“Valka” wind farm construction in the parish of Valka in Valka municipality

Environmental Impact Assessment Report version for Public Consultation

Riga, August 2026

INSPIRING ENVIRONMENT

SIA "Estonian, Latvian & Lithuanian Environment"

"Valka" wind farm construction in the parish of Valka in Valka municipality

Environmental Impact Assessment Report version for Public Consultation

SIA "Estonian, Latvian & Lithuanian Environment"

Project manager — Oskars Beikulis
Board member — Valts Vilnītis

Riga, August 2026

CONTENTS

INTRODUCTION 9

1. GENERAL DESCRIPTION OF THE PROPOSED ACTIVITY SITE AND JUSTIFICATION FOR SITE SELECTION 9

1.1. DESCRIPTION OF THE PROPOSED ACTIVITY AREA AND ITS SