings located within a 2 km radius of the planned wind turbines was also updated based on ETAK data (ETAK type 10 buildings enriched with building register data as of 07.08.2025), Residential and public buildings located within a 2 km radius of the wind turbines were identified as receptors.

4.6.1 Noise

Noise is an unpleasant or disturbing sound or other sound that is harmful to human health and well-being, and one of the most common and significant factors reducing the quality of the living environment. Noise affects health and well-being in many ways – it can disturb or hinder work, communication and rest, cause permanent damage to the ear and hearing loss, cause stress or various functional disorders.

Most people find a constant noise level of 55–60 dB in their everyday living environment disturbing, with traffic often being the main source of noise. Although this level of noise does not directly damage the body, it can cause concentration difficulties and low mood, as well as sleep disturbances at night, as it is difficult to fall asleep with the window open. A constant noise level of 60 dB can interfere with activities such as thinking, communicating and concentrating. At 70 dB, it becomes more difficult to understand others, and constant exposure to noise levels above 75 dB increases residents' complaints and the risk of health problems. Noise levels above 85 dB are considered harmful to health if they last for a long time, for example 8 hours. Noise levels of 130–140 dB can be dangerous to hearing. In general, an increase in noise level of 10 dB is perceived as a doubling of the noise level.

Studies of disturbances associated with different sources of environmental noise (e.g. comparing traffic noise and wind turbine noise) have found that although wind turbines are perceived as a disturbance at relatively low noise levels

[161] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.

(e.g. 35-40 dB)[162] . From a health perspective, broad-based studies on wind turbine noise have not found a direct link to chronic diseases, and the main impact may be in the form of disturbance[163] .

Noise disturbance caused by wind turbines has been studied in various countries (e.g. the USA, Germany, Finland and Sweden), and it has been found that even at noise levels of 35–40 dB (and even lower), a significant proportion of the population (up to 15–25%) may feel disturbed. Residents also associate their health problems with wind turbines ([164]) (,) ([165]) (,) ([166]) . At the same time, studies indicate that at low noise levels, disturbance is often associated with other factors, such as the visual impact of wind turbines, general attitudes towards wind turbines, involvement in the planning process, etc. This explains why even very low noise levels (25–30 dB) cause disturbance to some members of the population. Similar disturbance occurs with other sources of noise, such as traffic or industrial noise, even when noise levels remain within the norm.

4.6.1.1 Assessment methodology

This draft SEA was completed before the Ministry of Climate completed its new guidelines for assessing the impact of wind farms. As the SEA sought to use the best available information, the section on noise assessment was updated in August 2025 based on **the methodology presented in the guidelines prepared by the Ministry of Climate(**[167]) .

Noise in the outdoor air is regulated by the Atmospheric Air Protection Act, and noise standards are regulated by Regulation No. 71 of 16 December 2016, established on the basis of § 56(4) of the same Act
Section 56(4) of the same Act, Regulation No. 71 of 16 December 2016, 'Outdoor noise standards and methods for measuring, determining and assessing noise levels'.

The target noise level is the maximum permissible noise level in areas subject to new planning. A new planning area within the meaning of Regulation No. 71 is a new noise-sensitive area outside a densely populated area or a compact built-up area that is not yet built up.

The noise limit value is the maximum permissible noise level, the exceeding of which causes significant environmental disturbance and requires the implementation of noise reduction measures. The target and limit values for noise vary depending on the main functions of the areas. Noise categories are determined in accordance with the main purpose of land use in the comprehensive plan.

The assessment of noise from wind turbines during operation was based on the Atmospheric Air Protection Act and Regulation No. 71 of the Minister of the Environment. Noise from wind turbines is classified as industrial noise. The limit value for construction noise is the standard level of industrial noise for the relevant noise category between 9 p.m. and 7 a.m.

The limit value for industrial noise in residential areas is 60 dB(A) during the day and 45 dB(A) at night,
with a target value of 50 dB(A) during the day and 40 dB(A) at night.

As wind turbines operate around the clock and wind turbine noise can be considered more disturbing than some other types of industrial noise, it is strongly recommended that wind farm planning aim to ensure compliance with the night-time target value (40 dB(A)). Noise target values have been established to prevent health risks.

[162] Radun, J., Maula, H., Saarinen, P., Keränen, J., Alakoivu, R., Hongisto, V. 2022. Health effects of wind turbine noise and road traffic noise on people living near wind turbines,

[163] van Kamp, I.; van den Berg, F. 2021 . Health Effects Related to Wind Turbine Sound: An Update. Int. J. Environ. Res. Public Health 2021, 18, 9133.

[164] Pohl, H., Firestone, H., Rand, J., Haac, E. 2019. Monitoring annoyance and stress effects of wind turbines on nearby residents: A comparison of US and European samples.

[165] Pedersen, E. 2007. Human response to wind turbine noise – perception, annoyance and moderating factors,
Göteborg University.

[166] Turunen, A., W. Tiittanen, P., Yli-Tuomi, T., Taimisto, P., Lanki, T. 2021. Self-reported health in the vicinity of five wind power production areas in Finland, Environment International, Volume 151, 2021, 106419, ISSN 0160-4120, https://doi.org/10.1016/j.envint.2021.106419.

[167] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.

The noise standards applicable in Estonia take into account the recommendations of the World Health Organisation. The World Health Organisation recommends that wind turbines comply with the standard $_{Lden}$ < 45 dB([168]) $_{Lden}$ is the average sound pressure level, which takes into account the average of all days, evenings and nights in a year.

It should be noted that noise standards apply as averages for the daytime (7 a.m. to 11 p.m.) and night-time (11 p.m. to 7 a.m.) periods. However, when calculating wind turbine noise, it is conservatively assumed that noise occurs at a maximum level throughout the entire period.

The industrial noise standards applicable in the Republic of Latvia are presented in Table 17.

Table 17. Noise standards applicable in the Republic of Latvia[169] .

Function of the building area	Noise standards		
	$_{LPäev}$ (dB(A))	L $_{evening}$ (dB(A))	L $_{night}$ (dB(A))
Detached houses (private houses, low-rise or farmhouses) residential buildings, children's institutions, medical, health and social welfare institutions	55	50	45
Multi-storey residential building territory	60	55	50
Public building territory (territory of public and administrative buildings, including cultural institutions, educational and research institutions, state and local government agencies and hotels territory) (together with residential buildings)	60	55	55
Mixed-use territory, including commercial and service buildings territory (with residential construction)	65	60	55
Quiet areas in settlements	50	45	40

It became apparent that noise standards in residential areas in Latvia are less stringent than in Estonia. This impact assessment is based on the principle that there is no significant noise impact in residential areas in both Estonia and Latvia if 40 dB is guaranteed in residential yards around the clock or 45 dB with the consent of the property owner. However, given the distance of Latvian residential areas, they are all well outside the possible 40 dB noise level spread area and Latvian residential areas were not considered separately as noise receptors.

It is important to note that in the case of noise, there may be a difference between the noise level exceeding the standards and the noise level causing disturbance. Noise standards are set in such a way as to ensure that noise levels do not harm human health. However, this does not mean that the noise source cannot be heard. In the case of disturbance, a person hears the noise source and may not like it, but it is not a situation that is harmful to health. The disturbance caused by sound depends largely on the individual's perception. Based on the analysis of various studies, the threshold for noise disturbance (disturbance level) during the operation of wind farms has been set at 35 dB([170]) However, as mentioned above, people's sensitivity to wind turbine noise varies.

The noise generated by wind turbines during operation is assessed mathematically in new planning projects. In this case, specialised software WindPRO 4.0 was used for this purpose. The calculation was based on the international standard ISO 9613-2: "*Acoustics – Abatement of sound propagation outdoors, Part 2: General method of* calculation", which is the European Union's recommended method of calculating industrial noise for Member States that do not have national calculation methods (Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise). This standard is also widely used in other parts of the world for assessing wind farm noise propagation.

[168] Compendium of WHO and other UN guidance on health and environment, 2024

[169] https://likumi.lv/ta/id/263882-troksna-novertesanas-un-parvaldibas-kartiba

[170] Schmidt, J., H., Klokker, M. 2014. Health effects related to wind turbine noise exposure: a systematic review.

In this case, noise propagation was modelled under unfavourable conditions – downwind in all directions, which promotes noise propagation, Cmet=0. Based on the technical data provided by wind turbine manufacturers, wind turbine noise emissions typically increase up to wind speeds of 7–10 m/s([171]) .(.) This study used the worst-case wind speed, i.e. the noise maps were presented for a situation where wind turbine noise emissions were at their highest.

Noise modelling was performed at a height of 4 m above ground level. The ground roughness factor was set at 0.5 for the entire area. The accuracy of the calculation grid was set at 20 m. The ground relief was entered based on the elevation data of the Land Board (5 m grid ground elevation model) and Latvian elevation data (20 m grid ground elevation model). In accordance with the methodology guidelines, the atmospheric conditions used were a temperature of 10˚C and 70% humidity.

The modelling did not directly take into account objects that obstruct noise propagation, such as taller trees and forest areas. Similarly, existing buildings were not designated as objects that obstruct noise propagation in this case. If there are patches of forest or outbuildings between the wind turbines and the observer, the actual noise levels will be lower than those shown in the calculations.

The actual daily noise levels caused by wind turbines are therefore expected to be lower than the results of the modelling.
results.

The specific wind turbine model to be installed in the wind farms is not known within the framework of the SEA for the special plan. Noise emissions (sound power levels) vary between different wind turbine models. The SEA uses one of the largest wind turbines currently in production, the 7.2 MW Vestas V172 (rotor diameter 172 m, tower height 166 m), to assess noise levels. According to the wind turbine manufacturer, the maximum sound power level of a single wind turbine (model with "bladed blades") is Lw= 107.8 dB([172]) . In addition, a correction factor of +2 dB was added to the noise level of each wind turbine in the noise calculations to take into account the possible additional uncertainty in the case of prospective wind turbines and to describe the most unfavourable situation possible.

The guidelines for the computational assessment of wind turbine noise stipulate that if the modelled wind turbine has a larger blade diameter than the similar wind turbine used as a basis, a correction factor of +1 dB should be added to the wind turbine noise emission for each 10 m increase in blade diameter. Based on data from existing wind turbines, there is no linear relationship between the diameter of the wind turbine blades and the sound power level. However, it is possible that as the dimensions of the blades increase, the sound power level may also increase. As the noise calculation showed that the use of an existing wind turbine with a sound power level of 107.8 dB may cause problems with meeting the noise target value in the nearest residential areas, wind turbines with even higher sound power levels were not assessed separately.

Table 18. Sound power levels (Lw) of the Vestas V172 7.2 MW model in 1/3 octave bands at a wind speed of 8 m/s

1/3 octave band centre frequency, Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315
Sound power level level LWA, dB	48.8	53.4	58.1	62.7	67.9	72.6	76.4	81	84.9	87.2	89.7	92	93.6	95.7	97.2	96.9
1/3 octave band centre frequency, Hz	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	500	6300	8000	10,000	Total LwA, dB
Sound power level level LWA, dB	95.8	95.4	95.6	96.2	96.4	96	95.5	95.2	94.6	94.8	94.3	90	83.7	79.4	75.2	107.8

171 Conclusion based on the WindPro wind turbine database.

172 Based on the WindPro wind turbine database, this wind turbine is available in models with different noise levels. In this study, data from the model with the highest noise level (sound pressure level) and jagged edges in the database was used to assess the most unfavourable situation.

As a mitigating measure, the same Vestas V172 wind turbine with reduced sound power levels SO1 and SO2, with sound power levels of Lw=105 dB and Lw=104 dB, respectively, was used in the noise assessment.

For modern wind turbines, the noise level (i.e. the sound pressure level Lp at a certain distance from the noise source, for example directly below the wind turbine on the ground) is usually in the range of 50–60 dB. However, wind turbine manufacturers provide the sound power level (LwA) value for specific models, which characterises the total amount of acoustic energy emitted by the wind turbine, i.e. noise emission. The sound power level of wind turbines is generally in the range of 105–108 dB.

It is important to understand that the noise level at a specific point (sound pressure level Lp) and sound power level (Lw) are different concepts. Sound power level is a theoretical quantity used in noise propagation calculations and for comparing noise sources. This does not mean that the noise level experienced in the vicinity of a wind turbine or even directly below it would be equivalent (i.e. close to 100 dB).

Noise maps were drawn up to show noise propagation, presenting the A-weighted equivalent sound pressure level $L_{pA,eq}$ in decibels in 5 dB noise intervals. Residential or public buildings and residential areas located at a maximum distance of 2000 m from the planned wind turbines were used as receptors in the noise modelling. The ETAK database was used to identify residential areas in Estonia.

As a rule, the noise level of wind turbines is highest at wind speeds of 7–10 m/s. Such wind speeds do not normally persist throughout the night. As a result, there is often a difference between the average noise level measured over a period of time and the worst-case noise level forecast presented in this assessment. This assessment assumes that the wind turbines will operate at their maximum noise level continuously.

The noise during the construction of the wind farm has been assessed by experts.

The standard levels for low-frequency noise are set out in the annex to Regulation No. 42 of the Minister of Social Affairs of 4 March 2002 "Noise standards in residential and recreational areas, residential buildings and public buildings, and methods for measuring noise levels"[173](Table 19). The recommended sound pressure levels for assessing the disturbance caused by low-frequency noise in living and sleeping areas of residential buildings and equivalent areas at night, as specified in the annex to the regulation, are given in Table 19. These are therefore not standards applicable to outdoor areas, but standard levels applicable inside buildings.

Table 19. Recommended low-frequency sound values in living spaces.

1/3 octave band centre frequency , Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200
Sound pressure level Lp,eq, dB	95	87	79	71	63	55.5	49	43	41.5	40	38	36	34	32

The assessment of low-frequency noise is based on the guidelines of the Ministry of the Environment [174]and uses the WindPRO programme module "Decibel" setting *"Finnish Low Frequency* Sound", which is in line with the calculation methodology specified in the guidelines of the Ministry of the Environment.

As the standard value for low-frequency noise applies inside buildings, the sound insulation of buildings must also be taken into account when calculating it. The sound insulation values used are those found in scientific literature, which are appropriate for use in accordance with the current guidelines (Table 20)([175]).

[173]https://www.riigiteataja.ee/aktilisa/1291/2202/0047/myra_tabel.pdf#

[174] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.

[175]Keränen, J., Hakala, J., Hongisto, V., 2018: Façade sound insulation of residential houses within 5-5000 Hz, Euronoise 2018.

Table 20. Low-frequency noise insulation of buildings.

Frequency, Hz	20	25	31.5	40	50	63	80	100	125	160	200
Insulation, dB	7.6	8.3	9.2	10.3	11.5	13	14.8	16.8	18.8	21.1	22.8

Infrasound is sound transmitted through the air at a frequency below 20 Hz. The standard levels for infrasound are established by Regulation No. 75 of the Minister of Social Affairs of 6 May 2002, "Limit values for ultra- and infrasound sound pressure levels and measurement of ultra- and infrasound sound pressure levels". The regulation establishes limit values for ultra- and infrasound sound pressure levels in residential and public buildings in order to prevent damage to human health and unpleasant sensations. The limit value for the G-corrected sound pressure level LpG of constant-level infrasound or the G-corrected equivalent sound pressure level LpG,eq,T of variable-level infrasound is 85 dB. Ultra- and infrasound-generating equipment, machines and other sources of ultra- and infrasound, regardless of their location, shall be installed and maintained or used in such a way that the sound pressure level of ultra- and infrasound generated by them in residential and public buildings does not exceed the limit values specified in the regulation.

4.6.1.2 Construction noise

The construction of wind farms is accompanied by construction noise similar to that associated with normal construction activities. General construction activities include vegetation clearing, road construction and activities related to the erection of foundations and wind turbines. These activities are likely to involve the use of excavators, concrete mixers and pumps, cranes and trucks. The noise levels generated by the most common equipment are shown in Table 21([176]) .

Table 21. Noise levels of construction activities.

Equipment/activity	Typical sound pressure level (at a distance of 1 m)
Excavator	85–95 dB(A)
Concrete mixer	75–85 dB(A)
Concrete pump	80–90 dB(A)
Crane	70–85 dB(A)
Dump truck / lorry	75–95 dB(A)

Table 22 shows the noise levels that may occur at various distances from the construction site, according to WSDoT (2017) [177]guidelines. Based on the source, the combined noise level generated by various construction noise sources in the immediate vicinity of the construction site is 86 dB(A).

Table 22. Noise levels at different distances from the source of noise.

Distance, m	Approximate noise level of construction activities, dB(A)
15	86
30	78
60	70
120	63
244	56
489	49
975	41

Considering the distance of the prospective construction areas from residential areas, the construction noise associated with the establishment of the wind farm is not expected to cause significant disturbance to residents in the vicinity. As can be seen from Table 22, at a distance of 1 km (the distance to the nearest residential areas) from the site

[176] Natural Forces Developments LP. 2021. Sound Level Impact Assessment Study. Benjamins Mill Wind Project.
[177] Washington State Department of Transportation. (2017). Chapter 7 – Noise Impact Assessment. Retrieved from Biological Assessment Preparation for Transportation Projects.

the noise level originating from the construction site is below 40 dB(A), which does not exceed the construction noise
.

Although elevated noise levels during construction are unavoidable, noise levels in nearby residential areas are not expected to be significant, as the construction sites are located away from noise-sensitive areas.

Noise during construction must not exceed the standards set out in the Atmospheric Air Protection Act and Regulation No. 71 of the Minister of the Environment of 16 December 2016, issued on the basis thereof, "Standards for noise in the outdoor air and methods for measuring, determining and assessing noise levels" and Regulation No. 42 of the Minister of Social Affairs of 4 March 2002
"Noise standards in residential and recreational areas, residential buildings and public buildings, and methods for measuring noise levels". Avoid noisy construction work during the night.

4.6.1.3 Operational noise

Noise sources in wind farms can be divided into two categories:

- **mechanical noise** generated by the wind turbine gearbox, motor and other mechanisms**;**
- **aerodynamic noise** generated by the movement of rotor blades through the air.

In modern wind turbines, considerable attention has been paid to noise reduction, and mechanical noise has been reduced to a relatively insignificant level through the use of various insulation materials and technical measures. Technical solutions have also been implemented to reduce aerodynamic noise, but as these are large technical devices, a certain amount of noise emission occurs when the wind turbines are in operation.

The assessment of the noise level caused by wind turbines in residential areas was carried out in parallel with the development of the basic location of the wind turbines. After mapping the areas unsuitable for the construction of wind turbines due to the natural environment, the parties interested in the planning presented their own views on the desired number and location of wind turbines. The initial views were used as the basis for the initial noise modelling. It became apparent that there was a risk of industrial noise exceeding the night-time target value in several residential areas. Based on the results of the noise modelling, the location and number of wind turbines were optimised. During the process, the number of wind turbines was reduced and, where necessary, the distance from residential areas was increased. In order to ensure a balance of interests and maintain the quality of the living environment**, the goal** was set **that residential areas should not exceed the night-time target value for industrial noise, even under the potential combined impact of the wind farm. Exceeding the night-time target value for industrial noise, if the night-time limit value for industrial noise is met, is permitted with the written consent of the owner of the residential building concerned. Exceeding the night-time limit value for industrial noise in residential areas is not permitted even with the owner's consent, as adverse health effects cannot be ruled out.**

The noise assessment showed that, given the number and location of the wind turbines designed, the use of wind turbines with a sound pressure level of 107.8 dB (taking into account an additional correction factor of + 2 dB) may exceed the night-time target value for industrial noise in six residential areas. These are Kalda, Kure, Kuusiku, Nilbi, Une-Mati and Väike-Make. In all of these residential areas, there will be a combined noise effect from the wind turbines or groups of wind turbines.

In the southernmost area, i.e. location option 4, no exceedance of the noise target value is expected in the nearest residential areas even when using 107.8 dB + 2 dB wind turbines.

In order to ensure that the night-time target value for industrial noise is also met in these residential areas in weather conditions conducive to noise propagation, the noise level of the wind turbines located in the pre-selected areas 2 and 3 was reduced in the modelling. It was found that the night-time target value for industrial noise can be ensured in all residential areas if, for example, a maximum noise level of Lw=105 dB is applied to the three wind turbines located in area 3 and Lw=104 dB in area 2. In addition to the assessed solution, there are other combinations for ensuring the target value in residential areas. When designing the wind farm, it must be ensured that the target value is achieved in all residential areas when using the selected solution (exceptions are only permitted when establishing a servitude of tolerance).

The noise assessment for the wind turbine layout solution is presented in the noise maps in Figure 58 and Figure 59
and **Table 23**.

Table 23. Noise levels caused by the wind farm in residential areas.

Land parcel name	x	y	Sound pressure level Lw=107.8 dB+2dB for wind turbines, dBA	Sound pressure level in areas 2 and 3 with reduced sound pressure level for wind turbines, dBA
Aalte	625032	6422044	38	36.3
Gardener	621785	6421867	38.2	36.7
Garden	621711	6421530	36.6	35.1
Below	620603	6424751	37.9	36.4
Allaste	620659	6424068	38	36.6
Aude	620860	6425443	38.3	36.8
Eeriku-Peetri	625276	6418570	39.5	39.4
Elbra	620276	6424919	36.1	34.6
Haavatare	620910	6423243	38.1	36.7
Jaanimäe	625129	6422581	39.5	37.6
Jõemetsa	621181	6425313	40.7	39.1
Kajaja	626756	6415190	31.7	31.5
Kajaja-Vidriku	625368	6420051	37.1	36.7
Kalda	625234	6422890	40.7	38.6
Kastre	621480	6422340	38.7	37.2
Kiilatsi	627580	6421640	34.6	32.8
Kikka	628253	6425028	36.1	33.8
Kirpu	625658	6421943	37.4	35.5
Koidiku	628309	6425268	35.6	33.3
Koidu	620346	6425304	36	34.5
Kooba	622529	6426421	39.2	37.6
School grounds	626021	6421691	36.5	34.8
Kure	627163	6424741	42.4	39.8
Kuusiku	624654	6422789	40.8	39
Kääriku-Vidriku	625186	6418566	39	38.9
Künka	625821	6421922	37.3	35.4
Laanemetsa	624994	6422144	38.3	36.6
Laksi	621782	6421946	38.5	37
Liiva	621594	6421504	36.1	34.7
Liivamäe	621725	6421461	36.4	34.9
Lohu	621767	6421809	37.9	36.4
Metsaääre	621909	6421296	36.2	34.8
Metsniku	625521	6422342	38.7	36.8
Mustajärve	626495	6421044	35.2	34
Mõisa	620747	6424703	38.8	37.2
Männimetsa	624982	6422247	38.6	36.9
Naadi	627,471	6417460	35.6	35.5
Nilbi	621312	6423517	40.8	39.2
Penno	621758	6422054	38.9	37.4
Perve	625765	6421849	37	35.3
Pihlaka	621828	6421453	36.6	35.2
Pulga	625805	6427444	34.3	32.2
Pustse-Kotteri	626655	6426626	38.6	36.1
Pärtle-Vidriku	625822	6421139	35.6	34.3
Raudsepa	628132	6424530	37	34.7

Sakala	625738	6421902	37.2	35.4
Sepa	625681	6422045	37.7	35.8
Silla	621456	6421419	35.4	34
Bridges	620250	6425536	35.2	33.7
Simmerga	621503	6421703	36.6	35.1
Singa-Ado	624555	6417293	36.9	36.8
Tamme	620817	6425229	38.6	37
Tasa-Männiku	627366	6427280	33.6	31.4
Tedre	620277	6424211	36.2	34.8
Tiigi tn 6/2	622267	6420898	35.3	33.9
Tiigi tn 8/1	622386	6420849	35.2	33.9
Tuulepealse	622024	6421128	35.8	34.4
Udumäe	620822	6425611	37.7	36.2
Uibo	621839	6421368	36.3	34.9
Une-Mati	624995	6423098	41.2	39.2
Uniküla recreation area	625722	6421987	37.5	35.6
Uue-Vidriku	625132	6418588	38.7	38.6
Uulitse	624819	6420173	35.3	34.6
Vabriku	628106	6421871	33.9	32
Valli	625388	6422309	38.6	36.7
Vanamõisa	625787	6421969	37.4	35.6
Varnu	627538	6426010	38.1	35.7
Vintsi	627215	6421756	35.7	33.8
Võndi	624,431	6416574	34.8	34.7
Väike-Make	625981	6422526	40	37.8
Evening Sun	625632	6421905	37.2	35.4
Õisu	625563	6421933	37.3	35.5
Õnne	620267	6425082	35.9	34.4

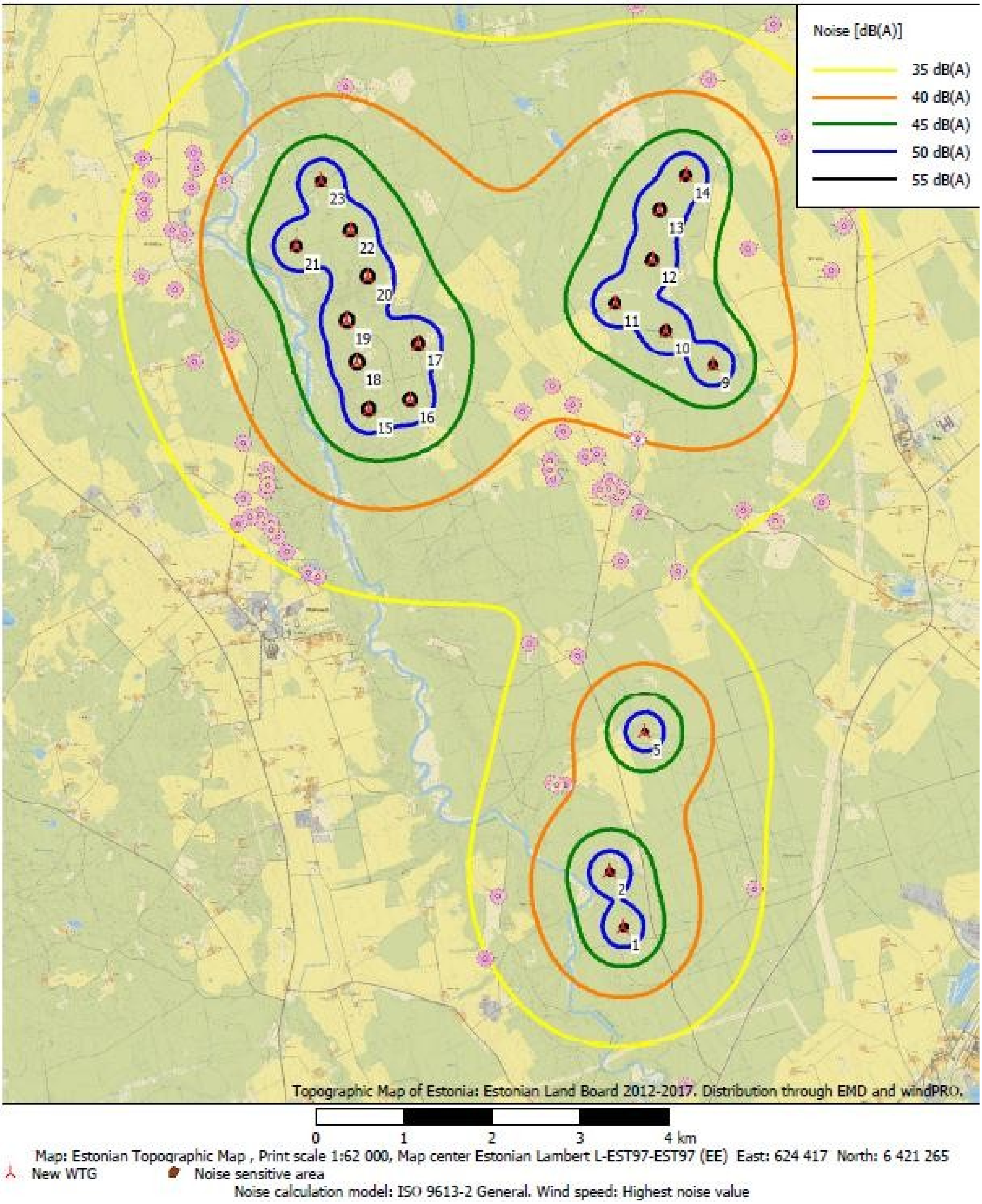

Figure 58. Noise propagation map 107.8 dB +2dB with wind turbines at a height of 4 m.

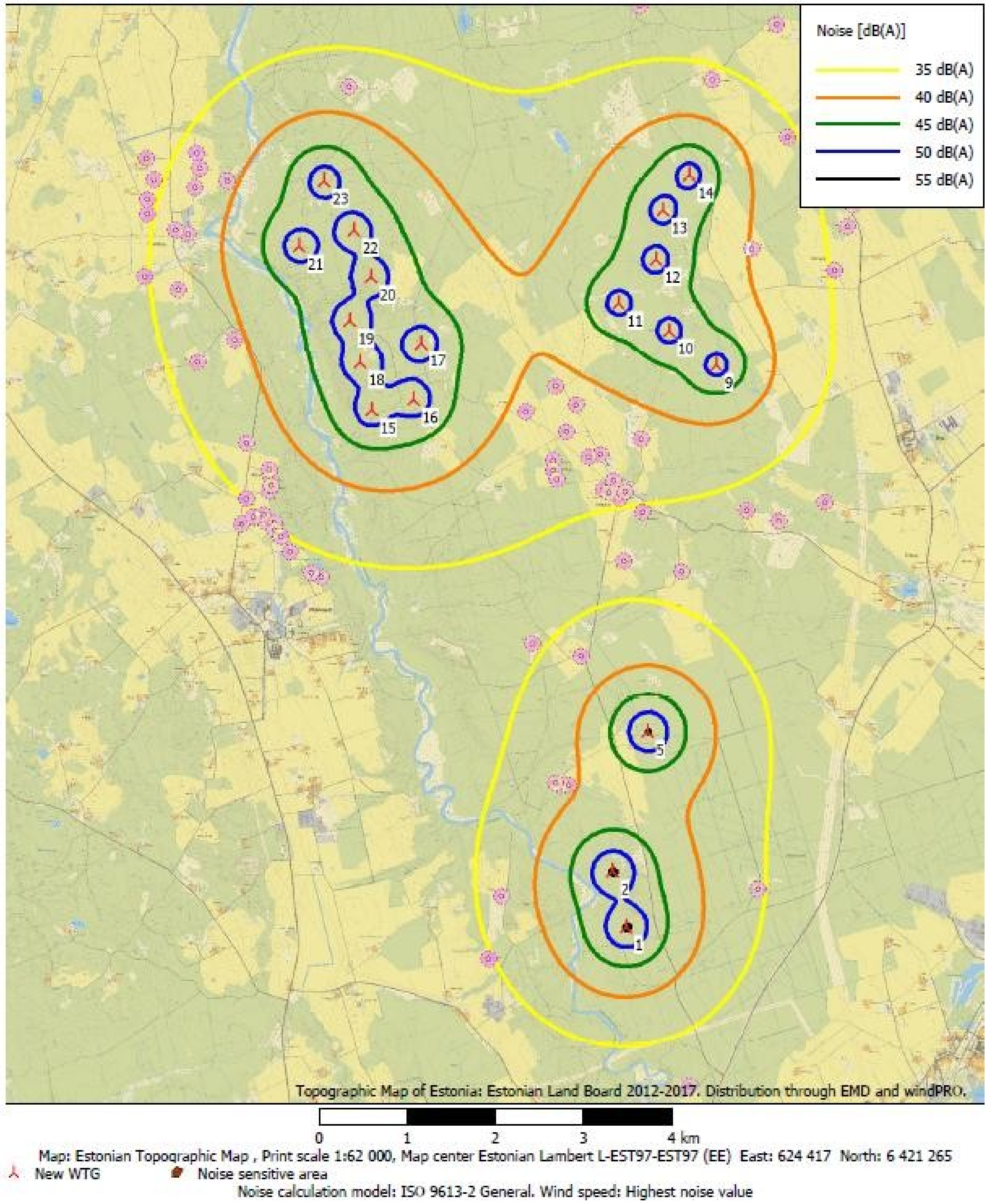

Figure 59. Noise propagation map at a height of 4 m for area 4 wind turbines 107.8 dB +2dB, area 3 wind turbines 105 dB +2dB and area 2 wind turbines 104 dB +2dB.

4.6.1.4 Low-frequency noise

Low-frequency sound (20-200 Hz) is present in most sounds. It is caused by both man-made (traffic) and natural (wind) sources. For low-frequency sound to be disturbing or harmful to health, its sound pressure is important.

Low-frequency noise has consistently been considered an important issue in relation to wind turbines, as the noise from wind turbines spreads over a very large area. When noise spreads, the mid-range and higher frequencies of the sound dissipate in the air more quickly than the low frequencies[178].

The low-frequency noise generated by wind turbines needs to be assessed when planning a wind farm. A noise assessment for low-frequency noise can be compiled based on the spectral distribution of the noise generated by the wind turbine used [179]. This was also done when compiling this SEA report. **Modelling of low-frequency noise showed that no residential area is expected to exceed the standard values for low-frequency noise indoors (Table 24).**

Table 24. Results of low-frequency noise modelling. The modelled value of low-frequency noise indoors is presented.

Residential	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
Standard level	71	63	55.5	4G	43	41.5	40	38	36	34	32
A Aalte	44	42.4	40.7	38.3	37	34.9	30.9	27.1	22.9	17.2	14.4
B Gardener	43.8	42.2	40.5	38.2	36.8	34.7	30.8	27	22.7	17.1	14.4
C Garden	42.7	41.1	39.4	37	35.7	33.6	29.6	25.8	21.5	15.8	13
D Below	43.4	41.9	40.2	37.8	36.5	34.4	30.4	26.6	22.4	16.8	14.1
E Allaste	43.6	42.1	40.3	38	36.6	34.5	30.6	26.8	22.6	16.9	14.3
F Aude	43.7	42.1	40.4	38.1	36.7	34.6	30.7	26.9	22.7	17.1	14.4
G Eeriku-Peetri	44	42.5	40.8	38.4	37.1	35	31.1	27.3	23.2	17.7	15.1
H Elbra	42.2	40.6	38.9	36.5	35.2	33.1	29.1	25.3	21	15.3	12.5
I Haavatare	43.8	42.2	40.5	38.1	36.8	34.7	30.8	27	22.7	17.1	14.4
J Jaanimäe	45	43.5	41.8	39.4	38.1	36	32.1	28.3	24.1	18.4	15.8
K Jõemetsa	45.3	43.8	42.1	39.7	38.4	36.3	32.4	28.7	24.5	19	16.5
L Kajaja	38.3	36.7	34.9	32.6	31.2	29	25	21.1	16.7	10.8	8
M Kajaja-Vidriku	42.7	41.1	39.4	37	35.7	33.6	29.6	25.8	21.6	15.9	13.2
N Kalda	45.8	44.2	42.5	40.2	38.8	36.8	32.8	29.1	24.9	19.3	16.7
O Kastre	44.1	42.6	40.9	38.5	37.2	35.1	31.1	27.3	23.1	17.5	14.9
P Kiilatsi	41.3	39.8	38	35.7	34.3	32.2	28.2	24.3	19.9	14.1	11.2
Q Kikka	42.1	40.6	38.9	36.5	35.1	33	29.1	25.2	20.9	15.2	12.4
R Kirpu	43.5	41.9	40.2	37.8	36.5	34.4	30.4	26.6	22.3	16.6	13.8
S Koidiku	41.8	40.2	38.5	36.1	34.8	32.7	28.7	24.8	20.5	14.8	12
T Koidu	42.1	40.5	38.8	36.4	35.1	33	29	25.2	20.9	15.2	12.4
U Kooba	44.3	42.7	41	38.7	37.3	35.2	31.3	27.5	23.4	17.8	15.1
V School district	42.9	41.3	39.6	37.2	35.9	33.7	29.8	25.9	21.6	15.9	13.1
W Kure	46.6	45.1	43.4	41.1	39.7	37.7	33.8	30	25.9	20.5	18
X Kuusiku	45.9	44.4	42.7	40.3	39	36.9	33	29.2	25	19.5	16.9
Y Kääriku-Vidriku	43.7	42.2	40.4	38.1	36.8	34.7	30.8	27	22.8	17.3	14.7

[178] Hansen, C.H., Doolan, C.J., Hansen, K., L. 2017. Wind Farm Noise: Measurement, Assessment and Control.
[179] Chiu, CH., Lung, SC.C. 2020. Assessment of low-frequency noise from wind turbines under different weather conditions. J Environ Health Sci Engineer 18, 505–514.

Z Künka	43.4	41.8	40.1	37.7	36.4	34.3	30.3	26.5	22.2	16.5	13.7
AA Lane forest a	44.2	42.6	40.9	38.6	37.2	35.1	31.2	27.3	23.1	17.4	14.7
AB Laksi	44	42.5	40.7	38.4	37	34.9	31	27.2	23	17.4	14.7
AC Liiva	42.4	40.8	39.1	36.7	35.4	33.3	29.3	25.4	21.2	15.4	12.6
AD Liivamäe	42.5	41	39.2	36.9	35.5	33.4	29.5	25.6	21.3	15.6	12.8
AE Lohu	43.6	42	40.3	37.9	36.6	34.5	30.6	26.7	22.5	16.8	14.1
AF Forest edge	42.4	40.9	39.1	36.8	35.4	33.3	29.3	25.5	21.2	15.5	12.7
AG Metsniku	44.4	42.9	41.1	38.8	37.4	35.3	31.4	27.6	23.4	17.7	15
AH Mustajärve	41.8	40.3	38.5	36.2	34.8	32.7	28.7	24.8	20.5	14.7	11.8
AI Manor	44	42.5	40.8	38.4	37.1	35	31.1	27.3	23.1	17.5	14.8
AJ Pine forest a	44.4	42.9	41.1	38.8	37.4	35.3	31.4	27.6	23.4	17.7	15
AK Naadi	41.1	39.6	37.9	35.5	34.1	32	28.1	24.2	20	14.3	11.7
AL Nilbi	45.6	44.1	42.4	40	38.7	36.6	32.7	29	24.8	19.3	16.7
AM Penno	44.2	42.7	41	38.6	37.3	35.2	31.3	27.5	23.3	17.6	15
AN Perve	43.2	41.7	40	37.6	36.2	34.1	30.2	26.3	22.1	16.3	13.6
AO Pihlaka	42.7	41.1	39.4	37.1	35.7	33.6	29.6	25.8	21.5	15.8	13
AP Pulga	41.1	39.5	37.8	35.4	34	31.9	27.9	24	19.7	13.8	10.9
AQ Pustse-Kotteri	43.7	42.1	40.4	38	36.7	34.6	30.7	26.9	22.7	17.1	14.5
AR Pärtle-Vidriku	42.2	40.7	38.9	36.6	35.2	33.1	29.1	25.2	20.9	15.1	12.2
AS Raudsepa	42.8	41.3	39.5	37.2	35.8	33.7	29.8	25.9	21.7	16	13.3
AT Sakala	43	41.8	40.1	37.7	36.4	34.3	30.3	26.5	22.2	16.5	13.7
AU Sepa	43.7	42.1	40.4	38.1	36.7	34.6	30.7	26.8	22.6	16.9	14.1
AV Silla	41.9	40.4	38.6	36.3	34.9	32.8	28.8	24.9	20.6	14.9	12
AW Sillaste	41.6	40	38.3	35.9	34.5	32.4	28.4	24.6	20.3	14.5	11.7
AX Simmerga	42.7	41.1	39.4	37	35.7	33.6	29.6	25.8	21.5	15.8	13
AY Singa-Ado	42	40.5	38.8	36.4	35.1	33	29	25.2	21	15.4	12.8
AZ Tamme	43.9	42.3	40.6	38.2	36.9	34.8	30.9	27.1	22.9	17.3	14.6
BA Equal Männiku	40.4	38.9	37.1	34.8	33.4	31.2	27.3	23.3	19	13.1	10.2
BB Tedre	42.4	40.8	39.1	36.7	35.3	33.2	29.3	25.4	21.2	15.4	12.6
BC Tiigi Street 6	41.9	40.3	38.6	36.2	34.8	32.7	28.7	24.9	20.5	14.7	11.9
BD Tiigi Street 8	41.9	40.3	38.6	36.2	34.8	32.7	28.7	24.8	20.5	14.7	11.9

BE Windward	42.2	40.6	38.9	36.5	35.1	33	29.1	25.2	20.9	15.1	12.3
BF Udumäe	43.2	41.7	40	37.6	36.3	34.2	30.2	26.4	22.2	16.5	13.9
BG Uibo	42.5	40.9	39.2	36.9	35.5	33.4	29.4	25.6	21.3	15.5	12.8
BH Une-Mati	46.2	44.6	42.9	40.6	39.3	37.2	33.3	29.5	25.3	19.8	17.2
BI Uniküla recreation area	43.6	42	40.3	37.9	36.6	34.4	30.5	26.7	22.4	16.7	14
BJ Uue-Vidriku	43.5	41.9	40.2	37.9	36.5	34.4	30.5	26.7	22.6	17	14.5
BK Uulitse	41.8	40.3	38.5	36.2	34.8	32.7	28.7	24.8	20.5	14.7	11.8
BL Factory	40.8	39.2	37.5	35.1	33.8	31.6	27.6	23.7	19.3	13.5	10.5
BM Valli	44.3	42.8	41.1	38.7	37.4	35.3	31.3	27.5	23.3	17.6	14.9
BN Vanamõisa	43.5	41.9	40.2	37.9	36.5	34.4	30.5	26.6	22.4	16.6	13.9
BO Varnu	43.4	41.8	40.1	37.8	36.4	34.3	30.4	26.6	22.4	16.8	14.1
BP Vintsi	42.1	40.5	38.8	36.4	35	32.9	29	25.1	20.8	15	12.2
BQ Swing	40.5	39	37.2	34.9	33.5	31.4	27.4	23.6	19.3	13.6	10.9
BR Small Make	45.1	43.6	41.9	39.5	38.2	36.1	32.2	28.4	24.2	18.6	16
BS Evening sun	43.4	41.8	40.1	37.8	36.4	34.3	30.4	26.5	22.2	16.5	13.7
BT Õisu	43.5	41.9	40.2	37.8	36.5	34.4	30.4	26.6	22.3	16.6	13.8
BU Happiness	42.1	40.5	38.8	36.4	35	32.9	29	25.1	20.8	15.1	12.3

Based on the above, current knowledge does not suggest that the low-frequency noise emitted by wind turbines and its propagation that the construction of wind turbines would result in the standard value for low-frequency noise being exceeded in residential buildings.

4.6.1.5 Infra-sound

The assessment of extremely low-frequency noise, or **infrasound** (sound in the frequency range of approximately 0–20 Hz), is based on the guidelines prepared by the Ministry of Climate in 2025[180]. No computational assessment of infrasound is carried out, as, according to relevant scientific research, the infrasound generated by wind turbines remains below the human perception threshold and therefore has no significant impact on human health (see section 2.4.2 of the guidelines, the Health Board's wind farm website[181] and in a letter from the Ministry of Social Affairs [182]).

[180] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.
[181] https://www.terviseamet.ee/tuulepargid#kas-terviseamet-on-s
[182] Ministry of Social Affairs 10.03.2025 No. 5.1-2/679-1

In the case of wind turbines, the question of the possible impact of **particularly low-frequency noise, or infrasound** (sound in the frequency range of approximately 0–20 Hz), often arises. In the case of infrasound, it is appropriate to consider two variables that characterise sound: the sound frequency spectrum (Hz) and the sound pressure level (dB). The impact of infrasound (as with other sounds) on humans depends primarily on its intensity (dB). It is understood that for infrasound to have an impact on health, its pressure must be close to the human perception threshold (Figure 60).

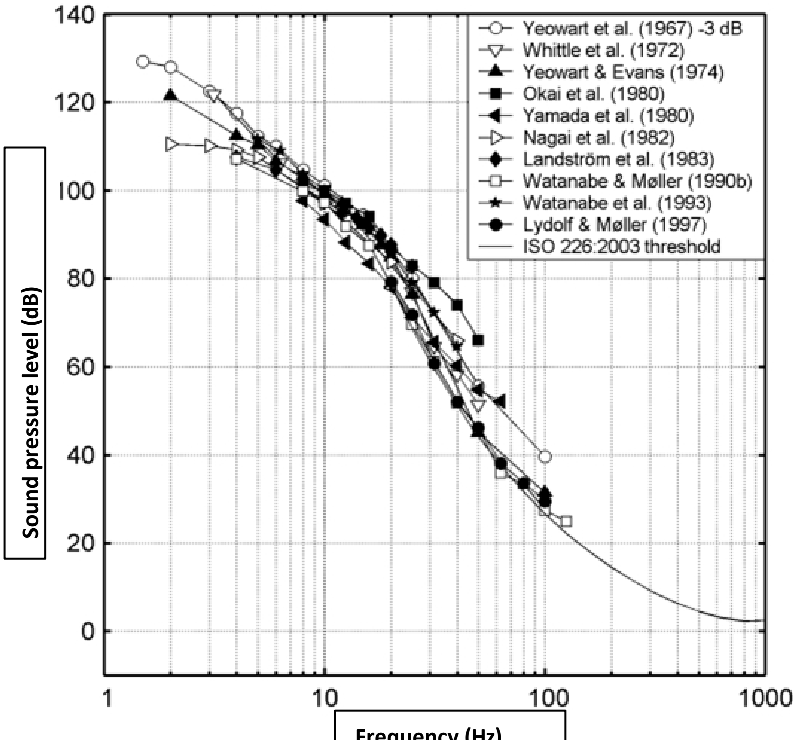

Figure 60. Human sound perception as a ... cy and pressure based on various scientific studies [183]

Standard levels for infrasound are established by Regulation No. 75 of the Minister of Social Affairs of 6 May 2002, 'Limit values for ultra- and infrasound sound pressure levels and measurement of ultra- and infrasound sound pressure levels'. The limit value for the G-corrected sound pressure level LpG of constant-level infrasound or the G-corrected equivalent sound pressure level LpG,eq,T of variable-level infrasound is 85 dB. The G-corrected sound pressure level is the sound pressure level measured with measuring equipment that complies with the requirements of the recommended standard series EVS-EN 61672 or other equivalent documents and frequency-corrected in accordance with the recommended standard EVS-ISO 7196 (*Acoustics – Frequency-weighting characteristic for infrasound measurements)* or other equivalent documents. The applicable infrasound standards are comparable to the standards applicable in other countries([184] (,[185]) .

The effects of infrasound on human health have been studied worldwide and it has been found that intense infrasound affects the human nervous system, causing various disorders such as fear, concentration problems, fatigue, drowsiness, nausea, weight problems/loss of appetite, headaches, etc. The possible effects of infrasound caused by wind turbine operation have been studied in several countries, including numerous test measurements. General findings of the studies

[183] Møller, H., Pedersen, C. 2004. Hearing at low and infrasonic frequencies. Noise & health. 6. 37-57.

[184] Lo Castro, Fabio & Iarossi, Sergio & Luca, Massimiliano & Orlando, Maria & Giliberti, Claudia & Mariconte, Raffaele. 2020. Health Protection Criteria for Airborne Infrasound Exposure: An International Comparison. 10.1007/978-3-030-50946-0_10.

[185] Pawlaczyk-Łuszczyńska, Małgorzata & Dudarewicz, Adam. (2022). Review of evaluation criteria for infrasound and low frequency noise in the general environment. 10.54215/Noise_Control_2022_A_Digital_Monograph_Pawlaczyk-Luszczynska_M_Dudarewicz_A.

The conclusion is that the infrasound generated by modern wind turbines operating in headwind conditions is at a low level, i.e. significantly lower than the threshold associated with health effects[186]. Therefore, infrasound can cause health problems, but in order for it to pose a real threat or cause disturbance (perception), the sound pressure must be extremely high (intense). Infra-sound at such intense sound pressure levels is not associated with the operation of modern wind turbines([187] [,188] .

The development of more accurate measurement methods for wind turbine infrasound continues to be an area of research [189], but measurements taken so far in wind farms in different countries have yielded relatively similar results.

Scientific research on wind turbine infrasound and current noise standards (including infrasound) was analysed in the United Kingdom in 2023, when a very thorough analysis was commissioned by the British government to update national noise guidelines for onshore wind farms. During the analysis, relevant scientific literature was reviewed ([190]. It was found that several studies have investigated the alleged links between health symptoms and wind turbine infrasound. Although some experimental studies have linked infrasound to changes in physiological indicators ([191,) ([192) , these have generally been based on infrasound levels that are not present in wind turbine infrasound. To date, there is no convincing evidence that exposure to wind turbine infrasound could cause adverse health effects at the frequencies and levels that can be expected in noise-sensitive locations near wind farms ([193].

Controlled experiments conducted in scientific studies, including participants who claimed to be sensitive to wind turbine infrasound, have demonstrated that exposure to infrasound at levels produced by wind turbines in residential areas is not associated with physiological or psychological

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186 Swen., M, Stefan., H, Martin., H, Susanne., K. 2022. Can infrasound from wind turbines affect myocardial contractility? A critical review. Noise Health

187 LUBW State Agency for the Environment Baden-Württemberg. 2020. Low-frequency noise including infrasound from wind turbines and other sources. https://pd.lubw.de/84558

188 Maijala, P., Turunen, A., Kurki, I., Vainio, L., Pakarinen, S., Kaukinen, C., Lukander, K., Tiittanen, P., Yli-Tuomi, T., Taimisto, P., Lanki, T., Tiippana, K., Virkkala, J., Stickler, E., Sainio, M. 2020. Infrasound Does Not Explain Symptoms Related to Wind Turbines. Publications of the Government's analysis, assessment and research activities 2020:34.

189 Nykänen, H. 2023. Health risks of noise and vibration generated by wind turbines – preliminary study.

190 WSP. 2023. A REVIEW OF NOISE GUIDANCE FOR ONSHORE WIND TURBINES. Department for Business, Energy & Industrial Strategy. https://www.wsp.com/en-gb/insights/wind-turbine-noise-report

191 Salt, AN & Hullar, TE, 2010. Responses of the ear to low frequency sounds, infrasound and wind turbines. Hearing Research, 268 (1- 2), 12-21. https://www.sciencedirect.com/science/article/abs/pii/S0378595510003126

192 Weichenberger, M, Bauer, M, Kühler, R, Hensel, J, Forlim, CG, Ihlenfeld, A, Ittermann, B, Gallinat, J, Koch, C & Kühn, S, 2017. Altered cortical and subcortical connectivity due to infrasound administered near the hearing threshold - Evidence from fMRI. PLoS ONE, 12, e0174420. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0174420

193 van Kamp, I & van den Berg, F, 2021. Health effects related to wind turbine sound: An update. International Journal of Environmental Research and Public Health, 18 (17), 9133. https://www.mdpi.com/1660-4601/18/17/9133

health effects[194,195,196,197] . In contrast, expectations of exposure to infrasound from wind turbines and positive or negative messages that influence these expectations may have an impact on the reporting of health symptoms([198]) .

One of the most recent and, to date, most comprehensive studies of low-frequency sound, including infrasound, in relation to wind turbines was conducted in Finland and published in English in 2020[199]. The study was commissioned by the Finnish government and conducted by the Technical Research Centre of Finland ([200]). The study combined long-term (308 days) sound measurements in wind farms with hearing tests and questionnaires among residents living in the vicinity of wind farms. The aim was to clarify the characteristics of low-frequency noise generated by wind turbines and its effects on humans. The study was prompted by the problem that some residents living near wind farms associate the presence of wind turbines with health problems, particularly sleep disorders.

According to the study, 5% of residents living near the wind farms covered by the study associated their health problems (respondents with symptoms) with the low-frequency noise from wind turbines. The highest number of symptom respondents were located in the vicinity of wind farms, which was defined in the study as a radius of 2.5 km. Among residents in the vicinity, 15% were symptom respondents.

According to the study, the frequencies of particularly low-frequency noise measured in the vicinity of wind farms ranged from 0.1 to 1 Hz, which is below the human hearing threshold (16–20 Hz). The lower the sound frequency, the higher the sound pressure must be for the sound to be perceptible. The study also found that wind turbines can cause isolated low-frequency sound peaks (short-term low-frequency sound pressure up to 102 dB). Theoretically, such peaks may be perceptible to some people, and therefore tests were also conducted with humans. The study did not find that people who believed they were experiencing health effects caused by wind turbines were able to hear/perceive low-frequency sounds better. Hearing tests were used to identify the nervous system's response to low-frequency sounds in people complaining of health problems, but no such connection was found. No response was detected in the nervous system or various physiological indicators of these people when they were exposed to low-frequency sounds from wind turbines.

The study also found that within a radius of approximately 1.5 km from the wind farm, a change in the sound spectrum can be observed, i.e. the proportion of low-frequency sounds, including infrasound, in the frequency distribution increases. The sound spectrum becomes very similar to that found in urban conditions.

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194 Tonin, R, Brett, J & Colagiuri, B, 2016. The effect of infrasound and negative expectations to adverse pathological symptoms from wind farms. Journal of Low Frequency Noise, Vibration and Active Control, 35 (1), 77-90. https://journals.sagepub.com/doi/10.1177/0263092316628257

195 Nelson, P, Bryne, A, Waggenspack, M, Lueker, M, Feist, C, Herb, B & Marr, J, 2019. Testing the human response to wind turbine emissions. Wind Turbine Noise 2019, 12-14 June, Lisbon. INCE-Europe.

196 Maijala, PP, Kurki, I, Vainio, L, Pakarinen, S, Kuuramo, C, Lukander, K, Virkkala, J, Tiippana, K, Stickler, EA & Sainio, M, 2021. Annoyance, perception, and physiological effects of wind turbine infrasound. Journal of the Acoustical Society of America, 149 (4), 2238- 2248. https://doi.org/10.1121/10.0003509

197 Krahé, D, Alaimo Di Loro, A, Müller, U, Elmenhorst, E, De Gioannis, R, Schmitt, S, Belke, C, Benz, S, Großarth, S, Schreckenberg, D, Eulitz, C, Wiercinski, B & Möhler, U 2020. Noise effects of infrasound emissionshttps://www.umweltbundesamt.de/publikationen/laermwirkungen-von-infraschallimmissionen

198 Crichton, F, Dodd, G, Schmid, G, Gamble, G & Petrie, KJ, 2014. Can expectations produce symptoms from infrasound associated with wind turbines? Health Psychology, 33 (4), 360-364. https://doi.org/10.1037/a0031760

199 Maijala, P., Turunen, A., Kurki, I., Vainio, L., Pakarinen, S., Kaukinen, C., Lukander, K., Tiittanen, P., Yli-Tuomi, T., Taimisto, P., Lanki, T., Tiippana, K., Virkkala, J., Stickler, E., Sainio, M. 2020. Infrasound Does Not Explain Symptoms Related to Wind Turbines. Publications of the Government's analysis, assessment and research activities 2020:34.

200 Maijala, P. 2020. VTT studied the health effects of infrasound in wind turbine noise in a multidisciplinary cooperation study. VTT Technical Research Centre of Finland.

The study concluded that low-frequency noise from wind turbines, including infrasound, cannot be linked to the health effects reported by people. At the same time, a hypothesis was put forward that fluctuations in the amplitude of wind turbine noise may be more significant than low-frequency noise.

Another recent and representative health impact study on this topic was conducted in Australia. The aim of the study was to identify the possible occurrence of wind turbine syndrome. During the study, three different noise exposures were tested in a sleep laboratory over a period of 72 hours at 10-day intervals. The study included 37 healthy but noise-sensitive adults. They were exposed to infrasound (1.6-20 Hz ~90 dB, simulating the infrasound signature of wind turbines), apparent infrasound (the same speakers that did not generate infrasound) and traffic noise. Changes in various physiological and psychological indicators in humans were studied. The results of the study did not support the idea that infrasound causes wind turbine syndrome. High-level but inaudible infrasound had no effect on any of the physiological or psychological indicators tested among the study participants([201]) .

There are several scientific theories as to why some people feel unwell in the vicinity of wind turbines and associate this with the infrasound generated by the turbines. One suggested explanation is that when infrasound encounters buildings, it can cause secondary structural vibrations that may be perceived by the occupants of the building. Most people are not affected by wind turbine infrasound, but some people may have a phobic reaction to it([202]) .

4.6.1.6 Interaction with other noise sources

According to the Valga municipality noise map ([203]), the closest industrial noise source to the Valga EP area is the Tsirguliina substation, which is located approximately 4.7 km southeast of the nearest wind turbine. The noise generated by the Tsirguliina substation is considered industrial noise. According to Annex 1 of Regulation No. 71 adopted by the Minister of the Environment on 16 December 2016, the limit values for industrial noise in Category II areas (residential areas) are 60 dB during the day and 45 dB at night, and the target values for industrial noise are 50 dB during the day and 40 dB at night. According to the Valga municipality night-time industrial noise map, the industrial noise levels at the Tsirguliina substation remain at 35–40 dB in the surrounding residential areas. Thus, both the night-time industrial noise limit value and the target value are met in the nearest residential areas.

During the day, there are more sources of industrial noise in the area of the planned wind farm, but these are also located too far from the prospective wind turbines to have a significant cumulative impact. Based on the daytime industrial noise map, daytime industrial noise levels also remain within the permitted industrial noise limit and target values in Category II areas. Considering the distance of the sources from the wind farm and the absence of noise levels close to the standard levels, the wind farm will not cause any significant combined impact (Figure 61).

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[201] Marshall, N. S., Cho, G., Toelle, B. G., Tonin, R., Bartlett, D. J., D'Rozario, A. L., Evans, C. A., Cowie, C. T., Janev, O., Whitfeld, C. R., Glozier, N., Walker, B. E., Killick, R., Welgampola, M. S., Phillips, C. L., Marks, G. B., & Grunstein,
R. R. 2023. The health effects of 72 hours of simulated wind turbine infrasound: a double-blind randomised crossover study in noise-sensitive, healthy adults. Environmental Health Perspectives, 131(3), 037012-1-037012-
12. Article 037012. https://doi.org/10.1289/EHP10757

[202] Flemmer, F., and Flemmer, R. 2023. Wind turbine infrasound: Phenomenology and effect on people, Sustainable Cities and Society, Volume 89, 2023, 104308, https://doi.org/10.1016/j.scs.2022.104308

[203] https://www.valga.ee/murakaart

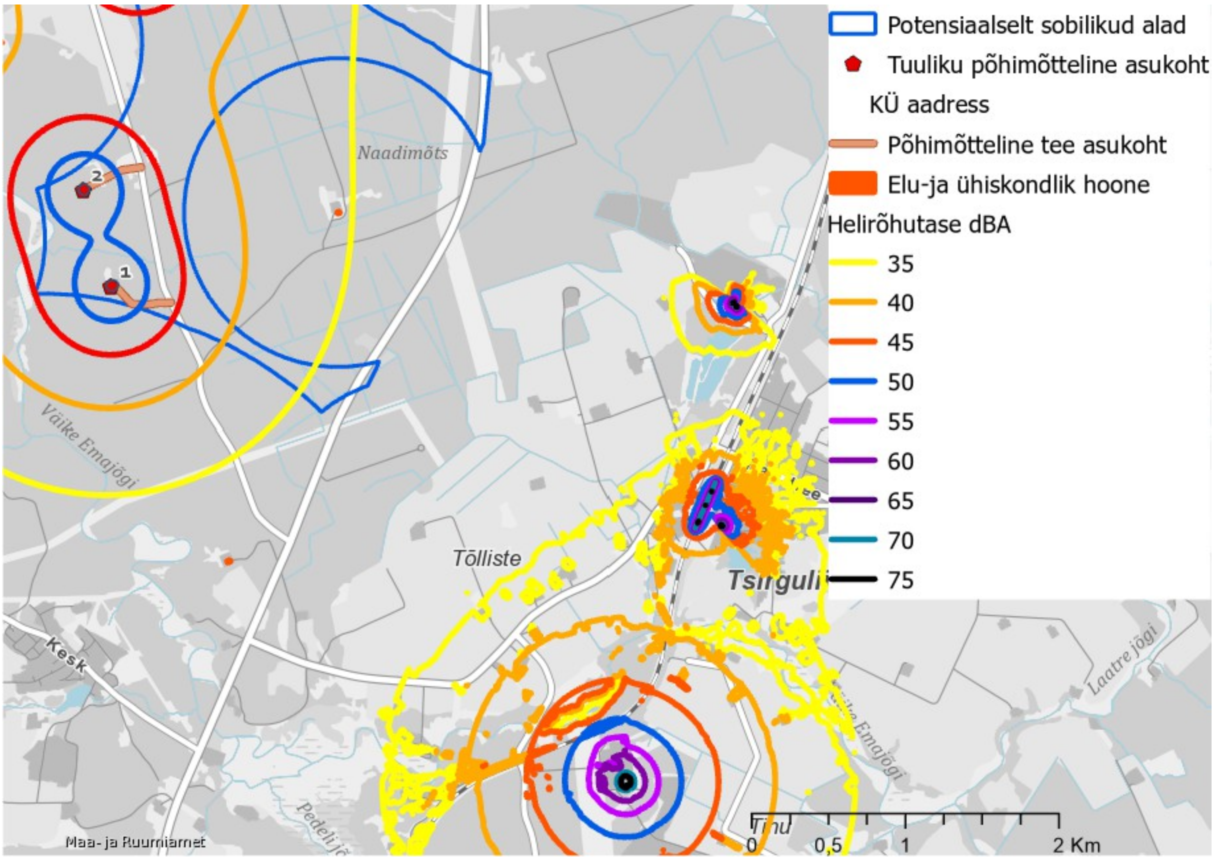


Figure 61. Possible combined impact of the Tsirguliina substation, industrial areas and the planned wind farm.

There may also be a small amount of traffic noise in the wind farm area. The source of traffic noise is primarily the Jõhvi-Tartu-Valga road, which has an average annual daily traffic volume of 2099. Uniküla is also connected to the rest of the region by the Tõlliste-Uniküla-Õruste road, but the traffic frequency on this road is less than 50 vehicles per day, which means that it is a road with very low traffic frequency that cannot be considered a significant source of traffic noise.

According to Annex 1 of Regulation No. 71 adopted by the Minister of the Environment on 16 December 2016, different noise limit and target values apply to industrial noise and traffic noise in Category II areas. The limit values for traffic noise in Category II areas (residential areas) are 60 dB during the day (65 dB on the roadside facade of buildings) and 55 dB at night (60 dB on the roadside facade of buildings), and the target values for traffic noise are 55 dB during the day and 50 dB at night. Thus, traffic noise standards are significantly higher than industrial noise standards.

According to the Valga municipality daytime traffic noise map, the traffic noise limit is guaranteed at a distance of approximately 43 m from the Jõhvi-Tartu-Valga main road No. 3 and the traffic noise target value is guaranteed at a distance of approximately 77 m. According to the traffic noise map, at night the traffic noise limit value is guaranteed at a distance of approximately 28 m from the road and the traffic noise target value is guaranteed at a distance of approximately 65 m (Figure 62).

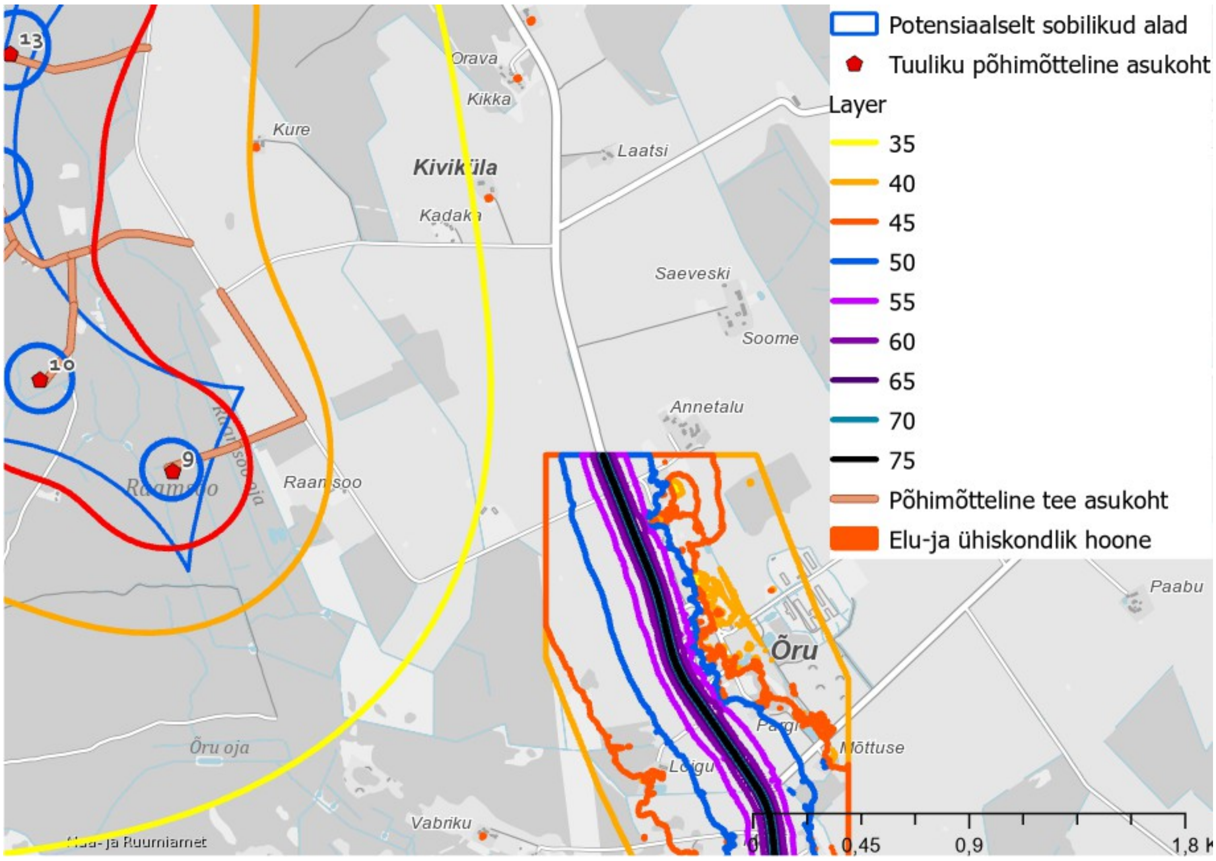


Figure 62. Combined impact of industrial noise from the planned wind turbines and existing traffic noise.

When compiling the Valga noise map, traffic noise maps were only compiled for areas with high population density. In this EP SEA report, indicative noise level contours were created for the same main road (Jõhvi-Tartu-Valga main road no. 3) (based on the distances obtained from the Valga noise map), according to which the target and limit values for night-time and daytime traffic noise would be guaranteed. The analysis showed that the combined impact of wind farm and road noise may occur primarily in the case of residential buildings located in the immediate vicinity of the road, where traffic noise levels are already close to the limit value. At the same time, it is not expected that the noise level of the wind turbines will reach the target value for industrial noise in any of these residential areas. It has been established that in cases where the expected noise level caused by wind turbines is low (below 40 dB), it can be assumed that road noise will mask wind turbine noise (reducing disturbance). This is particularly the case where road noise is significantly louder (+20 dB higher)([204]).

Therefore, no significant combined effect of wind farm noise and traffic noise is expected, which could cause traffic or industrial noise levels to be exceeded in residential areas. Rather, it can be assumed that wind farm noise will be masked by traffic noise in areas close to the road.

4.6.1.7 Measures, need for further studies and assessment

- As the noise generated by wind turbines can be heard from a long distance under certain conditions and may be disturbing, preference should be given to lower-noise models that use technical noise reduction measures (e.g. serrated blade edges, etc.). Use new, fully functional wind turbines.
- The owner of the wind farm must ensure that the noise level of the wind turbines does not exceed the target value for industrial noise öisel . Exceeding the target value is permitted only with a notarial

[204]Pedersen, E., van den Berg, F., Bakker, R.H., Bouma, J. 2010. Can road traffic mask the sound from wind turbines? Response to wind turbine sound at different levels of road traffic. Energy Policy. 38. 2520-2527. 10.1016/j.enpol.2010.01.001

if an agreement (tolerance easement) exists. Exceeding the industrial noise limit is not permitted. In order to ensure that the target value for night-time noise is met in all residential areas, four wind turbines with a sound power level of Lw<107.8 dB must be used in the area, with a maximum noise level of Lw=105 dB for the three wind turbines located in the area and Lw=104 dB for the two wind turbines located in the area. It is also possible to find alternative combinations of wind turbine operating modes during the design phase that ensure compliance with the night-time industrial noise target value in residential areas.

− When installing wind turbines, including when selecting the distance between them, the technical requirements of the wind turbine manufacturer must be observed. Wind turbine manufacturers guarantee the noise emissions specified in the technical documentation for the wind turbine if the wind turbines are installed and maintained properly. If wind turbines are placed closer to each other than is technically recommended, noise emissions may exceed the guaranteed noise level.

When applying for a building permit, the maximum noise level of the recommended wind turbine and the corresponding noise level modelling must be submitted (based on the recommendations for assessing wind turbine noise propagation valid at the time), on the basis of which the local government can verify that the noise standards are met in noise-sensitive areas when using the corresponding wind turbine model. If the wind turbine model is changed during construction, the relevant data must also be submitted with the application for a wind farm operating permit.

− Noise during construction must not exceed the limits set out in the Atmospheric Air Protection Act and Regulation No. 71 of the Minister of the Environment of 16 December 2016, issued on the basis thereof, 'Noise standards for outdoor noise and methods for measuring, determining and assessing noise levels' and Regulation No. 42 of the Minister of Social Affairs of 4 March 2002 "Noise standards in residential and recreational areas, residential buildings and public buildings and methods for measuring noise levels". Avoid noisy construction work during the night.

Follow-up:

− According to the noise assessment, the highest noise levels caused by the wind farm are expected in the residential areas of the following land parcels: Kure, Eeriku-Peetri, Nilbi, Une-Mati, Jõemetsa, Kuusiku. After the completion of the wind farm (within 6 months), control measurements of noise levels must be carried out in the courtyards of these residential buildings and assessed for compliance with the industrial noise limit value or the value specified in the noise tolerance easement. The measurements must be carried out in accordance with the relevant EVS-EN ISO standard and by an accredited measurer. The measurement results must be submitted to the local government.

If it turns out that the target noise levels are exceeded in residential areas due to the wind farm, the wind farm owner must develop measures to reduce the noise from the wind farm (e.g. limiting the wind turbines to a quieter operating mode during the night).

According to the noise assessment, the values closest to the standard levels of low-frequency noise may occur indoors at frequencies of 50 and 63 Hz in the residential buildings of Kure, Eeriku-Peetri, Nilbi, Une-Mati, Jõemetsa and Kuusiku. After the completion of the wind farm (within 6 months), low-frequency noise measurements must be carried out in the indoor spaces of the residential buildings on the aforementioned land parcels. Low-frequency noise measurements shall be carried out in accordance with standard EVS-EN ISO 16032:202453 or an equivalent document.

If it turns out that the sound insulation of the residential building is not sufficient to ensure compliance with low-frequency noise standards in the interior, the sound insulation must be improved (this is the responsibility of the wind farm owner, who must cooperate with the owner of the residential building to do so). Low-frequency noise levels in indoor spaces must be ensured across the entire low-frequency noise frequency curve.

4.6.2 Shading

4.6.2.1 Assessment methodology

This draft SEA was completed before the Ministry of Climate completed its new guidelines for assessing the impact of wind farms. As the SEA sought to use the best available information, the section on shadowing assessment was updated in August 2025 based on **the methodology presented in the guidelines prepared by the Ministry of Climate (**[205]) . In addition, the reduction in the number of wind turbines and the refinement of their positions were taken into account in connection with the additional measures planned to mitigate the impact on birdlife.

Wind turbines, as tall structures, inevitably cause shadows in sunny weather. There are two types of environmental impacts caused by the combined effect of wind turbines and sunlight: moving shadows and periodic reflections. Moving shadows are caused by the structural parts of the wind turbine. The moving shadows of wind turbines are caused by the rotating blades. As the blades move, the shadow also moves continuously. This can disturb people in nearby homes and drivers on the road in the mornings and evenings.

Reflections occur when the sun is reflected momentarily from the blades of the wind turbine, causing unpleasant glare at certain viewing points. Reflections are caused by the material of the blades; to prevent this, modern wind turbines use matt surface treatment methods.

There is no disturbing shadowing when there is no direct sunlight (cloudy weather) or when the wind turbine is not operating. The lower the sun is in the sky, the greater the extent of the shadows. Therefore, shadows are most extensive in the morning and evening hours and during the winter period. At the same time, the potential duration of shadows is greatest in summer (the days are longer).

Considering the movement of the sun across the sky at our latitude, wind turbines (or other objects) never cast shadows south of the turbine tower. The shadows are longest in the west and east. The total duration of the shadow is greatest in the immediate vicinity of the wind turbine tower in the north-west, north and north-east directions.

The level of shadowing is affected by the diameter of the wind turbine rotor, the height of the mast and the location of the wind turbine in relation to residential areas

.

The duration of the actual shadow is calculated based on the duration of direct sunlight according to meteorological station observations and the operating time of the wind turbines based on wind directions (i.e. the location of the wind turbine blades) and the occurrence of wind calm.

The extent of the shadow can be calculated using appropriate software and a shadow calendar can be compiled for each residential area. Theoretically, shadows can extend several kilometres. In reality, however, the shadow does not cause significant disturbance beyond a distance of approximately 10 times the diameter of the wind turbine rotor. When viewed from a greater distance, the effect of the optical properties of the atmosphere becomes so great that the shadow is no longer perceptible. Shadow flicker can also be a real issue in locations where the wind turbine is visible. The rotor diameter of today's largest onshore wind turbines is up to 175 m. In five years' time, it can be expected that wind turbines with even larger diameters will come into production, which will result in a calculated shadow range of up to 2 km. Again, it must be taken into account that the shadow range is highly dependent on the direction of the wind, the season, the time of day, the visibility of the wind turbine, etc.

The shadow calendar shows whether and when shadowing may occur and whether it is at a level that may be disturbing. The placement of wind turbines is usually optimised based on the duration of shadowing. It is also possible to avoid the disturbance caused by shadow flicker, for example by stopping the operation of wind turbines at certain times (in cases where there is sun, wind and disturbing shadow flicker in relation to residential areas).

[205] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.

Specialised software WindPRO version 4.0 was used for modelling. The shadow impact area and shadow intensity were modelled using the SHADOW module of the WindPRO software.

Shadowing was modelled for the given plan with a maximum permitted blade diameter of 180 m and a mast height of 180 m (tip height 270 m). With regard to shadowing, there is a correlation between the height of the wind turbine and the distance to which the shadow can extend.

The assessment was carried out according to the following principle

- If the worst possible situation is ≤30 h/year or 30 min/day, no further action is required ;
- If the worst possible situation is >30 hours/year or 30 minutes/day, calculations based on real conditions must be performed;
- If the real-world situation is >8 hours/year or 30 minutes/day, mitigation measures must be planned and implement mitigation measures.

Calculation assumptions:

- Worst-case scenario: wind turbines operating all day, sun shining in a cloudless sky from sunrise to sunset, rotor surface perpendicular to the sun's rays, wind direction aligned with the sun at all times. Light refraction in the atmosphere (which has a negligible effect on shadow location compared to other factors) and objects (buildings, trees, etc.) that obstruct the spread of sunlight, except in situations where the presence of an object (especially a building) is guaranteed at a given location for the entire duration of the wind farm's operation.
- Situation based on actual conditions: actual meteorological conditions in the region (duration of sunshine, wind direction). In the case of Estonia, it is possible to use long-term meteorological data from the Estonian Weather Service on the duration of sunshine and the distribution of prevailing winds in the region. More specifically, data from the nearest possible weather station/meteorological station should be used. Objects (buildings, trees, etc.) that obstruct the spread of sunlight are taken into account.
- Situations where the sun is below 3° are not taken into account.

Impact points and their determination:

- Impact points are considered to be indoor and outdoor spaces where shading may cause disturbances.
- Worst-case scenario:
  - The impact is assessed on residential and public buildings, which are determined on the basis of data from the Estonian Topographic Database (ETAK). Where appropriate, commercial buildings and residential and public buildings that have been granted building permits but have not yet been constructed are also included, based on data from local authorities.
  - More specifically, the assessment is carried out on an area measuring 15 m x 15 m, the centre of which is located the building mentioned in the previous point.
  - The calculation height is 1.5 m (normal human eye level).

Situation based on real conditions:

  - The impact is assessed only for buildings that exceed the worst-case scenario .
  - The impact points are determined based on the principles set out in the previous point (worst-case scenario).

The duration and extent of shading were assessed using average meteorological data for many years regarding the duration of sunshine [206] and the distribution of prevailing winds in the region. In order to assess the possible theoretical impact on more distant areas, no distance limit was used in calculating the shadowing, and the shadowing was calculated up to the possible theoretical maximum distance from the wind turbines (approximately 3 km).

The modelling used data from the Estonian Land Board's ground elevation model (data network with an accuracy of 5 m). The viewing height for the shadow map was set at 1.5 m, which is the normal viewing height for a person.

For modelling the actual total shading (*real case*), data from the nearest weather station measuring sunshine duration, i.e. the Tartu-Tõravere weather station, was used. Long-term average meteorological data on sunshine duration (Table 25) and the distribution of prevailing winds in the region (Table 26) were used to estimate the duration and extent of shading. If weather conditions differ significantly from statistical data, the amount of shading will also differ.

Table 25. Modelling used sunshine hours data per day. Basis: https://www.ilmateenistus.ee/kliima/kliimanormid/paikesepaiste-kestus/

Month	Average duration of sunshine per day, ha
January	1.08
February	2.33
March	4.53
April	6.36
May	8.58
June	8.60
July	8.67
August	7.34
September	5.07
October	2.56
November	1.00
December	0.78

Table 26. Estimated annual operating time of wind turbines by compass direction. It is assumed that wind turbines operate up to 90% of the time. Based on wind rose data from the Valga meteorological station.

Wind direction	Operating time (hours per year)
N	67
NE	1025
E	670
SE	828
E	1143
SW	1577
W	1262
NW	710

4.6.2.2 Occurrence and impact of shadow flicker

The shadow cast by wind turbines is highly disruptive when it falls on areas where people are present. This is particularly true in areas where people spend long periods of time, such as residential areas.

[206] State Weather Service. Duration of sunshine. https://www.ilmateenistus.ee/kliima/kliimanormid/paikesepaiste-kestus/

During prolonged periods of shading, a disturbing effect has been observed, particularly on people staying indoors. Due to continuous light flickering lasting more than 30 minutes, stress and impaired concentration have been observed in people[207].

In Estonia, there are no legal standards governing the occurrence of shadows. In the case of shadows, the significant impact threshold is based on the recommended values set out in the guidelines prepared by the Ministry of Climate in 2025 ([208]), which states that if the actual glare situation in a sensitive area is >8 hours/year or 30 minutes/day, mitigation measures must be planned and implemented.

Shading has also been linked to the occurrence of epileptic seizures. It is important to note that flashing light does not cause epilepsy, but it can trigger epileptic seizures in people who suffer from photosensitive epilepsy. Up to 0.03% of the population (up to 3 people in 10,000) suffer from epilepsy. Up to 5% of people with epilepsy are photosensitive. This means that in their case, changes in light intensity at frequencies above 2.5 Hz can trigger epileptic seizures (flashing at frequencies of 15-25 Hz is most likely to trigger epileptic seizures). It has been found that changes in light intensity at frequencies of 3 Hz and below can cause epileptic seizures in 1.7 people p e r 100,000 of the light-sensitive population. To mitigate this risk, the flashing frequency of wind turbine shadows must remain below 60 flashes per minute. ([209]) . The rotational speeds of modern wind turbines are too low (less than 20 revolutions per minute even at maximum rotational speed) to cause light flickering at frequencies above 3 Hz. Theoretically, it is possible for the shadows of several wind turbines to fall on a residential area at the same time, in which case the flashing frequency would be higher than that of a single wind turbine. If each wind turbine rotates at 20 RPM and has 3 blades, then the shadows of 3 wind turbines would have to fall on the residential area at the same time to cause a total flicker frequency of 3 Hz. Such a situation is extremely unlikely.

The results of the shadow modelling are presented in Figure 63. Shadow reports with shadow calendars for residential areas where shadowing at a disturbing level may occur are presented in Appendix 1.

The shadow assessment showed that, given the number and location of the wind turbines, the shadow disturbance level (8 h/a or 30 min/day, taking into account climatic conditions) is expected to be exceeded in a total of 22 residential areas (Table 27 and Figure 63), with 14 of these experiencing more than 8 h/a of shadowing.

Table 27. Duration of shadowing of residential areas caused by wind turbines. The table only shows residential areas that may be affected by the shadow of a wind turbine.

Land parcel	x	y	Maximum duration of shadow (without taking climate into account)	Maximum duration of shadowing per day	Duration of shade taking climate conditions into account
			h/year	h/day	h/year
Gardener	621785	6421867	23:02	00:32	06:48
Below	620603	6424751	28:47	00:31	06:50
Allaste	620659	6424068	21:46	00:32	06:00
Aude	620860	6425443	33:47	00:32	05:42
Eeriku-Peetri	625276	6418570	94:32	00:48	13:02
Elbra	620276	6424919	09:50	00:25	01:55
Jaanimäe	625129	6422581	11:22	00:26	02:44
Jõemetsa	621181	6425313	71:28	00:41	12:57

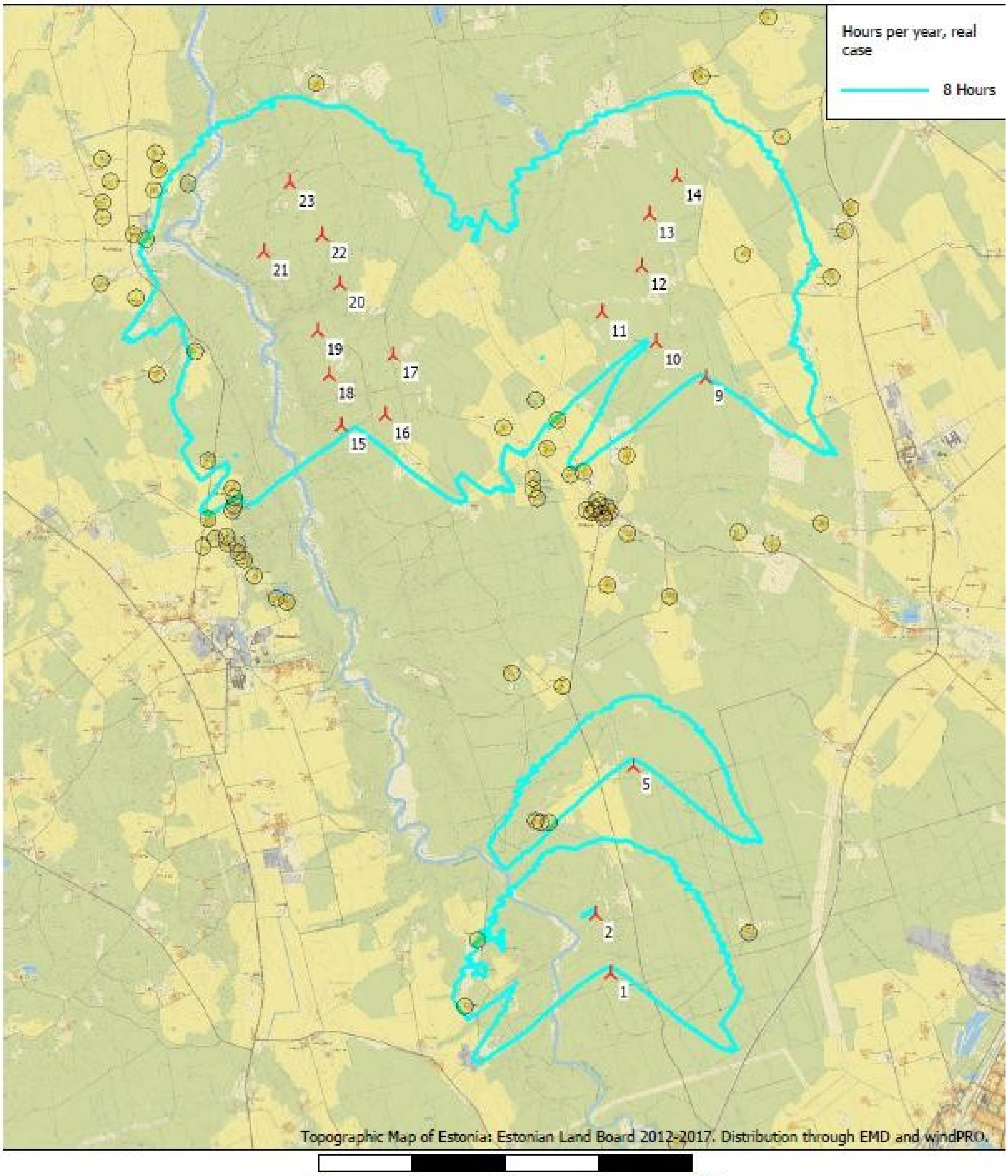
[207] Department of Energy and Climate Change; Parsons Brinckerhoff. Update of UK Shadow Flicker Evidence Base.

[208] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.

[209] Harding, G., Harding, P., Wilkins, A.J. 2008. Wind turbines, flicker, and photosensitive epilepsy: Characterising the flashing that may precipitate seizures and optimising guidelines to prevent them. Epilepsia, 49(6):1095–1098, 2008.

Kajaja-Vidriku	625368	6420051	31:10	00:40	03:17
Kalda	625234	6422890	26:28	00:28	07:23
Kastre	621480	6422340	45:15	00:31	12:50
Kooba	622529	6426421	66:09	01:04	05:18
School grounds	626021	6421691	00:00	00:00	00:00
Kure	627163	6424741	151:58	00:43	27:47
Kuusiku	624654	6422789	62:54	00:35	15:41
Kääriku-Vidriku	625186	6418566	107:39	00:50	16:30
Laanemetsa	624994	6422144	17:41	00:27	04:27
Laksi	621782	6421946	31:37	00:35	09:17
Lohu	621767	6421809	17:59	00:29	05:19
Metsniku	625521	6422342	22:04	00:29	06:32
Manor	620747	6424703	36:35	00:35	08:58
Pine forest	624982	6422247	16:30	00:27	04:01
Naadi	627471	6417460	24:15	00:29	05:16
Nilbi	621312	6423517	65:05	00:34	15:17
Penno	621758	6422054	42:00	00:36	12:08
Pustse-Kotteri	626655	6426626	71:54	01:10	05:41
Raudsepa	628132	6424530	12:29	00:27	01:38
Simmerga	621503	6421703	25:16	00:28	07:28
Singa-Ado	624555	6417293	37:43	00:35	08:57
Tamme	620817	6425229	33:49	00:33	06:22
Udumäe	620822	6425611	30:58	00:30	04:45
Uibo	621839	6421368	00:00	00:00	00:00
Une-Mati	624995	6423098	65:36	00:41	17:08
Uue-Vidriku	625132	6418588	87:29	00:40	16:31
Uulitse	624819	6420173	13:54	00:28	01:41
Varnu	627538	6426010	34:20	00:37	06:03
Võndi	624431	6416574	41:44	00:28	11:51

The necessary measures to reduce shadow flicker are presented in section 4.6.2.3.



Map: Estonian Topographic Map , Print scale 1:60 000, Map center Estonian Lambert L-EST97-EST97 (EE) East: 624 780 North: 6 421 280
New WTG   Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)
Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Figure 63. Shadow map (taking climate conditions into account) for wind turbines with a tip height of 270 m.

4.6.2.3 Measures, need for further studies and assessment

- Disturbing shadow flicker (i.e. taking climate conditions into account, more than 8 hours of shadow flicker in total per year or more than 30 minutes per day) must be avoided in residential areas. Disturbing shadow flicker may only be caused in residential areas with the consent of the owner of the shadow-sensitive area. There are two ways to avoid/reduce shading:

- To reduce disturbance in the relevant residential areas, a green barrier should be created – evergreen species such as spruce should be used to ensure year-round effectiveness. The barrier (a dense row of trees) should be created to protect the courtyard area on the wind farm side of the residential area affected by the shadow. As the measure should be implemented outside the detailed plan area, its implementation may be complex and require cooperation with the owner of the affected residential area.
- Use an automatic shadow monitoring system on wind turbines, which allows the automatic control system of the wind turbine to stop the turbine during periods of disruptive shadowing in cooperation with light intensity sensors. When developing a restriction plan, the location of the impact points can be specified as follows:
  - The exact point of impact indoors is the centre of the largest window in the room most affected by the building
    the centre of the actual size of the window of the relevant room on the facade.
  - The exact point of impact in the outdoor space is selected as the point that reflects regular use of the outdoor space (e.g. the centre of a terrace or seating area) and is located no more than 15 m from the building.

− If it becomes apparent that smaller wind turbines than those assessed in this SEA report are to be used (or some wind turbine positions are left unbuilt), it is possible that there will be no disturbing shadowing in residential areas, in which case the implementation of the measures described above may not be necessary.

Follow-up:

− The shadowing assessment carried out during the SEA revealed that several residential areas may experience disturbing levels of shadowing and that measures need to be implemented to address this. Disturbing levels of shadow flicker are usually avoided by using the wind turbine control system in accordance with the necessary wind turbine operating plan (*curtailment plan)*. The wind farm owner is obliged to keep records of the wind turbine control system, which allow for monitoring compliance with the plan for avoiding disturbing levels of shadow flicker. In the event of a complaint, the wind farm owner is obliged to submit the data to the local government and the complainant.

4.6.3 Other possible health effects

In the case of wind farms, the impact on human health is primarily related to the noise and potential shadow flicker caused by the operation of wind turbines, which is discussed in detail in sections 4.6.1 and 4.6.2.

In many countries, some people living near wind energy production areas have reported symptoms that they associate with wind turbines. The causes of these symptoms remain controversial. In a recent study in Finland, four wind energy production areas in Finland were selected. A questionnaire was sent to 4,847 adults in four distance zones (≤ 2.5 km, > 2.5–5 km, > 5–10 km, > 10–20 km from the nearest wind turbine), and 28% of the respondents replied. In the closest zone (≤ 2.5 km), 15% of respondents reported symptoms that they intuitively associated with the infrasound from wind turbines. The prevalence of symptoms in the entire study area was 5%. Many symptomatic respondents found the noise from the wind turbines disturbing and also associated their symptoms with vibration or electromagnetic fields caused by the wind turbines. One-third of symptomatic respondents rated their symptoms as severe, and the range of symptoms was very broad, affecting multiple organ systems. The analysis of the study found that factors such as proximity to wind turbines, poor health, annoyance with various aspects of wind turbines, and perception of wind turbines as a health risk were associated with the presence of infrasound-related symptoms([210]).

The potential health effects of wind turbines are primarily associated with the impact of the noise they generate. Studies of disturbances associated with various sources of environmental noise (e.g. comparing normal traffic noise and wind turbine noise) have found that wind turbines are perceived as a disturbance at relatively low noise levels (e.g.

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[210] Turunen AW et al. 2020. Symptoms intuitively associated with wind turbine infrasoundLinkki toiselle websiteOpens in a new window. Environmental Research 192: 110360.

in the range of 30-40 dB) [211] . From a health perspective, broad-based studies on wind turbine noise have not found a direct link to chronic diseases, and the main impact may be in the form of certain disturbances [212] . Unlike other sources of environmental noise, wind turbines are generally located at a considerable distance from residential areas, and the number of dwellings located within the area exposed to noise levels that could be harmful to health is small (unlike, for example, traffic noise). In certain cases, people living near wind turbines may experience difficulties sleeping.

As the potential health effects of wind turbines are a topical issue in many countries, various studies reflecting different health effects have been conducted in recent years. A study on medication use conducted in Finland showed that the use of diabetes medications, cardiovascular medications (including medications for arrhythmia), medicines affecting the nervous system (including sleeping pills, sedatives, antidepressants, painkillers and anti-dizziness medicines) and anti-inflammatory and rheumatism medicines near wind farms was no higher than in control areas during the same period, both before and after the start of wind energy production. Similarly, there was no increase in the number of new users of the aforementioned prescription drugs after the start of wind energy production compared to the period before production began ([213]) .

The most comprehensive study of the health effects of wind turbines is known to have been conducted in Denmark [214]. The nationwide Danish study was based on a long-term and comprehensive analysis of the health data of the Danish population. On this basis:

- No strong evidence was found of a link between higher noise levels from wind turbines and an increased risk of the following health problems: heart attack, stroke, hypertension, diabetes, adverse birth outcomes.
- Some evidence was found for an association between higher night-time wind turbine noise and an increased risk of clinical depression (antidepressant prescriptions). This finding was based on a comparison between the group with the highest noise levels (≥42 dB LAeq, at night) and the group with the lowest noise levels (<24 dB LAeq, at night). A gender-specific analysis showed that the effect was stronger in men than in women.
- A link was also found between long-term average night-time wind turbine noise levels (≥42 dB LAeq) and the purchase of sleeping pills among people aged 65 and older.

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[211] Radun, J., Maula, H., Saarinen, P., Keränen, J., Alakoivu, R., Hongisto, V. 2022. Health effects of wind turbine noise and road traffic noise on people living near wind turbines. https://doi.org/10.1016/j.rser.2021.112040

[212] van Kamp, I.; van den Berg, F. 2021. Health Effects Related to Wind Turbine Sound: An Update. Int. J. Environ. Res. Public Health, https://doi.org/10.3390/ijerph18179133

[213] Turunen A et al. 2022. Use of prescription drugs in the vicinity of wind power production areas. Link to another website Opens in a new tab Environment and Health magazine 1/2022.

[214] Poulsen, AH, Raaschou-Nielsen, O, Peña, A, Hahmann, AN, Nordsborg, RB, Ketzel, M, Brandt, J & Sørensen, M, 2018. Short-term nighttime wind turbine noise and cardiovascular events: A nationwide case-crossover study from Denmark. Environment International, 114, 160-166.

Poulsen, AH, Raaschou-Nielsen, O, Peña, A, Hahmann, AN, Nordsborg, RB, Ketzel, M, Brandt, J & Sørensen, M, 2018. Long-term exposure to wind turbine noise and redemption of antihypertensive medication: A nationwide cohort study. Environment International, 121 (1), 207-215.

Poulsen, AH, Raaschou-Nielsen, O, Peña, A, Hahmann, AN, Nordsborg, RB, Ketzel, M, Brandt, J & Sørensen, M, 2018. Long-term exposure to wind turbine noise at night and risk for diabetes: A nationwide cohort study. Environmental Research, 165, 40-45.

Poulsen, AH, Raaschou-Nielsen, O, Peña, A, Hahmann, AN, Nordsborg, RB, Ketzel, M, Brandt, J & Sørensen, M, 2018. Pregnancy exposure to wind turbine noise and adverse birth outcomes: A nationwide cohort study. Environmental Research, 167, 770-775.

Poulsen, AH, Raaschou-Nielsen, O, Peña, A, Hahmann, AN, Nordsborg, RB, Ketzel, M, Brandt, J & Sørensen, M, 2019. Long-term exposure to wind turbine noise and risk for myocardial infarction and stroke: A nationwide cohort study. Environmental Health Perspectives, 127 (3), 037004.

Poulsen, AH, Raaschou-Nielsen, O, Peña, A, Hahmann, AN, Nordsborg, RB, Ketzel, M, Brandt, J & Sørensen, M, 2019. Impact of long-term exposure to wind turbine noise on redemption of sleep medication and antidepressants: A nationwide cohort study. Environmental Health Perspectives, 127 (3), 037005.

4.6.3.1 Vibration

4.6.3.1.1 Methodology

The assessment of possible vibration from wind farms was based on the methodology presented in the guidelines prepared by the Ministry of Climate[215]. The guidelines state that, given that the spread of vibration depends, among other things, on the properties of the soil at the site and the capacity of the wind turbines, it is advisable, based on the precautionary principle, to ensure that wind farms are located at least 500 m away from vibration-sensitive buildings (residential and public buildings) in order to avoid negative (including cumulative) impacts. If this distance is maintained, it is not necessary to carry out detailed vibration studies. In the case of this detailed plan, the distance between the wind turbine and vibration-sensitive buildings is greater than 500 m, and therefore no vibration assessment will be carried out in the preparation of the SEA report.

4.6.3.1.2 Occurrence and impact of vibration

Vibration standard values are specified in Regulation No. 78 of the Minister of Social Affairs of 17 May 2002, "Vibration limit values in residential and public buildings and methods for measuring vibration".

Table 28. Vibration limit values during the day (07:00–23:00) and at night (23:00–07:00) in accordance with Regulation No. 78.

Buildings and rooms	Vibration exposure time	Vibration acceleration a_v limit values, (m/s^2)	Vibration acceleration levels L_{av} limit values, (dB)
Limit values for vibration levels shared accommodation and care institutions, pre-school childcare facilities living rooms, group rooms and bedrooms	During the day At night	1.26×10^{-2} 8.83×10^{-3}	82 79
Accommodation establishments Accommodation facilities	During the day At night	1.26×10^{-2} 8.83×10^{-3}	82 79
Healthcare service provision facilities, except hospital wards	24-hour 24 hours	1.26×10^{-2}	82
Hospital wards	Daily 24 hours	8.83×10^{-3}	79
premises of educational institutions, where teaching takes place	During the day	1.26×10^{-2}	82
Offices and administrative buildings	During the day	2.52×10^{-2}	88

The operation of wind turbines causes a certain amount of vibration in the blades and rotor, which is then transmitted to the tower. However, technological solutions have minimised the occurrence of vibration and prevented its transmission. An important part of preventing and dampening vibration is the wind turbine foundation, which must be designed to be sufficiently strong, taking into account the specific wind turbine and the geological conditions of the location. The specific foundation solution is developed during the design phase. To ensure the stability of the wind turbine (including over a long period of time and in extreme conditions), the foundations of wind turbines are built to be massive and of a suitable construction, which ensures minimal vibration in the foundation and surrounding soil.

Scientific analyses of wind turbine vibration in recent years have focused on technical vibration in wind turbine structures in order to identify possibilities for automatic monitoring [216] or to improve technical solutions [217]. The aim of such studies is to reduce the risk of technical failures and accidents in wind turbines.

[215] Ministry of Climate, 2025. Guidelines for assessing the environmental impact of wind farms. Noise, vibration, shadowing.

[216] Escaler, X., Mebarki, T. 2018. Full-Scale Wind Turbine Vibration Signature Analysis. Machines.

[217] Xie, F., Aly, A-M. 2020. Structural control and vibration issues in wind turbines: A review. Engineering Structures Volume 210.

As with other technical equipment and tall structures, it is important that vibration can be reduced to a minimum.

In the case of ground vibration, the level perceptible to more sensitive individuals is 0.15 mm/s. Measurements taken at wind farms have, on rare occasions, recorded vibration levels exceeding human sensitivity in the immediate vicinity of wind turbines (at the base of the turbine). Further away, vibration levels are below the human perception threshold. ([218]) Even more recent studies have not been able to measure vibration levels in homes located in the vicinity of wind turbines that exceed the human perception threshold or the applicable vibration limit values ([219]) . However, very low levels of vibration caused by wind turbines can be measured with sensitive seismographs at a distance of 10–15 km from the wind turbines ([220]) .

Considering that in this case the planned locations of the wind turbines are at least 1 km away from residential areas, vibrations exceeding the human perception threshold or the applicable vibration limit values are not expected.

However, there may be some impact on soil life in the immediate vicinity of the wind turbines, which is associated with vibration. For example, it has been found that the abundance of earthworms in the immediate vicinity of wind turbines is lower than in more distant areas (the study considered an area approximately 200 m away from the turbine to be a more distant area), but at the same time there is no impact on smaller soil organisms([221]) . For example, studies of voles and rodents (i.e. species living underground) in Poland have found no significant differences in species composition, abundance or population parameters between wind farm areas and control areas ([222]). At the same time, an increase in the abundance of reptiles has been observed in wind farm areas, but this is not related to vibration, but to changes in predator-prey relationships. Therefore, no significant adverse effects due to possible vibration are to be expected from the construction of wind farms.

4.6.3.2 Electromagnetic field

An electromagnetic field is a physical field created and influenced by electric charges, consisting of an electric field and a magnetic field as a single entity. Electronic devices cause electromagnetic waves. The strength of electric fields in the living environment is regulated by Regulation No. 38 of the Minister of Social Affairs of 21 February 2002
"Limit values for non-ionising radiation in living and recreational areas, residential buildings and public buildings, classrooms and measurement of non-ionising radiation levels" - The regulation establishes limit values for the numerical values of physical quantities characterising electric, magneticand electromagnetic fields obtained through measurement, from the perspective of harmful physical factors that may affect human health. The levels of electric, magnetic and electromagnetic fields in the living environment must not exceed the limit values.

Measurements in existing wind farms have shown that wind turbines do not cause any particular electromagnetic waves. The magnetic field in the immediate vicinity of wind turbines remains at a lower level than that of conventional household electronic devices ([223]). Electromagnetic fields are primarily associated with the high-voltage power lines that may accompany wind farms. No new overhead power lines are planned in the Valga special plan.

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218 Meunier, M. 2013. Wind Farm - Long term noise and vibration measurements. The Journal of the Acoustical Society of America 133.
219 Borowski, S. 2019. Ground vibrations caused by wind power plant work as environmental pollution - case study. MATEC Web of Conferences: 18th International Conference Diagnostics of Machines and Vehicles.
220 Nguyen, D-P., Hansen, K., Zajamsek, B. 2020. Human perception of wind farm vibration. Journal of Low Frequency Noise, Vibration and Active Control, Vol. 39(1) 17–27.
221 Velilla, E., Collinson, E., Bellato, L., Berg, M.P. and Halfwerk, W. (2021), Vibrational noise from wind energy-turbines negatively impacts earthworm abundance. Oikos, 130: 844-849. https://doi.org/10.1111/oik.08166
222 Lopucki, R., Mroz, I. 2016. An assessment of non-volant terrestrial vertebrates response to wind farms – a study of small mammals. Environmental Monitoring and Assessment- 2016; 188: 122.
223 McCallum, L.C., Whitfield Aslund, M.L., Knopper, L.D. et al. 2014. Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?. Environ Health 13, 9.

The following was written in an article published on delfi.ee on 28 November 2024 entitled *'Aidu wind farm interferes with Defence Forces signal intelligence': "The Defence Forces have also carried out control measurements, which have proven that wind turbines generate and reflect interference in the environment that affects their surveillance capabilities. "Over the last four years, the Consumer Protection and Technical Regulatory Authority has recorded civil radio interference caused by wind turbines measured from a distance of 16 kilometres – this exceeded the standardised electric field strength for sparsely populated areas by a hundredfold (40 dB)."* The KSH turned to the TTJA, as the supervisory authority, for clarification on this issue. The TTJA did not disclose the results of the measurements, but noted that the limits for non-ionising radiation concern strong fields and their limitation for health protection purposes. Wind farms are not radio transmitters by nature and do not generate strong fields. The discussion in this article therefore relates to the possible impact on the Defence Forces' radar and radio communication systems. The article does not discuss the exceeding of non-ionising radiation limits applicable to the protection of human health.

4.6.4 Impact on social needs and property

4.6.4.1 Location in relation to residential areas

In Estonia, the distance between wind turbines and residential areas is not directly regulated. The distance is indirectly regulated by noise standards. Based on noise modelling of various wind farms, compliance with the applicable noise standards is ensured in most cases at a distance of less than 1 km from the wind turbines. However, in certain cases, the combined noise of wind turbines and groups of wind turbines may exceed the night-time industrial noise limit even at distances greater than 1 km (see section 4.6.1).

Looking at the practices of other European countries, many countries regulate the distance of wind turbines as well as noise levels, which are similar to the values applicable in Estonia. The distance requirement or recommendation in European countries is 500–2000 m[224]. Often, the distance restriction is calculated based on a specific wind turbine parameter. For example, in Denmark, a wind turbine must be located at a distance of 4 times the height of the turbine, and in Northern Ireland, at a distance of 10 times the diameter of the rotor from residential buildings.

In the case of the Valga municipality special plan, according to the terms of reference, the distance between a wind turbine and the nearest residential building must generally be at least 1 km; wind turbines may be planned closer than this only with the consent of the owner of the residential building. According to the special plan solution as of 09.08.2025, there are no residential or public buildings closer than 1 km to the locations of the wind turbines.

In order to assess the number of sensitive areas affected by the construction of a wind farm, one important criterion is the number of potential residents/residential buildings in the vicinity of the area. To this end, the areas were examined on the basis of ETAK data and the number of residential and public buildings within the potential direct impact area of the selected locations was determined. Defining the extent of the impact area can be complicated in the case of wind farms (a wind turbine is potentially visible over a very large area, for example). In Denmark, for example, an approach is used whereby the area potentially directly affected is considered to be up to six times the height of the wind turbine ([225]), or in this case 290×6=1740 m. The environmental disturbance fee regulation in force in Estonia stipulates that for wind turbines up to 250 metres high, the fee is paid to residents located up to 2 km away, and for taller wind turbines, to residents located up to 3 km away. Accordingly, the impact area of a wind farm is considered to be 2 or 3 km.

[224] Dalla Longa, F., Kober, T., Badger, J., Volker, P., Hoyer-Klick, C., Hidalgo, I., Medarac, H., Nijs, W., Politis, S., Tarvydas, D. and Zucker, A. 2018. Wind potentials for EU and neighbouring countries: Input datasets for the JRC-EU-TIMES Model, EUR 29083 EN, Publications Office of the European Union, Luxembourg.

[225] IEA WIND TASK 28 . SOCIAL ACCEPTANCE OF WIND ENERGY PROJECTS "Winning Hearts and Minds" STATE-OF-THE-ART REPORT. Country report of Denmark.

Table 29. Number of residential and public buildings (not including residential units) located in the vicinity of potentially suitable areas. Source: Land Board ETAK data as of 08.08.2025.

	up to 2 km	2–3 km	Total 0-3 km
Residential and public buildings within the impact area of wind turbines buildings, pcs	71	206	277

The analysis revealed that the number of sensitive buildings within the potential impact area is highest for the locations of wind turbines in potentially suitable area 3 (the village of Hummuli falls within the impact area).

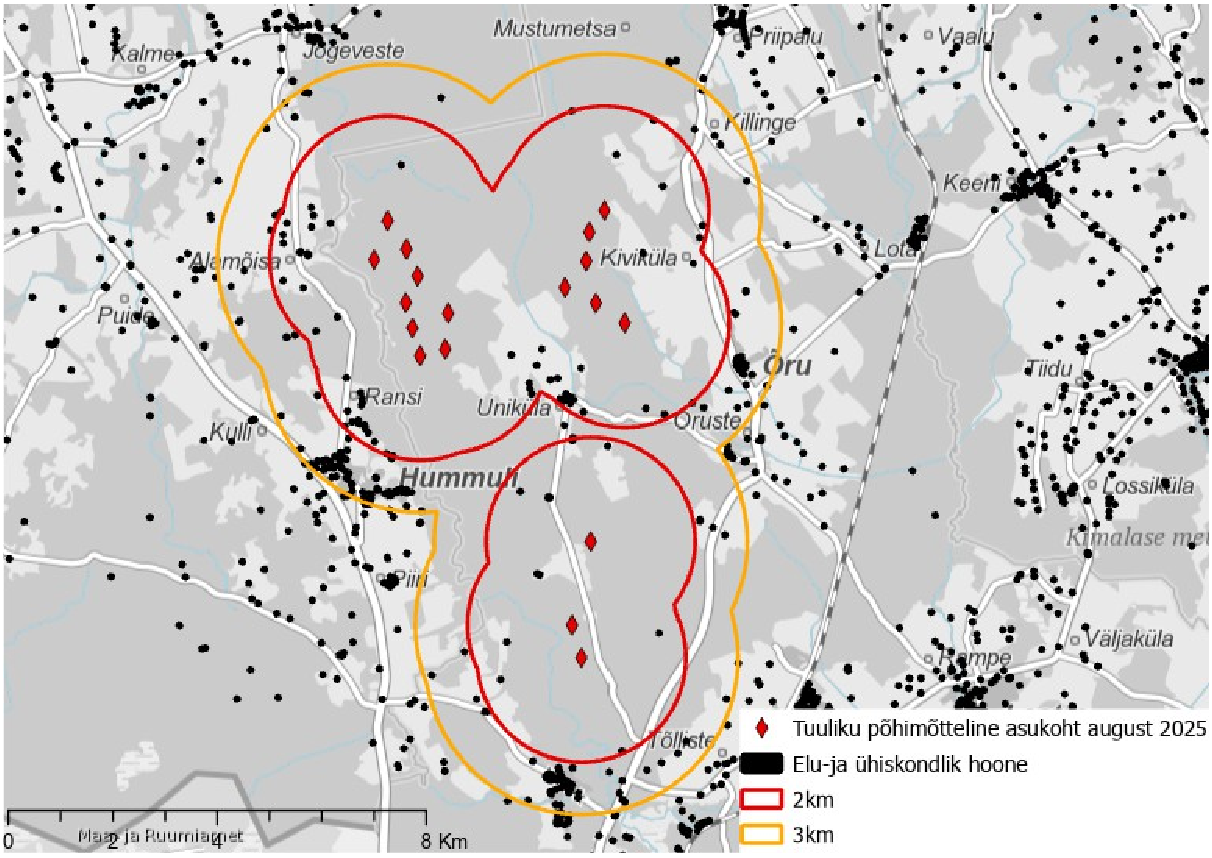

Figure 64. Residential and public buildings within a 2–3 km radius of the proposed wind turbine locations in the special planning area, based on ETAK data (08.08.2025).

4.6.4.2 Impact on the economy

Employment

The construction of a wind farm creates **jobs**. The average estimated number of additional jobs created by the construction of wind farms varies in different scientific and applied studies. A review article published in 2019([226])examines jobs related to wind farms per 1 MW of installed wind farm capacity. The review article shows that the results of individual studies vary widely in terms of employment (in some contexts, the number of jobs is less than 1, while in others it is more than 15 jobs per MW).

According to this study, the likely number of jobs created during the construction and installation phase is 2.5–5.5 jobs per megawatt of wind farm capacity.

[226] Aldieri, L., Grafström, J., Sundström, K., Vinci, C., P. Wind Power and Job Creation. Sustainability 2020, 12, 45; doi:10.3390/su12010045.

The construction of a wind farm is a labour-intensive but temporary process. It directly involves builders, engineers, technicians and logisticians, but indirectly also industry (e.g. wind turbine manufacturing, transport) and other services. For example, during the construction of Estonia's largest wind farm, Sopi-Tootsi (255 MW), approximately two hundred workers were employed on site each working day ([227]).

Based on this research article, the number of additional jobs created during the operation of a wind farm can be estimated at 0.3–2 jobs per megawatt. However, the actual employment generated by modern wind farms during operation may be lower due to the use of automation. Typically, an onshore wind farm requires approximately 0.1 direct permanent jobs per 1 MW, which means that approximately one full-time maintenance technician can service ~10 MW of wind farm capacity. In other words, one technician manages approximately 7–10 wind turbines (depending on the size of the turbines)([228]). It should also be noted that jobs related to the operation of wind turbines are mainly related to wind turbine maintenance, which requires specialised education.

The employment analysis of wind farms does not take into account indirectly affected areas where demand may increase – primarily services, but also other supporting areas, as their forecasting depends to a large extent on factors other than the construction of wind turbines. In this region, significant employment needs can be expected in the service and accommodation sectors, especially during the construction period. Similar to the construction period of the Tootsi-Sopi wind farm, significant demand for accommodation and catering services can be expected in the vicinity of the wind farm during the construction period.

Jobs related to the manufacture of wind turbines are not usually linked to the location where the wind farm is being built, as manufacturing requires resources, know-how and a suitably qualified workforce. Wind turbines are not currently manufactured in Estonia. Therefore, there is no impact on employment in the region.

Jobs related to logistics, installation and operation can be filled partly by local workers, depending on the specific knowledge required for the construction of the wind farm.

Jobs related to maintenance and administration are long-term, stable jobs. However, such jobs require specialised training. Wind turbine maintenance specialist courses are being launched at both Kuressaare Vocational School and Pärnumaa Vocational Education Centre. The impact of the construction of the wind farm on employment is therefore expected to be potentially positive to a small extent.

Direct line [229]

According to the Electricity Market Act in force at the time of compiling this SEA, it is permitted to establish a direct line on the same registered immovable property as the power plant, on a registered immovable property adjacent to it, or **to an electrical installation located up to six kilometres from the production facility**. There is some uncertainty regarding wind farms, which are considered to be 6 km away (either from the wind turbine or the substation within the wind farm, if planned, or even from the point connecting the wind farm to the main grid, i.e. the connection point).

In the direct line area, it is possible to use electricity at a lower network fee. In the case of wind power plants, this is also environmentally friendly renewable energy. This is an important factor for energy-intensive companies and/or companies that prefer renewable energy, which may affect companies already operating in the area and encourage the establishment of new companies and the creation of jobs in the area. Therefore, the construction of a direct line connected to the wind farm in the potential area may have a positive impact on the competitiveness of the region.

[227] Enefit Green. (2024, 13 August). *Enefit Green's Sopi-Tootsi wind farm supplied its first electricity to the grid*. [Press release]enefitgreen.ee

[228] Kotarbinski, M., Keyser, D., & Stefek, J. (2020). Workforce and Economic Development Considerations from the Operations and Maintenance of Wind Power Plants (NREL Report No. NREL/TP-5000-76957). National Renewable Energy Laboratory

[229] Direct line – a line located in the service area of a network operator that does not have a separate connection to the network, except for a closed distribution network, but which may be indirectly connected to the grid via a market participant's electrical installation and which is intended for the transmission of electricity from one power plant to another or to another market participant for its own use, resale or transmission.

There are several misconceptions surrounding the topic of direct lines. Electricity is not automatically cheaper for companies in the potential area of a direct line (within a 6 km radius of a wind farm). It is necessary to build a power line from the production facility to the relevant electricity consumer, and the cost of building such a line is generally borne by the company interested in the matter. Therefore, in reality, it is realistic (i.e. economically viable) to locate production facilities as close as possible to the power plant, provided that the company has a high electricity consumption. Therefore, in order to take advantage of the positive impact on the competitiveness of business development in the region, it is necessary to establish energy-intensive companies as close as possible to the wind farm or for such companies to already exist in the region.

When compiling the SEA, the location of commercial and industrial land within a 6 km radius of the proposed wind turbine sites was analysed.

All potentially suitable areas are located near industrial land (Figure 65). Area 4 can be considered to have the greatest potential positive impact, as it is located in the immediate vicinity of cadastral units with a significant proportion of land designated for industrial use.

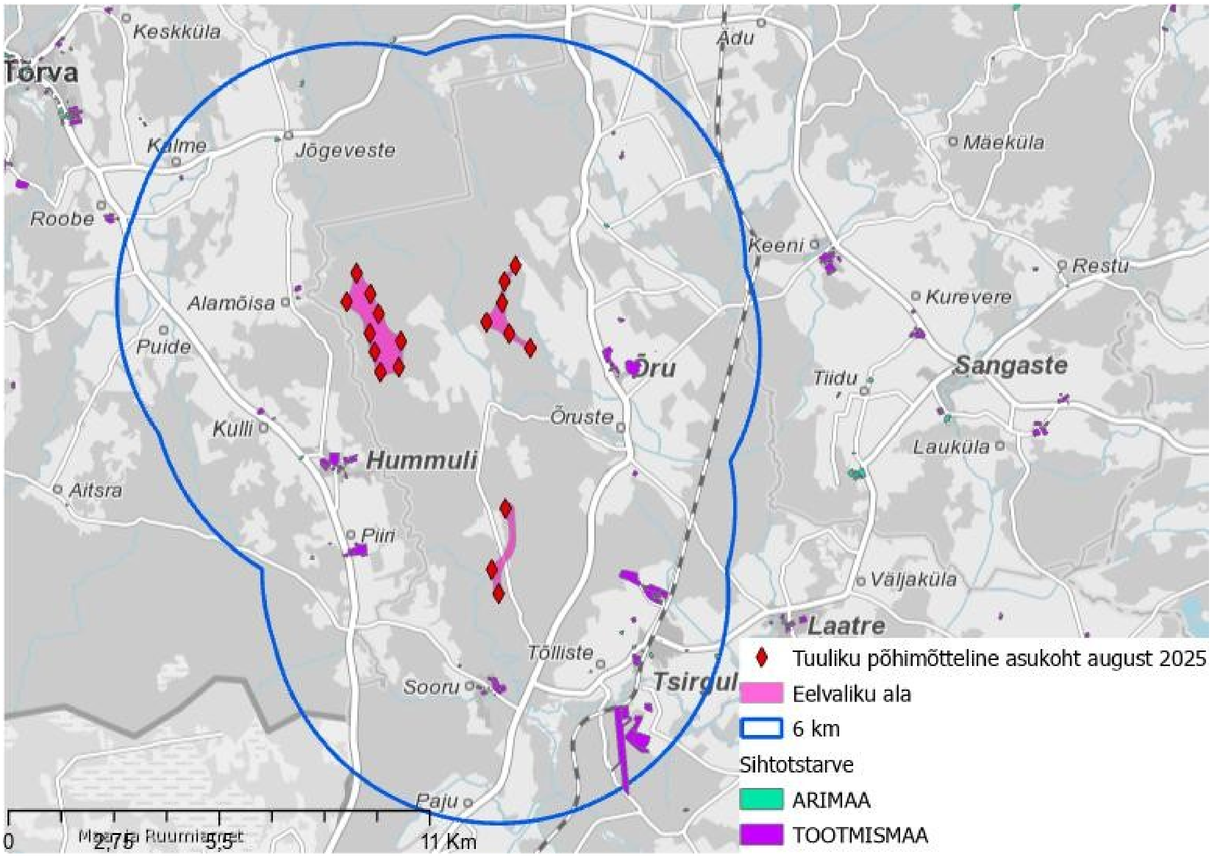

Figure 65. Possible direct line extent of the special planning area and commercial and industrial land located within it. (Source: Land Board map; commercial and industrial land in Valga and Tartu counties, cadastral units as of 26 September 2024).

4.6.4.3 Impact on property

In the context of the Environmental Impact Assessment Act, impact on property is considered to be the impact on property resulting from changes in environmental conditions – typically, such an impact may manifest itself, for example, in the form of vibrations that may affect neighbouring buildings. The construction of a wind farm will not have such an impact on property. Vibration is discussed in section 4.6.3.1. The construction and operation of the wind farm will not cause vibration that could damage buildings and thus have an impact on property within the meaning of the KeHJS. However, this SEA is being carried out in an expanded manner, also addressing the relevant impacts within the meaning of the PlanS, and therefore the impact on property values is also being addressed.

It is not possible to assess the impact on the price of each specific property when preparing the SEA for the special plan, as the price of real estate depends on the condition of the specific property, the marketing associated with the sale, the potential buyer's ability to obtain a loan, etc. Given the scarcity of wind farms in Estonia, there is also no adequate database of real estate transactions to provide estimates of changes in the value of real estate in the vicinity of Estonian wind farms. In view of the above, the following is an overview of possible changes in real estate value based on practices in other countries, but no location-based real estate valuation was performed.

Impact of wind farm construction on the value of land parcels under wind farms

The construction of a wind farm does not significantly interfere with the current use of agricultural land. The land under the wind turbines will remain the property of the owner (at their request), and agreements on easements or building rights regulating the construction of the wind farm and infrastructure will be concluded between the wind turbine developer and the landowners. The value of these agreements depends on the agreement between the developer and the landowner. In general, the landowner receives direct income in the form of a building fee under the building right agreement. In order to construct technical networks, it is necessary to conclude personal right of use agreements in favour of the (network) owners in their protection zones, which may also include agreements on technical network tolerance fees.

Agricultural land that is directly under wind turbines (vertical projection of the blades on the ground) may be reclassified as production land or part of the land may be designated as production land. This change affects the calculation of land tax for the land in question. The intended use of the remaining part of the land parcel will not be changed and forestry or agricultural use may continue there. On forest land, trees must be removed (cleared) within the assembly site (an area of approximately 1 ha) and the area necessary for the construction of infrastructure in order to erect wind turbines.

Along with the construction of wind farms, it is also possible to develop other activities suitable for production land, such as solar parks or other production projects.

In summary, the owners of the land on which the wind farm is built generally derive direct economic benefits from the construction of the wind farm. At the same time, the current use of the land is restricted only in the area directly affected by the construction activities.

Impact of wind farm construction on the change of use of registered immovable property within a 1 km radius

Areas suitable for wind farms are identified taking into account the location of existing residential buildings. If the criterion for selecting the location of the area has been a 1 km buffer zone from existing residential buildings, this also means that there will be no residential or public buildings within a 1 km radius of the wind farm (unless otherwise agreed with the owner of the respective residential building).

Pursuant to § 110(1) of the Planning Act, the organiser of the preparation of a local government special plan may establish a temporary planning and construction ban in the planning area or part thereof for the duration of the preparation of the detailed solution of the local government special plan, if the plan being prepared is intended to change the building rights previously established for the planning area. This prevents the planning of new noise-sensitive objects in a potentially unsuitable area, i.e. an area where noise levels exceeding the target value for industrial noise may occur and where the construction of noise-sensitive buildings is therefore not recommended. The restriction does not apply to the construction of buildings necessary for infrastructure, agriculture, forestry and mineral resource extraction. However, the construction of residential buildings, holiday homes, etc. in the area may become impossible in the future. **The restriction limits the possible uses of land in the area.** Depending on the noise emitted by the wind turbines, the extent of such a restriction is usually up to 1 km from the wind turbines (isocontour line corresponding to the target value for industrial noise). Local authorities have an important role to play in ensuring that all persons who may be affected by such a restriction are involved in the planning process.

The establishment of a wind farm often leads to the development of the region's infrastructure. If necessary, direct lines are built without network charges and the road network is developed. The possibility of building direct lines without network charges may encourage the development of energy-intensive businesses in the region and thus create jobs. The possibility of constructing direct lines may (but does not necessarily) lead to an increase in the proportion of commercial and industrial land in the region. Considering that it is more economical to construct direct lines that are as short as possible, the construction of a wind farm may encourage the use of land within the immediate vicinity of the wind farm for commercial and industrial purposes. Commercial and industrial enterprises are not noise-sensitive areas and can be established in the immediate vicinity of the wind farm.

Impact of wind farm construction on the value of residential properties more than 1 km away

The planned activity will not have a direct (physical) impact on residential properties and their yards, as wind turbines are generally not planned to be located closer than 1 km from residential buildings. The impact may be reflected in a change in property values. To our knowledge, no studies have been conducted in Estonia on the impact of wind farms on real estate prices. It is not possible to conduct such a study in Estonia because the amount of real estate in the vicinity of wind farms is still so small that there is no sample of comparable transactions available to assess changes in real estate prices. However, studies on changes in real estate prices related to wind farms have been conducted in many other parts of the world.

In general, studies show a negative impact or no impact on real estate prices. In certain cases, there may also be a positive impact, for example, if the construction of a wind farm significantly improves access to the land or if there are other factors affecting real estate prices.

Distance

The main factor affecting property prices is presumably the proximity of the wind farm.

Parsons and Heintzelman (2022)[230]compiled a summary of previous studies on this topic. They used four distance ranges and found that the variation in impact is large in each distance range. For example, for distances of less than 1 km, the impact ranged from -13% to 1.6%. As the distance increased, the variation decreased but remained high. For distances of 3–4 km, the impact ranged from -8% to 3.6%. The average impact decreased steadily with increasing distance. At a distance of < 1 km, the average impact of all data was -5.0%. In the following three ranges, it fell to -4.0%, -2.6% and -1.2%, respectively. Thus, the evidence points to a negative average impact of wind turbine distance, which dissipates relatively quickly with increasing distance. Thirdly, the proportion of studies in which no impact is found at a distance increases with increasing distance: < 33% of studies for 1 km, 28% of studies for 1–2 km, 50% of studies for 2–3 km and 72% of studies for 3–4 km.

Visibility

Parsons and Heintzelman (2022) summarise previous studies on the importance of visibility as follows: in studies comparing the effects of view and distance, the results were mostly the same. They highlight Gibbons' (2015) ([231])approach, in which binary view ([232])is linked to distance ranges in the model. His hypothesis was that effects only occur when there is a view, i.e. direct visibility between the dwelling and the wind farm. The average price decline was found to be around 5–6% for dwellings located in the vicinity (within a radius of up to 2 km) of a visible wind farm. Price decline

[230] Parsons, G., & Heintzelman, M. D. (2022). The Effect of Wind Power Projects on Property Values: A Decade (2011-2021) of Hedonic Price Analysis. *ResearchGate*. https://www.researchgate.net/publication/361261371_The_Effect_of_Wind_Power_Projects_on_Property_Values_A_Decade_2011-2021_of_Hedonic_Price_Analysis

[231] Gibbons, S., 2015. Gone with the wind: Valuing the visual impacts of wind turbines through house price. Journal of Environmental Economics and Management. 72:177-196.

[232] Binary in this context means whether something is visible or not visible from that location.

decreased to less than 2% at a distance of 2–4 km and to almost zero at a distance of 8–14 km, which is the likely threshold for significant visibility.

<u>Number of wind turbines</u>

The impact of wind farms on property prices has been examined in several studies. Gibbons (2015) used the number of wind turbines for each distance range in his analysis to examine scale effects. He divided the number of wind turbines into three groups: 1–10, 11–20 and >20 wind turbines. In the range of 0–2 km, more than
20 wind turbines caused a 15% decrease in property values. The two smaller groups in the same distance range caused a decrease in property values of approximately 8%. The impact of the group '>20 wind turbines' was greatest in all other distance ranges, and even in the furthest range (8–14 km), a negative impact on value (-1.8%) was evident. The other groups showed no impact in this furthest range.

Vyn (2018) [233] examined scale effects in three separate models. Each model used one distance range, which was either 1, 2 or 5 km. In all three models, he found that more wind turbines correlated with a greater decline in property values. However, the decline slowed down at a decreasing rate. For example, in the 1 km model, the first wind turbine reduced property values by $8,141[234], while the fifth wind turbine reduced the value by $1,982 and the twentieth wind turbine by $491 (the average house price was $231,000). Similar but smaller effects were also found in the 2 km and 5 km models.

Jensen et al. (2018)[235] used the number of wind turbines within a 3 km radius and a weighted density measure that combined number and distance to account for scale effects. The weighted density measure essentially gave greater weight to wind turbines located closer to the house. Both measures pointed to scale effects — '... each additional wind turbine within a 3 km radius reduced prices by between -0.2% and -1.1%'. The number of wind turbines ranged from 0 to 15. Like Vyn (2018), they also reported a decrease in impact as the number of wind turbines increased.

To understand the scale effect, Parsons and Heintzelman (2022) reviewed the previous three studies along with eight other studies that examined it. Of the eight studies, five found that the scale effect exists and three did not detect its impact. Dröes and Koster (2021([236]) , 2016([237]))and Eichholtz et al. (2021)([238]) ,using similar data from the Netherlands, found a negative impact on property values. They did not identify the significance of the scale effect.

Overall, the evidence on scale effects is somewhat contradictory, but at least in the studies that found negative effects on property values, these effects tended to increase as the number of visible or nearby wind turbines increased.

<u>Height of wind turbines</u>

The characteristics of wind turbines, particularly their height, also influence the variability of the impact on property prices.

Dröes and Koster (2021) have found that the extent and magnitude of the impact depend mainly on the height of the wind turbines. The study considered wind turbines located within a 2 km radius of residential properties and divided them into three groups according to height: < 50 m, 50-150 m and > 150 m. The taller the nearest wind turbine, the greater the impact was found to be

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[233] Vyn, R. J. (2018). Property value impacts of wind turbines and the influence of attitudes toward wind energy. *Land Economics*, 94(4), 496–

[234] 2018 USD/EUR - €0.88

[235] Jensen, C.U., Panduro, T.E., Lundhede, T.H., Nielsen, A.S.E., Dalsgaard, M., Thorsen, B.J., 2018. The impact of on-shore and off-shore wind turbine farms on property prices. Energy Policy 116, 50–59. https://doi.org/10.1016/j.enpol.2018.01.046

[236] Dröes, M.I., & Koster, H.R.A. (2021). Wind turbines, solar farms, and house prices. Energy Policy. 155:112327

[237] Dröes, M.I., Koster, H.R.A., 2016. Renewable energy and negative externalities: The effect of wind turbines on house prices. J. Urban Econ. 96, 121–141. https://doi.org/10.1016/j.jue.2016.09.001

[238] Eichholtz, P., Kok, N., Langen, M., van Vulpen, D., 2021. Clean Electricity, Dirty Electricity: The Effect on Local House Prices. J. Real Estate Finance Econ. https://doi.org/10.1007/s11146-021-09878-6

impact. The <50 m group reduced property values by -1.1%, but without statistical significance. The 50-150 m and >150 m groups reduced property values by -2% and -5.5% respectively, with statistical significance.

Most modern wind turbines are significantly taller than 150 m. It can be assumed that the impact of taller wind turbines may be greater than previously indicated. As the height of wind turbines increases, the same amount of energy is generally produced with fewer wind turbines, so the effects of the number and height of wind turbines may balance each other to a certain extent.

Differences between real estate market segments or regional differences

Skenteris et al. (2019)[239] studied two different wind turbine projects on different Greek islands and found that there was no impact on the island focused on tourism (4 wind turbines), but there was a negative impact on the island with a more extensive residential area (13 wind turbines). Although the number of wind turbines differed, the capacities of the wind farms were similar.

Jensen et al. (2018) found a negative impact on property prices in five regions of Denmark, ranging from 0.2% to 1.1% per additional wind turbine within a 3 km radius. The impact was smaller in the holiday home area.

Dröes and Koster (2016) found that the average impact, when different market segments in the Netherlands were not separated, was approximately -1.6% per additional wind turbine within a 2 km radius. When the markets were separated, the impact was up to -4% in several areas, while in some areas the impact was also positive.

Other similar studies have also found that the impact on property prices may vary when the context and characteristics of the property market are examined more closely. For example, the impact may be smaller in tourist areas than in areas with permanent residents. Most studies have so far been conducted in rural areas, as wind energy projects are often built there due to the availability of land resources and fewer restrictions. However, as time goes on, wind energy projects closer to urban areas are being considered more and more. The fact that there are more affected properties in urban areas also plays a role here, as smaller individual impacts can still lead to larger cumulative impacts.

Later studies investigating the differences between urban and rural areas (Jensen et al. (2018)) found that the first wind turbine has the greatest impact, but the impact of subsequent wind turbines gradually decreases. Their main recommendation is to establish wind farms in isolated areas and develop them on a large scale. Dröes and Koster (2016) and Eichholtz et al. (2021) support this conclusion. Using similar data covering a large part of both rural and urban areas in the Netherlands, both studies found a greater negative impact in urban areas.

The real estate market's anticipatory response to the announcement of wind farm construction

Parsons and Heintzelman (2022) found that 10 out of 18 studies examined the behaviour of real estate prices in the period prior to the actual construction of wind farms. Six of the 10 studies found no pre-construction effects on prices. The so-called anticipatory effect is the market's reaction to a future event before it has become a reality. Four studies identified anticipatory market behaviour. The onset of the anticipatory effect can be linked to either the first public announcement of the wind farm project or the disclosure of information during the environmental impact assessment process. (Dröes and Koster, 2016; Heintzelman and Tuttle, 2012([240]) ;Jarvis, 2021([241]) ;Vyn, 2018) have found that the anticipatory effect can occur approximately two years before the actual completion of a wind farm. In areas where people have a negative attitude towards wind farms, some studies have found that the impact o n property

[239] Skenteris, K., Mirasgedis, S., Tourkolias, C., 2019. Implementing hedonic pricing models for valuing the visual impact of wind farms in Greece. Econ. Anal. Policy 64, 248–258. https://doi.org/10.1016/j.eap.2019.09.004

[240] Heintzelman, M.D., Tuttle, C.M., 2012. Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Land Econ. 88, 571–588. https://doi.org/10.3368/le.88.3.571

[241] Jarvis, S., 2021. The Economic Costs of NIMBYism - Evidence From Renewable Energy Projects (No. crctr224_2021_300), CRC TR 224 Discussion Paper Series, CRC TR 224 Discussion Paper Series. University of Bonn and University of Mannheim, Germany.

prices were in the same order of magnitude as during the period when wind turbines actually began to have an impact
.

Conclusions

In summary, based on the results of the study of changes in property values, it can be concluded that the development of wind farms may have a negative impact on residential property prices. Based on various studies, it can be argued that the negative impact on property values is greater when the wind farm is closer to residential buildings and visible from them.

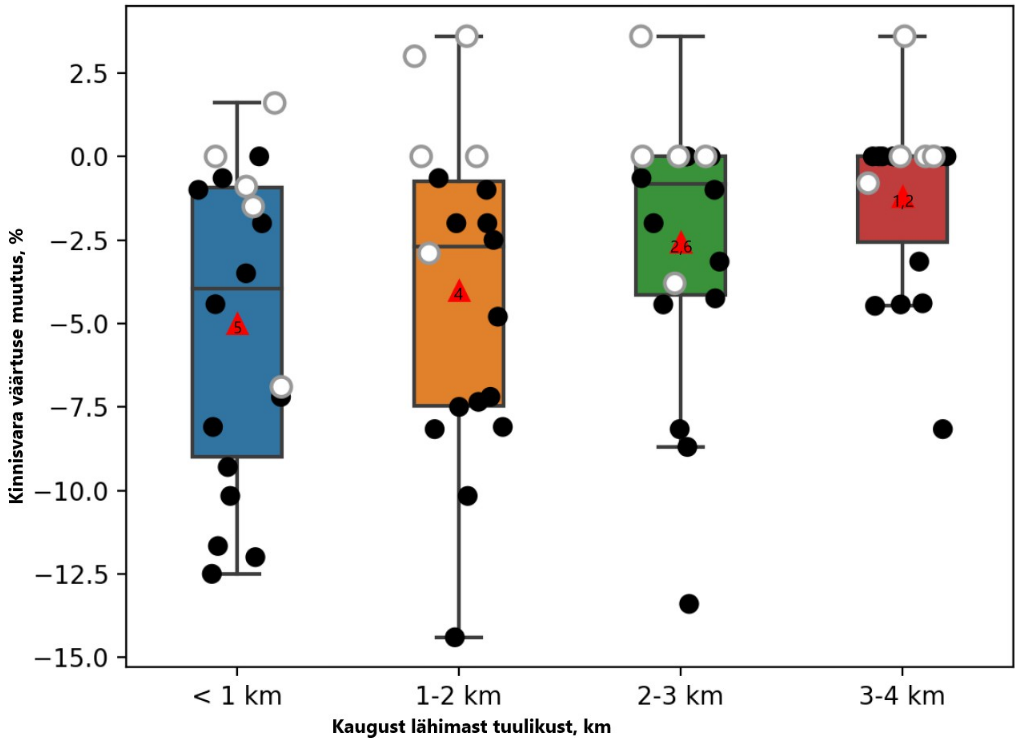

Figure 66. Net impact on property prices based on a study of 18 wind turbines. The black line in the box represents the median ([242]. The red triangle shows the average. The black dots represent studies with statistically significant coefficient estimates, while the white dots represent studies with statistically insignificant estimates. Source: Parsons and Heintzelman (2022).

The figure above shows that moving 1 km away from wind turbines is expected to cause an average change in property prices of -5.0% at a distance of up to 1 km, -4.0% at a distance of 1-2 km, -2.6% at a distance of 2-3 km
-2.6% at 2-3 km, and -1.2% at 3-4 km. No significant change in the value of dwellings located further than 4 km away is expected.

There are currently no regulations in Estonia governing compensation based on property value. It is also known that compensation for a decline in property value is relatively rare in international practice. An exception is Denmark, where a separate system has been developed for assessing changes in real estate value, compensation and, at the request of the property owner, purchase by the developer.

To our knowledge, no compensation has been paid in Estonia for changes in real estate value resulting from possible disturbances in connection with any development project. The impact may not be limited to wind farms alone. For example, a road, quarry or other object may also affect the value of real estate in the surrounding area. This topic, including the obligation to tolerate interference arising from property law, has been thoroughly analysed in the planning of Rail Baltica by the law firm Sorainen AS and the Centre for Applied Research

[242] The median is the number above which there are as many values as below it in a series of variations.

Centar OÜ [243] in the planning of Rail Baltica. The analysis found that the implementation of a large infrastructure project also affects immovable property, which in legal terms does not mean or presuppose the transfer of ownership. These are restrictions for which there is a legal obligation to tolerate. However, the prerequisite for the obligation to tolerate is that the restrictions are in accordance with environmental protection standards and do not significantly impair the use of the immovable property. Therefore, under current law, compensation cannot be claimed, for example, for noise that complies with the limits if the owner of the immovable property cannot prove that the impact significantly impairs the use of their immovable property. ([244])

Studies to date have shown that the impact of wind farms on the value of residential property is closely linked to their visual impact. At the same time, it has also been found that the negative impact diminishes, at least in part, over time. Based on the above, in order to minimise the decline in property values, it is important that the visual impact of wind farms is taken into account in their planning and that measures are implemented to reduce it (the visual impact is discussed in section 4.7). The decline in property values can also be minimised if the construction of a wind farm is accompanied by infrastructure development that improves accessibility and promotes, for example, the economic development of the region. A possible decline in property values should be offset by a so-called tolerance fee for wind turbines (see section 4.6.4.5).

4.6.4.4 Social conflicts

In many cases, the construction of wind farms in Estonia is met with resistance from the local community. There are several instances where the planning of wind farms has been halted by the collection of signatures from local residents or strong opposition (Hiiumaa offshore wind farm, Vormsi wind farm, Risti wind farm, etc.). The main reasons given in the objections are usually fears about possible noise, shadowing and health effects. Visual disturbance is also often mentioned, and there are also situations where no clear reason can be identified. Somewhat surprisingly, the opposition seems to be just as intense in the case of offshore wind farms.

Despite very sharp conflicts and opposition to several wind farm projects, according to a Kantar Emor survey[245], 72% of respondents support the construction of offshore wind farms and 62% support the construction of onshore wind farms. The construction of wind farms is viewed more positively by younger residents aged 15–34 than the average.

Nearly three-quarters (71%) of those who live near a wind farm support the expansion of onshore wind farms (26% are against). At the same time, only 40% of those who live near a planned wind farm support its construction (58% are against). Of those who have not yet had any contact with wind turbines, 60% are in favour of the construction of onshore wind farms and 30% are against, while among those who have been in the vicinity of wind farms, the figures are 66% and 28% respectively. Thus, those who are most positive about the construction are those who have experience of living near wind turbines and who have visited areas with wind turbines.

When comparing those who live near wind farms with those who have no contact with wind farms, it appears that the attitude of residents who have contact with wind farms is more positive. The less exposure the survey participants had to wind farms, the more respondents were unable to form an opinion.

With the most effective compensation measure, 53% of residents would have a positive attitude towards a wind farm being built in their neighbourhood. The most positive attitudes were found among the 15–24 and 25–34 age groups, 69% and 68% of whom, respectively, would support the construction of a wind farm near their home with compensation measures.

243 Law firm Sorainen AS, Centre for Applied Research Centar OÜ. 2015. Analysis of the possibilities for compensating owners and users of immovable property for the possible negative impacts associated with the construction of the Rail Baltic railway.

244 RKTKo 3-2-1-104-12.

245 https://mkm.ee/sites/default/files/tuulepargid_l6pparuanne_final_taiendatud.pdf

In the survey, 74% of respondents considered the increase in the share of green energy from wind farms to be important, 68% of respondents considered the impact of wind farms on local infrastructure (electricity supply, roads) to be important, 64% of respondents considered the impact of wind farms on the promotion of local life through tolerance payments (e.g. improvement of kindergartens, schools, health trails) to be important, and 57% of respondents considered the impact of wind farms on the creation of jobs in the region to be important.

Social conflicts cannot be ruled out in any of the selected locations when establishing a wind farm.

4.6.4.5 Local benefits

The local benefit systems applicable to wind farms in different countries were analysed at the request of state authorities when developing the Estonian local benefit system[246]. As a result of the analyses, a disturbance fee system was established in Estonia in 2023.

When compensating for the impact of disturbances, the ability of compensation mechanisms to alleviate the situation of people affected by development is considered important. Currently, local benefits are regulated by the Environmental Charges Act[247]. According to the Act, the fee for the production of electricity from wind energy is an environmental disturbance compensation fee paid by the owner of the wind farm or the person entitled to use it, which is distributed to the local government unit in whose territory the onshore wind farm is located. The fee for producing electricity from wind energy is paid from the date of registration of the notification of the start of construction of the wind farm until the removal of the wind farm from its location. The fee for the production of electricity from wind energy by an onshore wind farm is set at between 0.7% and 1% of the product of the following two indicators:

- the amount of electricity produced by the wind farm in megawatt-hours per quarter, but not less than 70% of the wind farm's nominal capacity multiplied by 750;
- the arithmetic mean of the next day's market price of electricity in the Estonian price area for the corresponding quarter.

The rate of the fee for the production of electricity from wind energy by an onshore wind farm shall be established by a regulation of the local government of the local government unit in whose territory the wind farm is located.

If the local government unit has not established a fee for the production of electricity from wind energy at an onshore wind farm, the lowest possible fee specified in subsection 21^3 1) of the Environmental Charges Act shall be applied when determining the fee.

The fee for the production of electricity from wind energy by an onshore wind farm shall be paid into the budget of the local government unit in whose territory the wind farm is located.
the budget of the local government unit in whose territory the wind farm is located.

Of the fee for the production of electricity from wind energy by an onshore wind farm received by the local government unit, 50% shall be paid by the local government unit to the owners of residential premises located within the area of influence of the onshore wind farm (hereinafter *referred to as the residence-related wind energy production fee)* if the residential property meets the following conditions:

- the residential property is owned by a natural person;
- the residential property is the owner's place of residence according to the population register.

The fee for electricity production from wind energy related to the place of residence is paid once a year for the calendar year.

Approximate fee calculations are presented in Table 30.

[246] Kasemets, L., Täpp, E., Michelson, A., Elias, S. (2020) Analysis of local benefit instruments. Tallinn: Praxis Centre for Policy Studies.
[247] https://www.riigiteataja.ee/akt/109082022028?leiaKehtiv

Table 30. Approximate calculation of environmental disturbance fees.

Pre-selection area code	2	3	4	
Number of wind turbines	6	9	3	18
Expected average market price (EUR/MWh)	50	50	50	
Payment rate, % (range 0.7-1)	1	1	1	
Approximate calculation for 5 MW wind turbines				
Nominal capacity of wind turbine, MW	5	5	5	
Estimated annual production (1 wind turbine 17,000 MWh/a)	102,000	153,000	51,000	306,000
Wind energy from wind power plants fee for electricity production, EUR	51,000	76,500	25,500	153,000
Fee to the municipal budget, EUR	25,500	38,250	12,750	76,500
Total fee to residential property owners, EUR	25,500	38,250	12,750	76,500
Approximate calculation for 7 MW wind turbines				
Nominal capacity of wind turbine, MW	7	7	7	
Estimated annual production (1 wind turbine 23,000 MWh/a)	138,000	207,000	69,000	414,000
Wind energy from wind power plants fee for electricity production, EUR	69,000	103,500	34,500	207,000
Fee to the municipal budget, EUR	34,500	51,750	17,250	103,500
Total fee to residential property owners, EUR	34,500	51,750	17,250	103,500

The impact area of an onshore wind farm within the meaning of the Environmental Charges Act is the area of the Republic of Estonia extending **up to two kilometres in the case of a wind farm with a height of up to 250 metres** and up to three kilometres **in the case of a wind farm with a height of 250metres for wind turbines with a height of 250 metres or more, and three kilometres for** wind turbines **with a height of** 250 metres **or more** from the centre of the nearest tower of the wind farm (Figure 64). If the boundary line extending two or three kilometres from the centre of the nearest tower of the wind farm passes through a registered immovable, the impact area extends to the furthest boundary of the registered immovable.

The maximum amount of the fee for the production of electricity from wind energy related to the place of residence is the minimum wage in Estonia for six months of the corresponding calendar year. The local government unit shall publish information on the fee for the production of electricity from wind energy related to the place of residence on its website. If the maximum total amount of the fee for the production of electricity from wind energy related to the place of residence exceeds 50% of the fee received by the local government unit per year, 50% of the fee received shall be distributed proportionally among the owners of residential premises located within the area of influence of the wind farm.

If the total amount of fees for the production of electricity from wind energy related to the place of residence to be paid per year is less than 50% of the fees for the production of electricity from wind energy received by the local government unit from the onshore wind farm, the portion of the fee received that exceeds the amount paid shall remain with the local government unit.

The local government unit shall pay the fee for the production of electricity from wind energy related to the place of residence for a wind farm located in its territory also for a dwelling located in the territory of another local government unit if there is no wind farm in the local government unit where the dwelling is located.

During the period beginning on the day following the submission of the notification of the commencement of construction of the wind farm and ending on the day of commencement of electricity production by the wind farm, the fee for electricity production from wind energy shall be paid at a rate of ten per cent of the fee for the period of operation.

4.7 Impact on the landscape, including visual impact

4.7.1 Assessment methodology

The initial assessment of the visual impact of this special plan was based on a preliminary assessment based on the opinion of the local community, which is known to be the first of its kind in Estonia. After the initial clarification of nature conservation restrictions, an initial wind turbine layout solution was drawn up for areas not subject to nature conservation restrictions. The solution consisted of 27 wind turbines.

On 25 July 2024, a visual impact assessment workshop was held at the Tsirguliina community centre. The aim of the visual impact assessment workshop was to map the community's wishes and opinions on the values of the living environment and to use the information obtained to improve the layout of the wind turbines. At the beginning of the workshop, Kerttu Otsa, a landscape architect and expert with international experience in assessing the visual impact of wind farms, introduced the participants to the topic of the visual impact of wind turbines. Afterwards, all interested parties were given the opportunity to view preliminary visualisations created using Windplanner software based on Google Street View photos of all locations of interest. The attendees then analysed the views during discussions in small groups and expressed their opinions on which wind turbines are the most visually dominant and disturbing. They also mapped out the viewpoints that are important to the community.

Based on the feedback and following the guidelines of an external expert, the number of wind turbines was reduced (to 23) and their location was slightly changed (Figure 67). The changed layout was used as the basis for the initial assessment of impacts in the SEA. In the summer of 2025, bird protection considerations were further specified in the four areas of the preliminary selection, and the number of wind turbines was reduced to 18 in order to avoid significant adverse effects on birdlife.

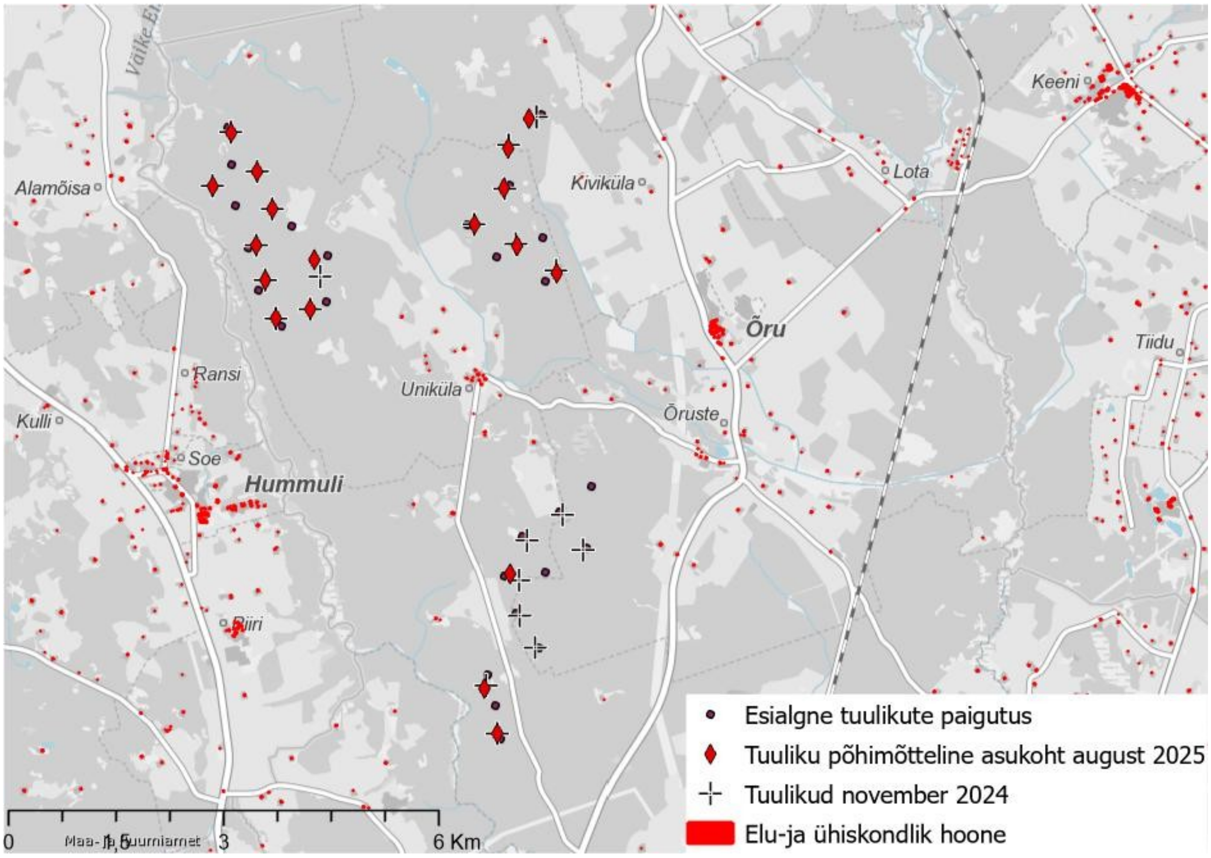

Figure 67. Initial location of wind turbines, modified layout in the draft solution and finalised solution in August 2025.

The visual impact of the wind farm has been assessed taking into account the recommendations of the guidance material[248]prepared by AB Artes Terrae OÜ in 2020 to the extent that they are transferable to onshore wind farms. The visual impact assessments of the wind farm are based on the scale described in Tara, A., 2022, in the article "DVC as a Supplement to ZVI: Mapping Degree of Visible Change for Wind Farms".

The planned underground cable connection has no impact and is therefore not assessed in detail. Similarly, the impact of wind farm roads and possible substations on the landscape is negligible and is not addressed separately.

Specialised software WindPRO 4.0 was used to assess the visibility of the wind farm. The relief data used was the Land Board's ground elevation model with an accuracy of 25 m and the Latvian ground elevation model with an accuracy of 20 m. For land cover, the Corine land cover dataset (2018) was used, in which forest areas were assigned a height of 15 m. This approach makes it possible to obtain an approximate map of the visibility of the wind farm, i.e. to identify areas from which the wind farm may be significantly visible. The software also allows the vertical and horizontal viewing angles of the wind turbine to be calculated, which makes it possible to determine the significance of the change in view caused by the wind farm. The Corine land cover dataset (instead of the Land Board's vegetation height model) was used to enable an equivalent analysis of the entire area under consideration, including the territory of the Republic of Latvia. In addition, a more detailed analysis of changes in the landscape view was carried out in the nearest impact area using data from the Land Board's vegetation height model.

The vertical viewing angle is the angle formed between the viewpoint and the top of the wind turbine (Figure 68). The horizontal viewing angle is the angle formed between the viewing point and the furthest points of the two furthest wind turbines (Figure 69). Based on the product of the horizontal and vertical viewing angles, it is possible to assess the significance of the change in view for the human eye.

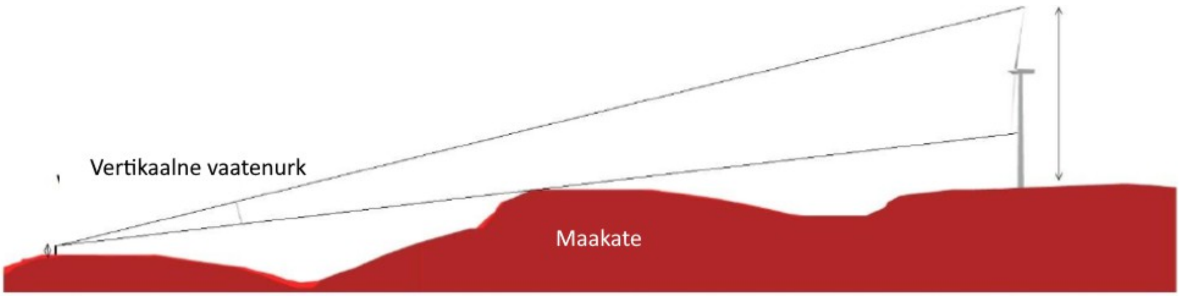

Figure 68. Vertical viewing angle. Source: WindPro user manual.

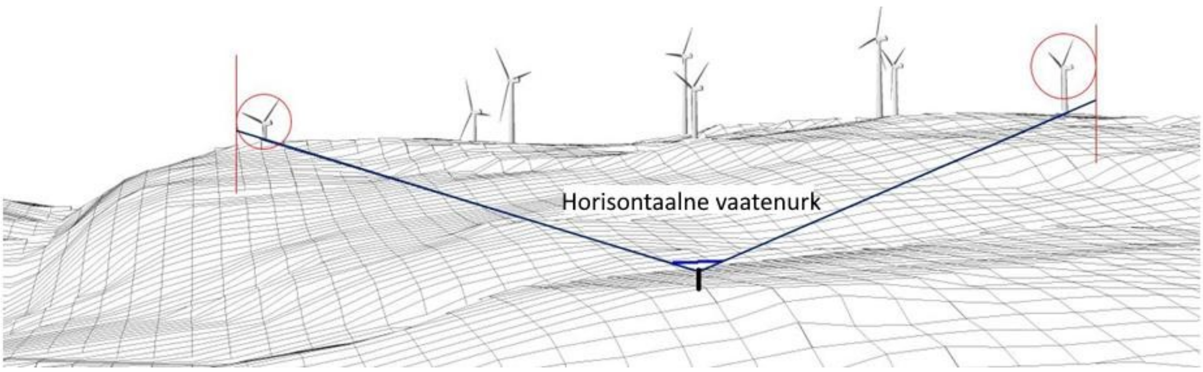

Figure 69. Horizontal viewing angle. Source: WindPro 4.0 user manual.

Visibility and viewing angle modelling was performed on a 25×25 m grid. The viewing height for the visibility map was set at 1.5 m, which is the normal viewing height for a human.

[248] AB Artes Terrae OÜ. 2020. Guidance material on methodological recommendations for assessing the visual impact of offshore wind farm development
https://www.fin.ee/media/2706/download

The determination of valuable landscapes and valuable views was based on the Valga County Plan and the Tõrva municipality comprehensive plan.

Viewpoints were selected on the basis of a visibility analysis – places with public access from which the wind farm may be visible, with preference given to areas with valuable landscapes and/or beautiful road sections. Photomontages of observation towers were also compiled. Viewpoints located within a radius of up to 15 km from the planned wind turbines were preferred, as the wind farm is no longer clearly distinguishable/dominant to the human eye at greater distances. Preference was given to viewpoints located in valuable landscapes. For more distant viewpoints, it is appropriate to compile photo montages if the viewpoint is very important (e.g. an important tourist attraction) and has extensive visibility.

The locations of the viewpoints were specified using an integrated solution of WindPRO 4.0 and Google StreetView. WindPRO allows the use of Google StreetView to find viewpoints (photos) from which the wind turbines are actually visible. This means that using StreetView photo material, it is possible to immediately change the viewing angle to find the angle from which the wind turbines are most visible. Real photos were taken from viewpoints where the wind farm remained visible based on the initial StreetView photo montages.

The photo montages were taken on 14 August 2024 and 22 June 2025 with a Ricoh WG-6 camera with a focal length of 28 mm. The camera has a built-in GPS device, which was used to record the location where the photos were taken.

The parameters used for the wind turbines were a rotor diameter of 180 m, a tower height of 180 m and a tip height of 270 m. In all images, the blades of the wind turbines are positioned perpendicular to the viewer in order to achieve maximum visual impact.

4.7.2 Landscape value and architectural monuments

There are no valuable landscapes or road sections with beautiful views in accordance with the Valga County Plan 2030+ in the potentially suitable areas. At the same time, there are several valuable landscapes and road sections with beautiful views and vantage points in the vicinity of the wind farm areas (Figure 71).

The comprehensive plan of Õru Municipality considers the following areas to be of environmental value, the future use of which should ensure the preservation of open natural views: Jaanimägi in Uniküla and Uniküla Park.

Of the cultural monuments (Figure 53), the wind farm could potentially affect architectural monuments, both in terms of the views from them and the views of them. The nearest architectural monuments (within a 5 km radius) are:

- Hummuli Manor and Manor Park – the nearest wind turbine is 2.3 km from the manor park and 2.6 km from the main building ;
- Sooru Manor and Manor Park – the nearest wind turbine is 2.4 km from the manor park and 2.6 km from the main building;
- Killinge granary – the nearest wind turbine is 2.5 km away;
- Kuigatsi Manor hunting lodge – the nearest wind turbine is 2.5 km away;

Further than 5 km away, but noteworthy architectural monuments due to their high cultural value include:

- Barclay de Tolly mausoleum and mausoleum park – the nearest wind turbine is 5.3 km from the park and 5.4 km from the building km away;
- Sangaste Manor and Manor Park – the nearest wind turbine is 7.5 km from the manor park and 8 km from the main building.

4.7.3 Possible impacts

The visual impact of the wind farm depends on the size of the wind turbines, the distance of the observer, the characteristics of the landscape, including the relief and vegetation cover, the time of day, atmospheric conditions, etc. In clear weather conditions and with open sightlines, the wind farm may be visible from a distance of up to 40 km (large wind farms

, visibility of up to 58 km has been observed)[249] . In Estonia, the visibility of wind turbines is not significantly affected by relief, but is affected by extensive forest areas and built-up areas. Due to obstacles in the vicinity of the observer (e.g. forests, buildings, etc.), a wind turbine may not be visible even if it is located close to the observation point. At the same time, viewing corridors may occur at greater distances.

The visibility analysis showed that, as there are no significant differences in elevation in the area, the relief has little impact on visibility. However, the area is forested and the trees significantly reduce the visibility of the planned wind farm. In populated areas, buildings significantly reduce visibility.

The visibility analysis for the special planning area was carried out on an area of 160,200 ha (40 x 40 km). It was found that the wind turbines remain visible in 25.3% of the analysed area (Figure 70). As this is a forested area and there is also a screening effect from the relief, the visibility of the wind farm at this location is lower than, for example, the wind farm development projects in Central Estonia and Pärnu County.

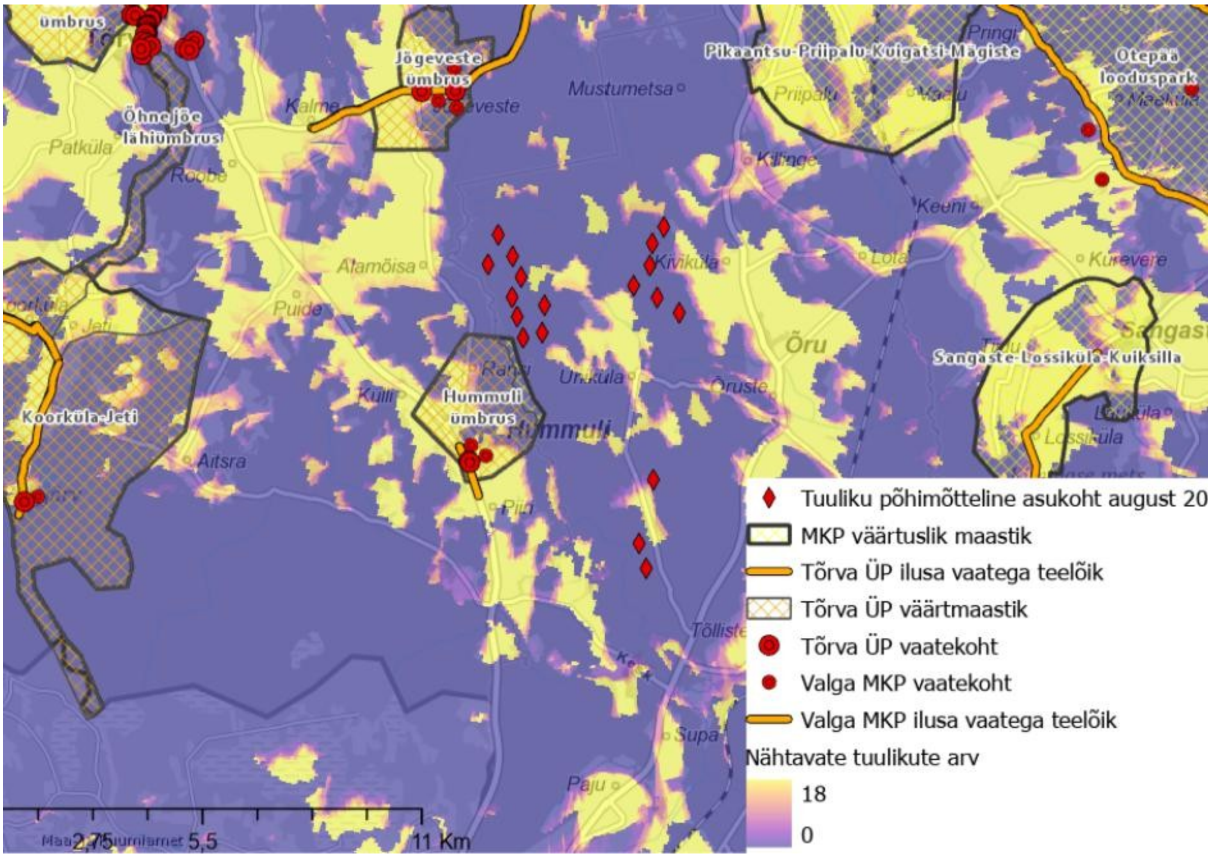

Figure 70. Approximate visibility of the wind farm.

Visibility in this area is affected by both the terrain (relatively large differences in elevation) and vegetation. The wind turbines are visible from open areas such as agricultural land and clearings in the area. The wind farm is also visible from higher locations.

The visual impact of the wind farm has been assessed based on the scale described in Tara, A., 2022, in the article "DVC as a Supplement to ZVI: Mapping Degree of Visible Change for Wind Farms". The significance of the vertical and horizontal viewing angle impact caused by the wind farm and the size of the affected area are presented in Table 31.

[249] Sullivan, R., Kirchler, L., Lahti, T., Roché, S., Beckman, K., Cantwell, B., Richmond, P. 2012. Wind Turbine Visibility and Visual Impact Threshold Distances in Western Landscapes.

Table 31. Significance of the impact of changes in vertical and horizontal viewing angles.

Vertical viewing angle	Significance of change	Area affected Size ha
Over 25^0	Very large	69
10-25^0	Large	628
5-10^0	Moderate	1602
3-5^0	Low	3129
1-3^0	Very low	12957
Horizontal viewing angle	**Significance of change**	**Area affected Size ha**
Over 124^0	Very large	1072
50-124^0	Large	496
25-50^0	Moderate	14001
10-25^0	Low	12857
Below 10^0	Very low	5649

Based on the change in the vertical (v) and horizontal (h) viewing angles, the total change in the landscape view (v*h) was calculated and used to assess the significance of the change in the view. The significance of the change in the view is shown in Figure 71.

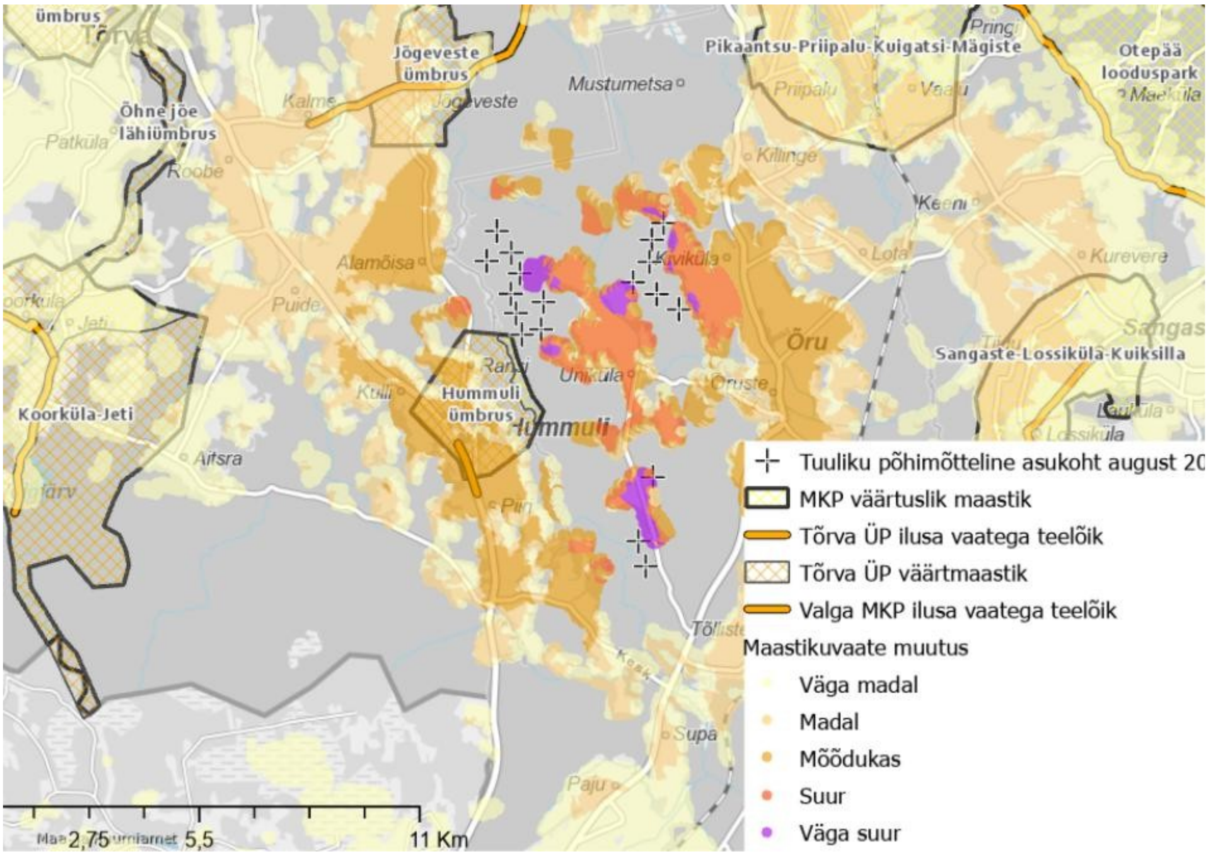

Figure 71. Landscape change caused by the wind farm in a large-scale assessment.

The visibility analysis showed that the valuable landscapes and road sections with beautiful views in the area will experience a moderate to very low change in view. The views of the valuable landscape around Hummuli will be most affected. More than half of the valuable landscape is expected to experience a moderate change in views towards the Väike Emajõgi River. Other valuable landscapes and scenic road sections in the area are expected to experience a low or very low change in views. The view will not change on forested road sections and landscapes.

An additional view analysis was carried out for the architectural monuments located in the area. The visibility of the wind farm will be as follows:

- Hummuli Manor and Manor Park – considering the location of the object, there could theoretically be a significant impact on the monument. A more detailed analysis revealed that the view of the main building of the manor will not be affected. The view of the main building is from the driveway and is limited in scope (the view is restricted by tall vegetation), and no wind turbines are planned behind the main building of the manor in relation to the view from the driveway (Figure 72, Figure 73). The wind turbines will be visible from the edge of the manor park (from the school stadium area, Figure 74). The wind farm will also be visible from the tower of Hummuli Manor (which is not a viewing point open to the public).
- Sooru manor barn and manor park – the wind farm will not affect the views; the views of the manor barn and park are to the south, and the wind farm is planned to the north of the buildings. The wind farm will also not be visible from the recreation area by Lake Sooru next to the manor park, as the forest by the lake obscures the view;

Killinge granary – the building is surrounded by forest, the wind farm will not affect the view of the object affect the view of the object;

Kuigatsi Manor hunting lodge – the building is directly surrounded by forest, the wind farm does not change the view of the object ;

- Barclay de Tolly mausoleum and mausoleum park – the wind farm does not alter the view of the object, considering the viewing direction and the forest cover of the area.

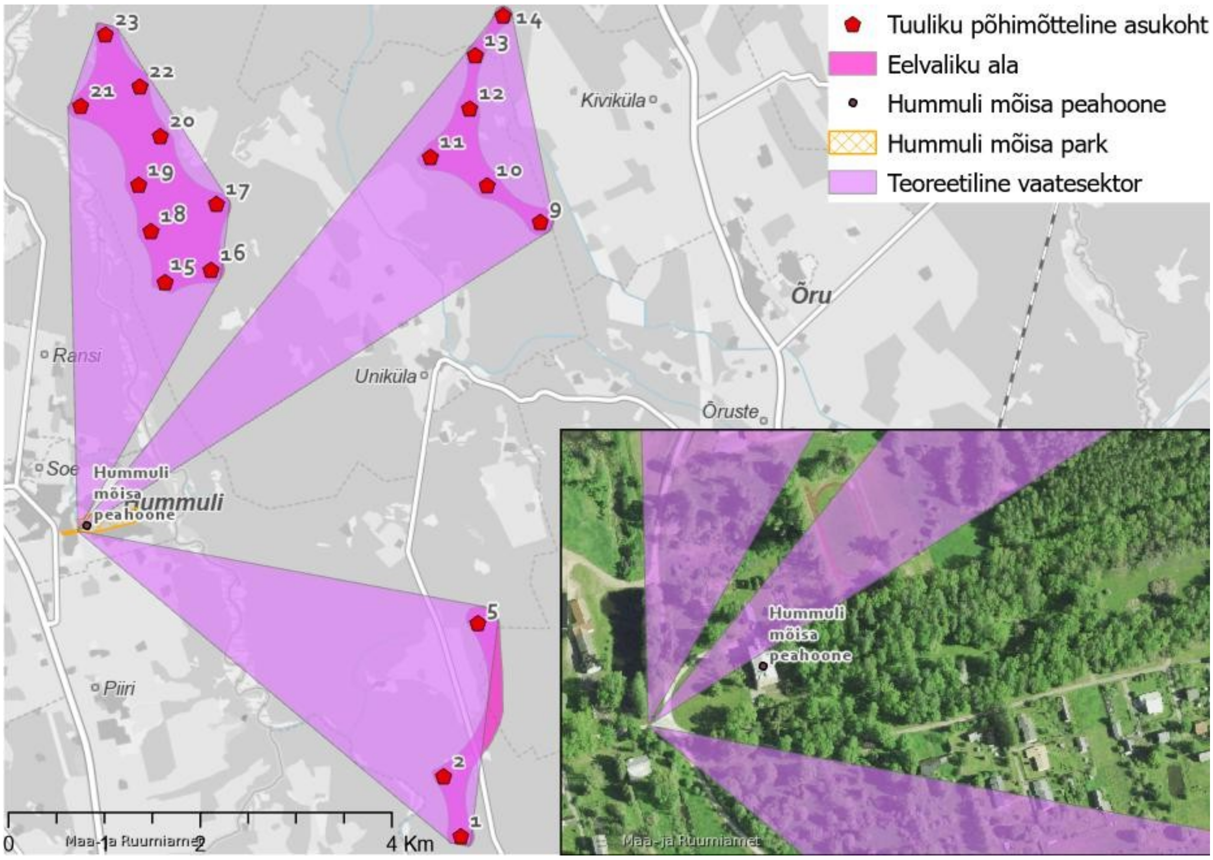

Figure 72. Theoretical view sectors of the wind farm from Hummuli Manor. It can be seen that the extent of the view corridors is actually limited by the vegetation. The most extensive view corridor opens up from the access road and square in front of the main building of the manor.

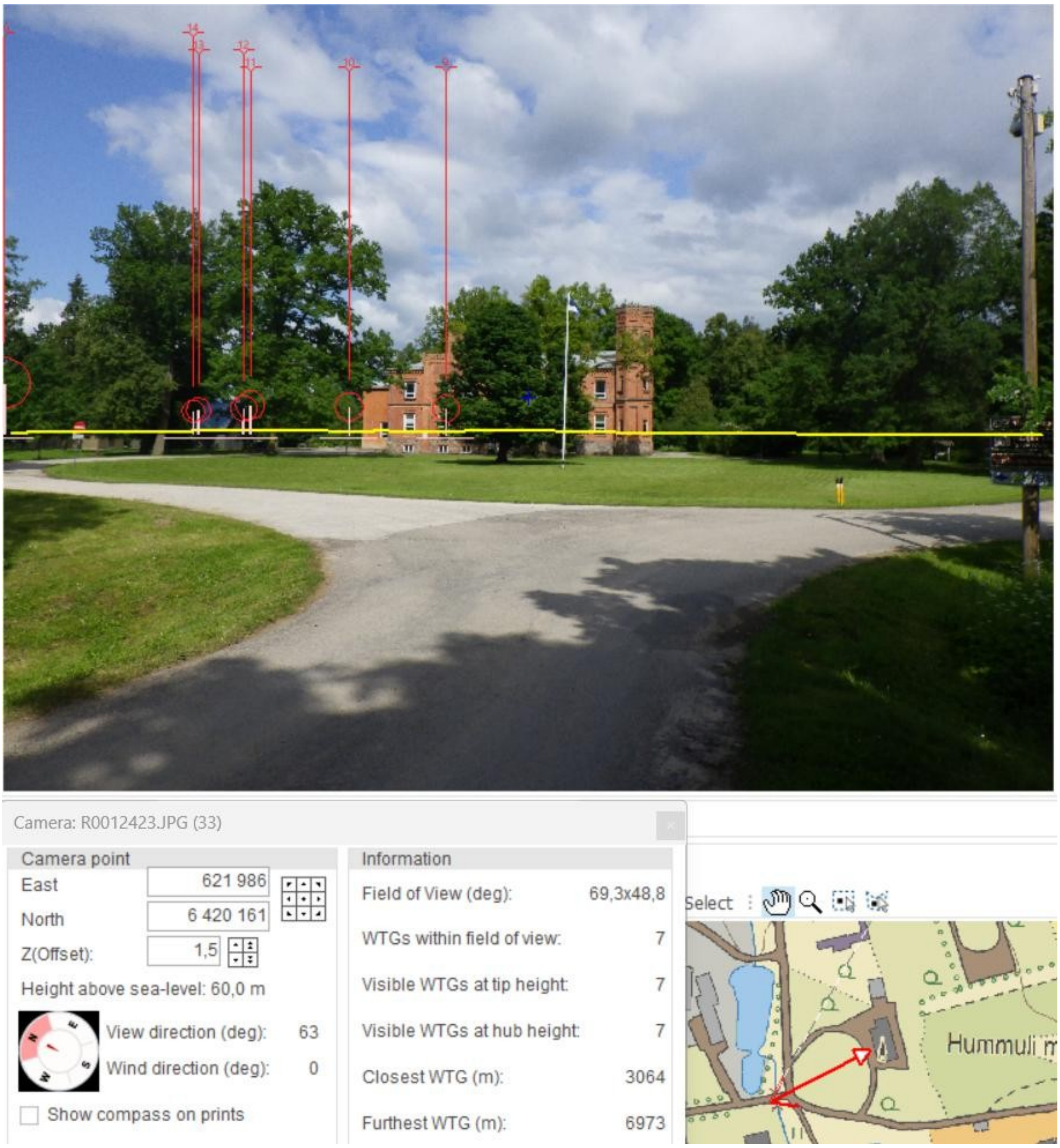

Figure 73. View of the main building of Hummuli Manor and the location of the planned wind turbines. The wind turbines will remain hidden by the vegetation surrounding the manor building. The view of the manor building and the views from the manor park will not be affected.

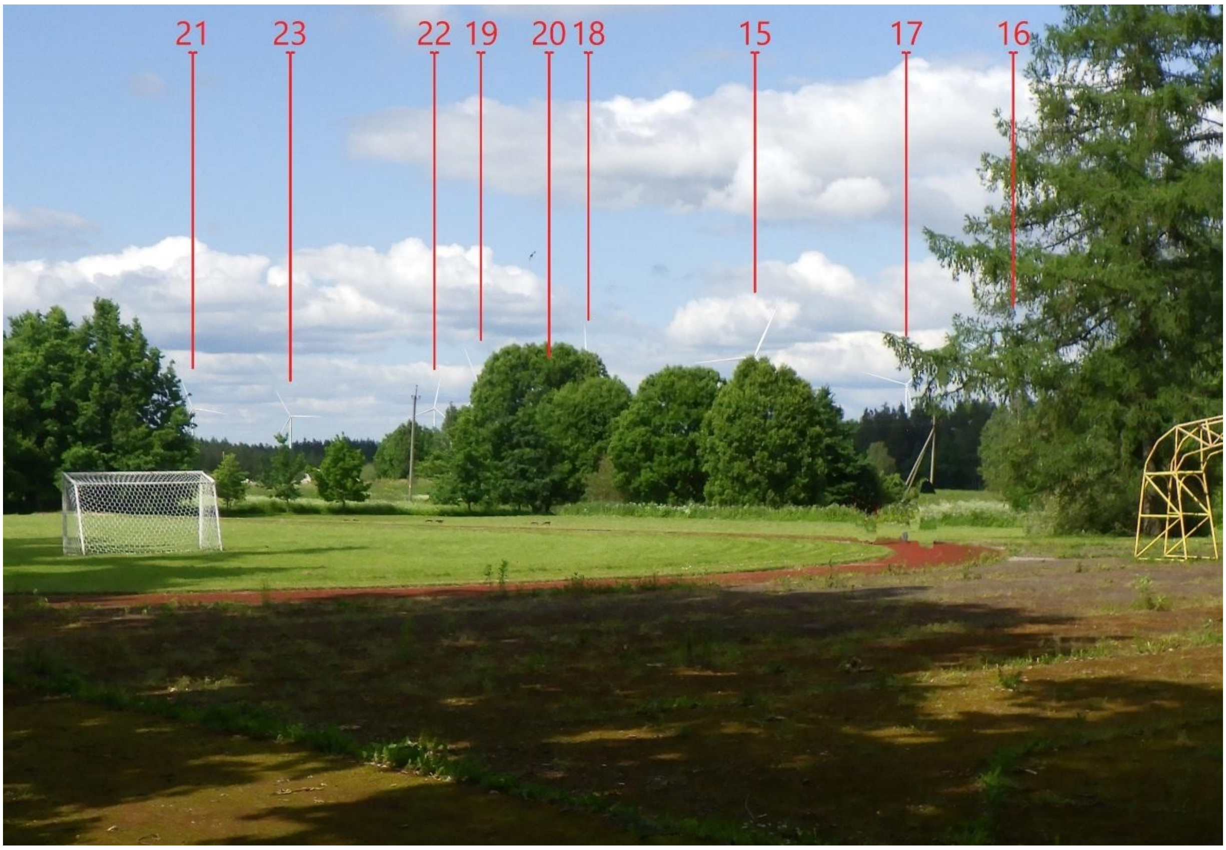

Figure 74. View of the Hummuli school stadium and wind farm located on the edge of Hummuli manor park.

With regard to important tourist attractions/cultural monuments in the area, it should be noted that the wind farm will be visible from the tower of Sangaste Castle on clear days. Considering the relatively large distance between the castle tower and the wind farm (the nearest wind turbine is about 8 km from the tower) and the great diversity of views from the tower of Sangaste Castle, the wind farm will not dominate the view from the tower. The wind farm will not be visible from the castle garden, as it is surrounded by tall trees and a wall, which limit the view.

The residential areas of Uniküla, Tõlliste, Kiviküla and Õruste, which are located in more open areas, will be most affected by the construction of the wind farm. Under the developed planning solution, there will be no residential areas where the landscape view would be significantly affected, but there will be up to 28 residential areas where the wind farm will cause a significant change in the landscape view. Both Hummuli and Õru compact settlement areas fall within the area of moderate landscape view change (Figure 75). In densely built-up areas, there is a significant difference between the calculated change in the landscape view and the actual change, as the buildings and street landscaping in the settlements are not reflected in the landscape model, but significantly reduce the visibility of the surrounding area, including the planned wind farm.

In accordance with the comprehensive plan of Õru Municipality, development activities in areas of environmental value are based on and buildings are planned, designed and constructed in such a way as to preserve and highlight local natural, historical and cultural values. The principles of the current comprehensive plan are guaranteed in areas of environmental value and cannot be violated by special plans.

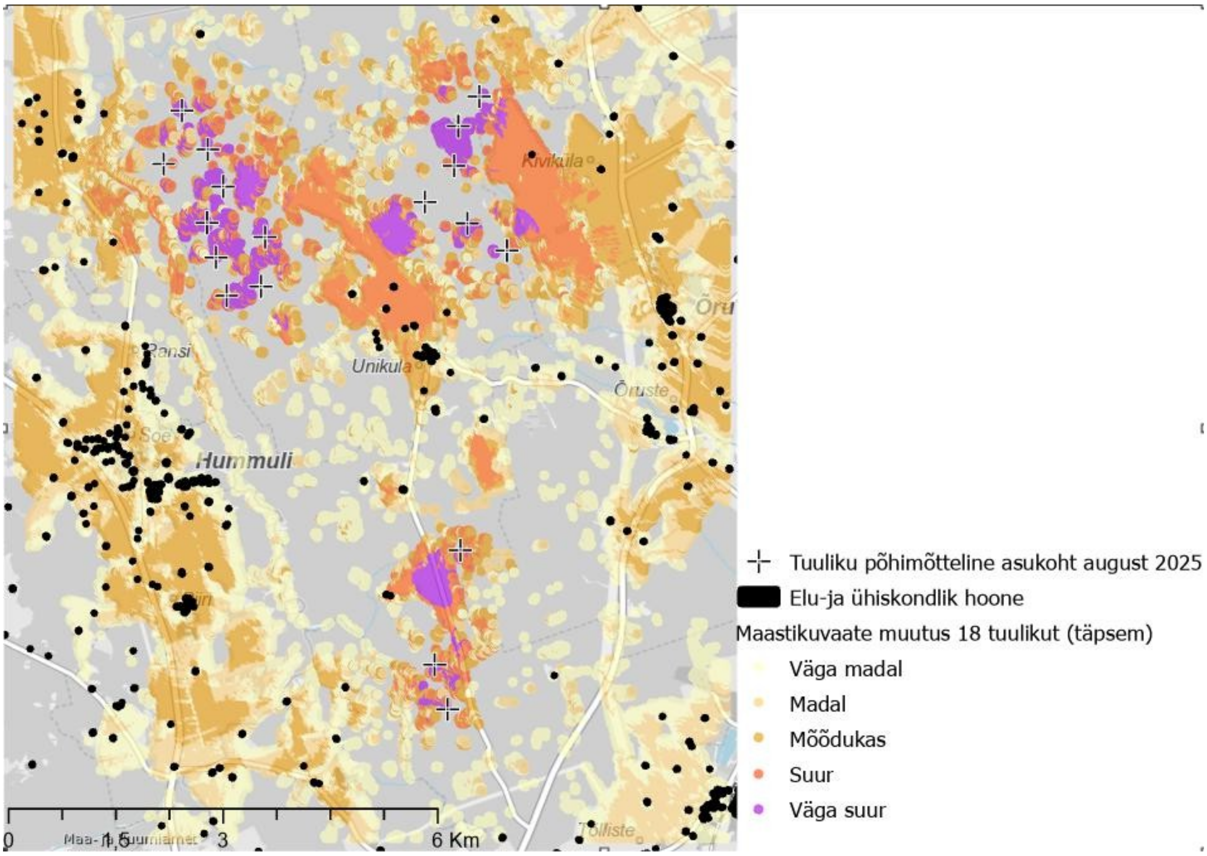

Figure 75. Location of residential buildings in areas with significant changes in landscape views, taking into account the Land Board's vegetation cover elevation model data.

4.7.3.1 Photo montages

A total of 24 viewpoints from which the wind turbines would be potentially visible were selected for the visualisations. The viewing height of the photomontages is generally 1.5 m above ground level (except for observation towers, where the height of the tower was used).

Table 32. Location of viewpoints for photomontages.

Mark	Description	y	x	Distance to nearest wind turbine, m
A	Harimäe observation tower, nearest windmill 13.5 km	639437	642932	13514
B	Priipalu/Õlatu, Priipalu-Noorkõivu road, nearest windmill 5075 m	630293	6428850	5075
J	Lake Soontaga, nearest windmill 6564 m	623243	6431347	6564
K	View of the road through Uniküla (Kalda and Jaanimäe) to the southeast, nearest windmill 3633 m	625290	6422736	3633
L	View of the road through Uniküla (Kalda and Jaanimäe) to the northeast, nearest windmill 1406 m	625290	6422757	1406
M	View of the road through Uniküla (Kalda and Jaanimäe) to the northeast, nearest windmill 1909 m	625286	6422749	1909
N	View of the centre of Uniküla village towards the north, nearest windmill 2564 m	625717	6421832	2564
O	View southwards from the centre of Uniküla village, nearest windmill 2656 m	625722	6421828	2656

G	Tartu-Valga road, Õruste, nearest wind turbine 3733 m	629297	6421251	3733
F	Tartu-Valga road Õruste, nearest wind turbine 3274 m	629297	6421251	3274
E	Tartu-Valga highway between Õru and Õruste, nearest wind turbine 4051 m	629330	6421748	4051
C	Õru shop-café, nearest windmill 4227 m	6291	6422238	4227
D	Õru shop 2, nearest windmill 2573 m	629120	6422239	257
H	Tsirguliina railway crossing, nearest windmill 4565 m	629971	6415717	4565
I	Valga-Uulu road Piiri café (section with beautiful views road section), nearest windmill 4195 m	621824	6418722	4195
P	Jõgeveste-Soe road, Alamõisa, nearest windmill 1982	620526	6426294	1982
R	Jõgeveste-Soe road, Alamõisa 2, nearest windmill 1427 m	620599	6424664	1427
S	Hummuli Manor main building, nearest windmill 3064 m	621986	6420161	3064
T	Hummuli Manor Stadium, nearest windmill 2615 m	622165	6420256	2615
U	Hummuli Hill (towards Hummuli), wide angle, nearest windmill 3295 m	621426	6419817	3295
V	Hummuli Hill (towards Sooru), wave angle, nearest windmill 4770m	621423	6419821	4770
Õ	Alamõisa village (Elbra), nearest windmill 1779 m	620236	6424684	1779
Ä	Õruste village centre, nearest windmill 3081 m	628690	6420982	3081
Ö	Sooru, Sooru-Piiri road, nearest windmill 2125 m (wave angle)	624690	6415296	2125

The photomontages are presented as a separate appendix to the SEA report to enable the photos to be viewed in higher resolution. When viewing the photomontages, it should be noted that the locations of the wind turbines are indicative and may be specified in more detail in the design to the extent specified in the plan. The photomontages have also been compiled using the maximum dimensions of the wind turbines. If smaller wind turbines are constructed, the visible view may also differ.

The photomontages and visibility analysis showed that the most important viewpoints that would be affected by the construction of the wind farm are the roads bordering the fields in the immediate vicinity. Based on the photomontages, the wind turbines can be considered clearly distinguishable and, in some cases, dominant if they are located closer than 5 km from the viewpoint. At greater distances, the wind turbines are certainly visible in clear weather, but they can no longer be considered dominant in the view.

4.7.3.2 Aviation warning lights

In addition to changes in visibility during the day, it must be taken into account that, in order to ensure flight safety requirements, tall structures must be equipped with aviation warning lights to ensure their visibility at night and in poor visibility conditions. In Estonia, these are red lights that burn continuously. When the wind turbine is operating and the blades are between the observer and the nacelle (the direction of the blades depends on the wind direction), the observer sees a red light flashing (because the blade passes in front of the light).

Aviation warning lights change the view in the dark. The navigation lights are located at the height of the wind turbine tower/nacelle. From locations where the wind turbine nacelles are visible, the navigation lights are also visible at night. The lights can be seen at a distance of 30–40 km in good visibility conditions.

In some countries, it is permitted to use adjustable-intensity aviation safety lights, the power of which is reduced in conditions of good visibility l.[250]

To reduce the visual impact of aviation safety lights, there are also technical solutions available whereby the lights are only switched on when necessary (when an aircraft is approaching) [251]. Such solutions are mainly relevant in the case of large wind farms or highly sensitive landscapes. The solution must also be permitted under nationally applicable aviation safety requirements. As far as is known, such temporary lighting with aviation safety lights is not currently permitted in Estonia, so this measure cannot be considered in this case.

It is possible to shield the lights to some extent, which reduces their visibility from the ground [250].

4.7.4 Measures, need for further research and assessment

The visual impact assessment revealed that the residential areas of Uniküla, Tõlliste, Kiviküla and Õruste, which are located in more open areas, will be most affected by the construction of the wind farm. The change in the landscape of these residential areas will be significant. Existing plantings, traditional plots bordered by large trees and hedges are important in mitigating the visual impact. For example, a 270 m high wind turbine located 1 km away is not visible from a 12 m high plantation 50-60 m away in the yard area. The higher the vegetation and the closer it is to the viewer, the greater the effect of the vegetation in screening the wind turbine (

Figure 76)[252] . The visual impact has been mitigated in the planning process by reducing the number of wind turbines and increasing the distance between them and residential buildings. This planning solution ensures that no residential area will experience a significant change in the landscape. In addition, it is possible to reduce the visual impact in the courtyards of residential buildings by planting additional greenery in the directions of view where the view of the wind turbines is to be avoided. In the case of residential areas, it is appropriate to reduce the visual impact of the wind farm in residential areas where there is a significant change in the landscape and this is disturbing to the residents .

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[250] Van der Zee H.T.H. 2016. Obstacle Lighting of Onshore Wind Turbines - Balancing aviation safety and environmental impact.

[251] https://www.youtube.com/watch?v=6nqBnGUbVGY

[252] Ots, K. 2024. 5211 Visual impact of Herro Wind Farm on private homes.

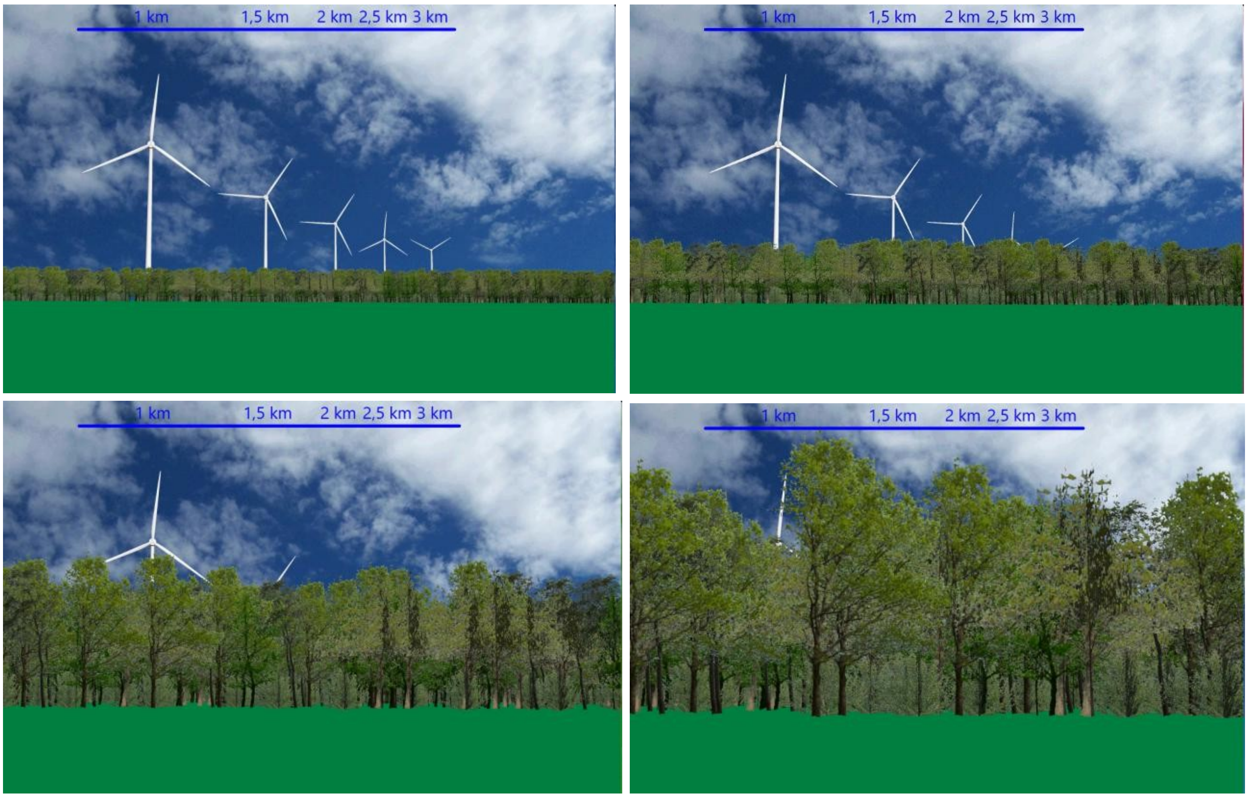

Figure 76. 270 m high wind turbines at distances of 1, 1.5, 2, 2.5 and 3 km, illustrated with a 20 m forest is located at distances of 500, 250, 100 and 50 m from the viewer.

4.8 Combined effects and cumulative impact

Combined effects, or cumulative effects, are the cumulative impact of individual factors. For example, the simultaneous impact of implementing different plans and projects. The cumulative nature of the impacts is taken into account in an integrated manner as a logical part of the usual environmental impact assessment for each topic discussed in the above chapters. The assessment of combined effects and cumulative impacts is complicated in the case of this SEA by the fact that although several wind farm plans have been initiated in the region, most of them are still in the preparation stage and it is therefore unclear where and how many wind turbines may be built.

The Valga County Plan 2030+ applies in the region. The Valga County Plan does not designate any preferred areas for the construction of wind farms.

As of November 2024, the new Valga Municipality comprehensive plan is still being prepared and the draft comprehensive plan has not yet been made public, so it is not possible to present the conditions for the construction of wind farms in accordance with the new comprehensive plan.

The neighbouring municipality of Tõrva has not designated any areas for wind energy development in its new comprehensive plan due to the time frame of the comprehensive plan. Another neighbouring municipality, Otepää Municipality, has not planned any wind turbines or wind farms in its comprehensive plan, as the construction of wind turbines would cause changes in the landscape (visual effect) and open views, which cannot be assessed to the extent necessary in a comprehensive plan. As far as is known, no special planning has been initiated for the planning of wind farms in the territory of Otepää Municipality. As far as is known, Otepää Municipality also remains largely within the area subject to national defence height restrictions. Elva Municipality does not plan to build wind farms in its comprehensive plan as structures with a significant spatial impact on the territory of Elva Municipality. The designation of potential areas for wind farms has been abandoned due to national defence considerations – most of Elva Municipality is located in an area that is unsuitable for wind energy production from a national defence perspective. To our knowledge, no special planning has been initiated for the development of wind farms in the territory of Elva Municipality.

Other wind farms may be planned within a 15 km radius of potential wind farm areas **under the special plan for the Tõrva municipality wind farm** [253] . To date, a draft special plan for the Tõrva municipality wind farm has been completed (as of November 2024, it is being prepared for submission to the coordination round), which provides for the planning of a wind farm approximately 20 km away from the potentially suitable areas covered by the Valga municipality special plan (Figure 77). Given the large distance, no significant cumulative impact is expected on any Natura area.

A second special plan for wind farms has also been initiated in Tõrva municipality, for which there is no information available to assess the cumulative impact. As this is a much later plan, the cumulative impact must be assessed during the SEA of this plan, if necessary.

In the Republic of Latvia, **the Valmiera-Valka wind farm** [254]is currently being planned. The developer, Latvijas vēja parki Ltd, plans to build a wind farm with up to 60 wind turbines with a maximum rated capacity of 8 MW, an expected maximum height of 300 m and a rotor diameter of up to 200 m. The total area of the wind farm construction site is 5387 ha. The project is located in Plani parish in the administrative unit of Valmiera and in Vijciems and Valka parishes in the administrative unit of Valka. The planned activity is located approximately 4 km from the Estonian border ([255]) (Figure 77). Latvia has carried out cross-border involvement in this project. According to the submitted EIA report (as of November 2024), the project will have an impact on birdlife and the landscape in Estonian territory. Based on the EIA carried out, the Valmiera-Valka wind farm is not expected to have any impacts that could cause a significant cumulative impact with the Valga wind farm. There is a distance of more than 17 km between the wind turbines of the Valga wind farm and the Valmiera-Valka wind farm, and therefore no significant combined impact is expected.

In addition, **the Valka wind farm** is being planned in the Republic of Latvia[256] is also being planned inthe Republic ofLatvia. Latvia has notified Estonia of the Valka wind farm project under the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention). The project is planned to be located approximately 2 km from the Estonian-Latvian border and approximately 15 km from the Valga wind farm. The developer, LLC
EWE Neue Energien plans to build a wind farm with up to 15 wind turbines in the municipality of Valka, with a total capacity of 120 MW (each wind turbine has a nominal capacity of 8 MW, the maximum possible height of a wind turbine can reach up to 260 m, and the rotor diameter ranges from 160 to 175 m). The exact number of wind turbines will be determined during the environmental impact assessment (EIA) process. This project is currently in the EIA programme stage. The results of the impact assessment are not yet known, and therefore it is not possible to assess the cumulative effects appropriately.

[253] https://kov.torva.ee/eriplaneering

[254] More information: https://www.eva.gov.lv/lv/ietekmes-uz-vidi-novertejumu-projekti/veja-parka-valmiera-valka-un-ta-saistitas-infrastrukturas-projekta-istenosana-valmieras-novada-planu-pagasta-un-valkas-novada- vijciema-un-valkas-pagastos-sia-latvijas-veja-parki

[255] According to the letter from the Ministry of Climate dated 19 October 2023 No. 6-3/23/4775-2

[256] More detailed information
https://www.eva.gov.lv/lv/ietekmes-uz-vidi-novertejumu-projekti/veja-parka-valka-un-ta-saistitas-infrastrukturas-buvnieciba-valkas-novada-valkas-pagasta-sia-ewe-neue-energien-1

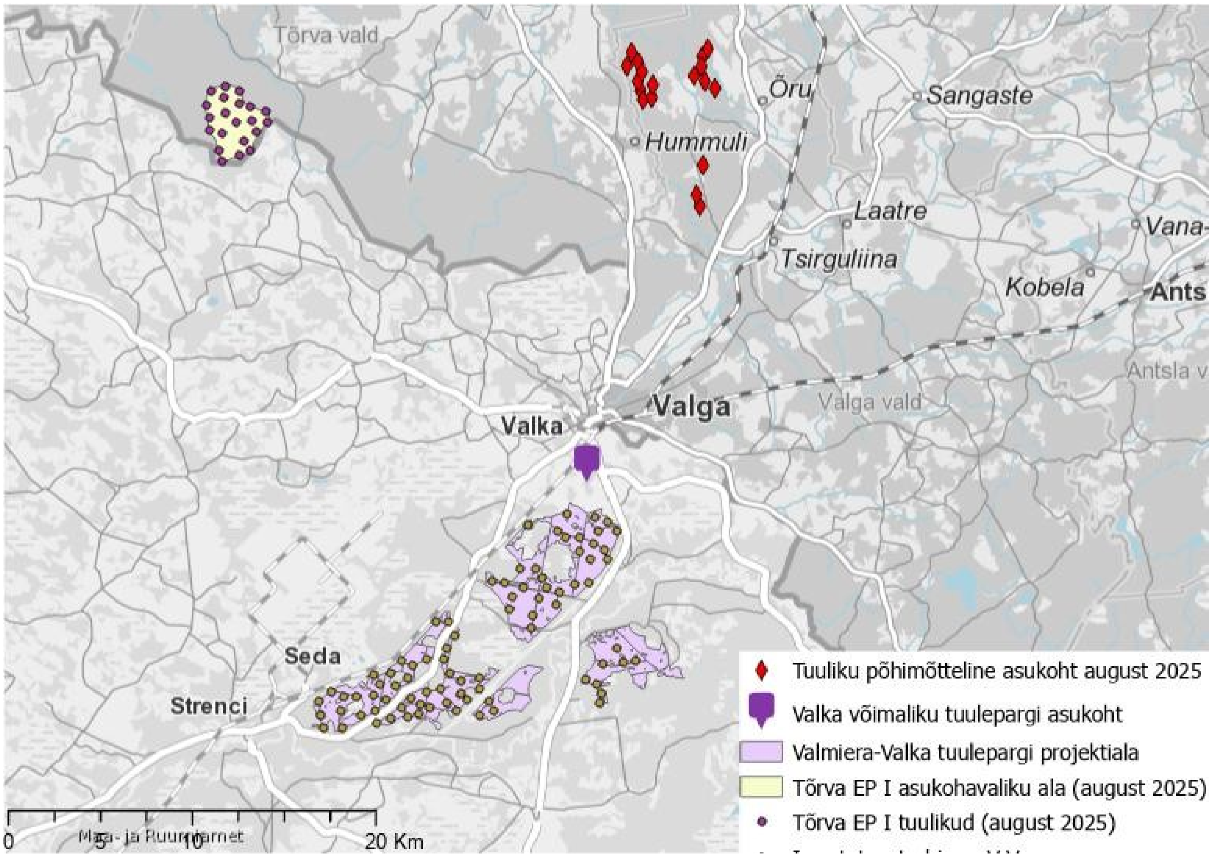

Figure 77. Known wind farm development projects in the region. In the case of the Valmiera-Valka project area, the various wind turbine positions analysed in the environmental impact assessment of this project are also shown.

4.9 Possible cross-border impact

The nearest potentially suitable area 4 is located approximately 4.7 km southwest of the Estonian-Latvian border and approximately 5.1 km southwest of the nearest wind turbine location in area 4. The nearest residential building in Latvia is located approximately 7.4 km southwest of the planned location of the nearest wind turbine, the nearest protected area (Northern Vidzeme Biosphere Reserve) is 5.1 km away, and the nearest micro-reserve (permanent conservation area in Estonian terms) No. 438, which is protected by a micro-reserve buffer zone, is approximately 8.2 km away. [257] The aforementioned objects located on Latvian territory are sufficiently far from the planned wind turbine locations, and therefore there will be no impact on them.

When compiling the SEA programme, the Latvian Nature Conservation Agency pointed out that the assessment should cover not only the possible impacts on bird species living on the Estonian side, but also on bird species found in Latvia, taking into account the fact that areas with protection priority have been designated in the border areas of Latvia for the protection of the Tengmalm's owl, the *Eurasian eagle-owl* (*Bubo bubo*) and the *Ural* owl (*Strix uralensis*). Attention should be paid to the impact of noise pollution on owls, and as there are several micro-reserves for capercaillie (*Tetrao urogallus)* on the Latvian side, the possible impact on the conservation of this species in the border areas should also be assessed. Based on the wind farm noise assessment (see section 4.6.1), the modelled noise levels associated with the wind farm in Latvian territory remain well below 35 dB, which is lower than the noise level considered disturbing to birds, including owls. Therefore, no impact on Latvian birdlife, including the habitats of protected bird species in border areas, was identified. The impact on the capercaillie population, including the impact on the connectivity between capercaillie (*Tetrao urogallus)* habitats, taking into account the need to maintain connectivity with Latvian capercaillie habitats, is discussed in detail in section 4.1.3.2.5 and Annex 5. Capercaillie habitats

[257] https://www.lvmgeo.lv/en/data

In order to avoid significant impact and preserve connectivity between habitats, the size of the planned wind farm was significantly reduced. The wind farm was not planned for the northernmost area initially mapped, and the number of wind turbines in the southernmost area was significantly reduced. The implementation of these measures will make it possible to avoid significant impact on the capercaillie population, including connectivity with the Latvian capercaillie population.

The establishment of a wind farm may theoretically have an impact on migratory species, which in turn may be an important aspect in assessing cross-border impacts. The bird survey carried out focused on both the spring and autumn migration periods. Based on the intensity of migratory bird occurrence, the area suitable for a wind farm was reduced, initially excluding the potentially suitable area 1 that had been mapped. When constructing wind turbines, mitigation measures must be implemented to prevent significant mortality during the migration period. During the migration period, wind turbines must be shut down during periods of high bird activity or by means of an appropriate control system in all location areas. Based on spot observations, migration is most active in this region in autumn from 1 to 20 October and in spring from 15 March to 15 May. Scientific research has shown the effectiveness of such measures in preventing collisions and thus also in preventing bird deaths. The length of the period and the need for implementation can be specified on the basis of follow-up monitoring.

In Latvia, there is a requirement that wind turbines must not be erected closer than 800 m to residential buildings[258]. The nearest residential building in Latvia is located approximately 7.4 km from the planned location of the nearest wind turbine, and the applicable distance requirement is fully met.

The SEA did not identify any areas of impact where the wind farm planned in the Valga municipality's special plan could have a significant environmental impact extending to the territory of the Republic of Latvia. The only impact that may extend to the territory of the Republic of Latvia is a visual impact. The planned wind farm will be visible from the open areas near the border of the Republic of Latvia in good weather conditions. Considering that such areas are more than 5 km away from the nearest wind turbine, the wind farm will not dominate the view. There are no significant cultural objects or observation towers in Latvia within a 15 km radius of the planned location of the nearest wind turbine. ([257]) No significant visual impact on any significant cultural or tourist sites in Latvia has been identified.

[258] Cabinet Regulation No. 240 *"General Regulations for the Planning, Use and Building of the* Territory" (30.04.2013.)

5 Comparison of alternatives Comparison and likely development if if the special plan is not implemented

5.1 Comparison of location alternatives

The aim of the preliminary selection stage of the local government special plan is to determine the location for the desired object (in this case, a wind farm). According to the starting points of this special plan, the aim is to find not just one, but all potentially suitable areas within the special plan area where it would be possible in principle to establish a wind farm or wind farms. Since the aim is to find all suitable areas, it is not appropriate to compare location alternatives. Therefore, this SEA report presents recommendations for reducing the number of areas or setting additional conditions to reduce and avoid adverse effects, but does not compare the areas with each other.

5.2 Likely development if the special plan is not implemented

At the local level, there will be no significant impact if the special plan is not implemented. This means that no positive effects on the business environment are to be expected, which could accompany the establishment of a wind farm in the region. Potentially suitable areas are largely forest areas, where forest management will continue in accordance with the Forest Act. The current use of other areas (berry picking, tourism, hunting, etc.) will also continue, i.e. the development of the region will continue as before.

From a national perspective, there is a risk that if the special plan is not implemented, renewable energy targets will not be met and Estonia will not be able to sufficiently reduce its greenhouse gas emissions and thus slow down climate change.

6 Establishment of a grid connection, possible route corridors and impacts

In order to connect the wind farm to the main grid, it is necessary to construct a power line from the wind farm area, which will be connected to the wind farm's main grid substation or to a new substation to be built on the main grid's 330 kV or 110 kV line. The nearest main grid substations are located south of the special planning area (Figure 78). It is possible to connect the wind farms to the substation located to the south. Due to current regulations, it is not known at the time of preparing the special plan where it will be possible to build a substation/create a grid connection for the wind farm. Possible route corridors are shown in Figure 78.

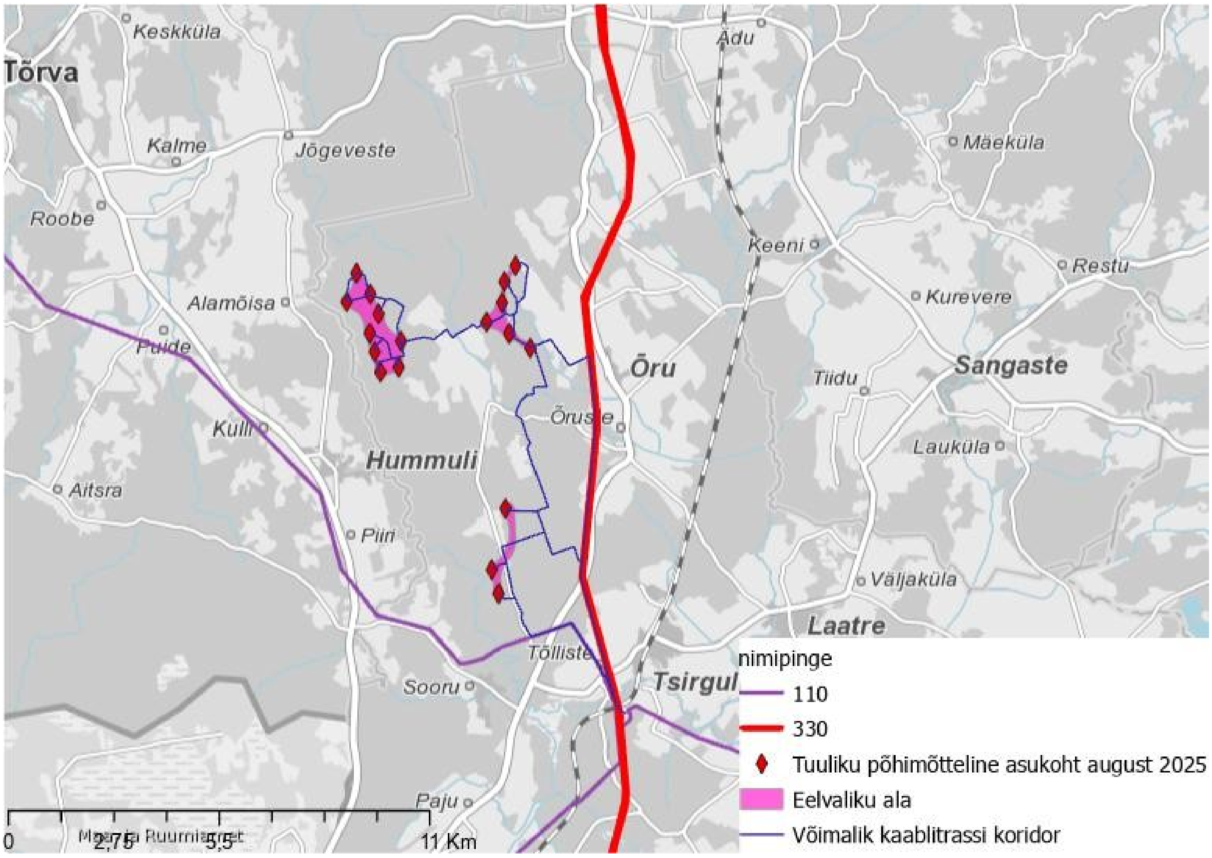

Figure 78. Possible power connection route corridors in the special plan area.

6.1 Positive and negative aspects of overhead lines and underground cables

High-voltage power lines are usually constructed as overhead lines. There are several technical and economic considerations involved in this. Compared to low- and medium-voltage lines, high-voltage lines are technically much more complex and economically more expensive to construct as underground cables. The positive and negative aspects of underground and overhead lines have been thoroughly analysed, for example, in the planning of the Harku-Lihula-Sindi 330/110 kV power line([259]) .

According to the analysis, the positive characteristics of overhead lines can be considered to be:

- simplicity of construction;
- relative reliability;
- speed of fault detection and removal;
- long service life;
- high transmission capacity;
- seasonal (winter) overload capacity;

[259] TTÜ Institute of Electrical Power Engineering. 2013. Harku-Lihula Sindi 330/110 kV overhead line *versus* cable line. Expert assessment.

- low cost.

The main negative aspects can be considered to be:

- visual pollution;
- wide corridors along the line route that need to be maintained (in the case of forests, clear-cutting in line corridors);
- negative impact on birdlife (deaths in collisions).

The positive characteristics of underground cables are:

- no visual pollution;
- possibility of short-term overload;
- low failure rate;
- storm resistance.

Negative characteristics include:

- large capacity;
- lower throughput;
- expected shorter technical lifespan;
- longer repair times;
- high cost.

It is also possible to construct **combined** power lines (partly overhead and partly underground).

Certain negative aspects must be taken into account in the case of combined lines:

- The positive feature of overhead lines, which can be overloaded seasonally, and the positive feature of cable lines, which can be overloaded for short periods, are lost.
- There is a risk of more frequent faults in underground cable sections, as various lightning surges can be transmitted from overhead lines;
- Significantly longer fault location times and high repair costs in the event of a ground cable fault time.

6.2 Environmental impact of high-voltage lines

The main impact of high-voltage overhead lines on humans is **visual**. High-voltage lines, especially their pylons, are large and prominent features in the landscape. Pylons for power lines of different voltages are illustrated in Figure 79.

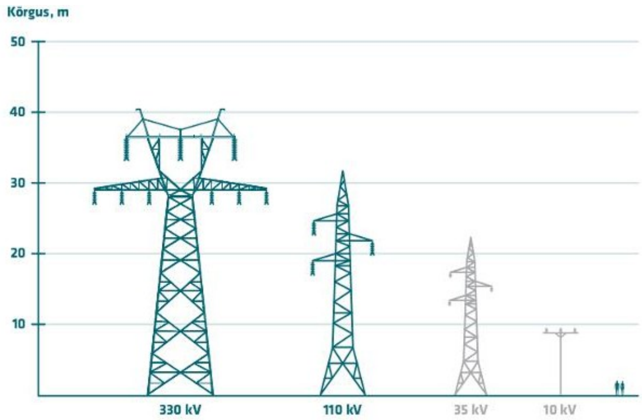

Figure 79 Pylons for overhead lines with different voltage classes. Source: Elering AS.

According to Regulation No. 73 of the Minister of Economic Affairs and Infrastructure of 25 June 2015 "Extent of the protective zone of a structure, procedure for operating in the protective zone and requirements for marking the protective zone", the extent of the protective zone of an electrical installation for lines with a nominal voltage of 110 kV is 25 metres on both sides of the line axis. The protection zone of an underground cable line is the area along the cable, bounded on both sides by imaginary vertical planes located 1 metre

. Around substations and distribution equipment, the protective zone extends 2 metres from the boundary fence, wall or, in their absence, the equipment.

The construction of an overhead line therefore requires a route corridor approximately 50 m wide, within which

the forest must be cleared.

One factor affecting the natural environment is **the risk of birds colliding with overhead** power **lines**. Large or fast-flying bird species are most at risk: ducks, geese, swans, cranes, herons, birds of prey, etc. In the USA, power lines have been found to be one of the three main causes of bird deaths due to human activity. The frequency of bird deaths due to collisions with power lines varies widely, ranging from 2.95 to 489 birds per kilometre of line per year([260]) .

To reduce the likelihood of bird deaths and as a mitigating measure, power lines are marked with deterrents such as streamers, balls or similar devices [(261)] .

Based on the above, high-voltage power lines have a significant negative impact when they are located:

- near residential buildings (especially line pylons) – spoils the view;
- in or near the habitats of protected bird species – power lines are one of the most significant causes of death due to human activity;
- in high-value forest habitats – forests are cleared when power lines are built.

High-voltage power lines are sometimes associated with **noise**. Noise measurements have been carried out to determine the noise level in the vicinity of a 330 kV power line and substation([262]) .The noise measurements showed that the noise level returns to the natural background level (estimated at 35 dB) in the protection zone of the 330 kV power line. The noise from the 330 kV substation falls to the natural background level at a distance of 75 m. Therefore, no long-range noise disturbance from the line or substations is to be expected. No noise emissions have been observed from underground cables.

Another possible impact associated with high-voltage power lines is the health effects associated with **electromagnetic fields**. The nature of electromagnetic fields and their occurrence around various electrical appliances is thoroughly described in the SEA report on the location of the Harku-Lihula-Sindi 330/110 kV power line route and will not be repeated here.

In order to avoid exposure to electromagnetic fields that are larger and pose a risk to humans, both national and international limit values have been set for the strength of fields present in the environment. The maximum permissible values established in Estonia are set out in Regulation No. 38 of the Minister of Social Affairs of 21 February 2002 ([263]) "Limit values for non-ionising radiation in living and recreational areas, residential buildings and public buildings, classrooms and measurement of non-ionising radiation levels".

According to the regulation, the limit value for the strength of a 50 Hz electric field for the population is 5000 V/m and the limit value for magnetic flux density is 100 µT. Magnetic flux density values are directly dependent on the load of the high-voltage line, i.e. the current in the line. Outside the protection zone of a 330/110 kV power line, the magnetic flux density (limit value 100 µT, actual value under the line less than 10 µT) and the electric field strength (limit value 5000 V/m, actual value at the boundary of the protection zone less than 1000 V/m) are below the standard levels set out below([264]) .In the case of high-voltage cables, it has been observed that the magnetic flux density directly above the cable may be higher than under a high-voltage line of the same voltage (e.g. 2.6 µT has been measured under a 500 kV high-voltage line and 105 µT above the cable), but as the distance increases, the magnetic flux density decreases significantly in the case of cables

[260] Nellis, R. 2014. Harku-Lihula-Sindi 330/110 kV high-voltage overhead line bird monitoring plan and assessment of the need for marking

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[261] Maves AS. 2016. Strategic environmental assessment of the thematic plan specifying the planning of Harju, Lääne and Pärnu counties, "Determination of the location of the Harku-Lihula-Sindi 330/110 kV power line route". APPENDIX 2 Line sections requiring marking in Harju, Lääne and Pärnu counties.

[262] Health Board Central Laboratory Physics Laboratory. Noise measurement report 6/4-6-2/1004. 29.09.2014.

[263] https://www.riigiteataja.ee/akt/163816

[264] Maves AS. 2016. Strategic environmental assessment of the thematic plan specifying the planning of Harju, Lääne and Pärnu counties, 'Determination of the location of the Harku-Lihula-
Sindi 330/110 kV power line route" in Harju, Lääne and Pärnu counties.

greater than in the case of overhead lines (e.g. 2.6 µT has been measured 15 m from a 500 kV high-voltage line and 0.25 µT 15 m from a cable[265]).

6.2.1 Measures, need for further research and assessment

A more effective measure to reduce the significant adverse impact of the construction of power lines associated with the construction of wind farms, both from a natural [266] and human environment perspective, is to use underground cables instead of overhead power lines. As it is not possible to determine the exact routes of power lines when drawing up a special plan, it is strongly recommended that power connections be made using underground cables. In most cases, this will make it possible to avoid significant adverse environmental impacts.

The following measures must be implemented in the further design and construction of underground cables in order to avoid significant adverse effects.

- When designing the network connection (specifying the route corridors), avoid known locations of valuable forest habitats, habitats in good condition (representativeness A and B) under the Habitats Directive, and protected plant, fungus and lichen species in protection categories I and II. The route should also avoid areas of permanent habitats and protected areas.
- When crossing watercourses, electrical cables must generally be installed using a closed method/drilling in the construction restriction zones of watercourses to avoid damage to the banks and soil and pollution entering the watercourse. This measure may be deviated from with the permission of the Environmental Board if there is confidence that the chosen construction solution will not damage the condition of the water body. Construction machinery and vehicles are not permitted to drive in water bodies.

When burying cable routes, it is recommended to remove the excavated material in layers – grass separately, soil separately and bedrock separately. After installing the cables, fill the channels as naturally as possible, first with bedrock, then a layer of soil, and finally plant turf taken from the same route area to level the ground. This measure is particularly necessary if the cable route passes through semi-natural communities, habitat types listed in the Habitats Directive or sites where protected plant, fungus and lichen species are found.

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[265] Moorabool Shire Council. 2020. Comparison of 500 kV Overhead Lines with 500 kV Underground Cables.
[266] IFC (International Finance Corporation), EBRD (European Bank for Reconstruction and Development), KfW Group 2023. Post-Construction Bird and Bat Fatality Monitoring for Onshore Wind Energy Facilities in Emerging Market Countries. Good Practice Handbook and Decision Support Tool. https://www.ifc.org/en/insights-reports/2023/bird-bat-fatality-monitoring-onshore-wind-energy-facilities

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Appendices

Appendix 1 – Shadow modelling report (with shadow calendars) Appendix 2 –

Photomontages

Appendix 3 – Report on the study of birds and bats (full version for internal use)

Appendix 4 – Vegetation survey report

Appendix 5 – Expert opinion on capercaillie (full version for internal use)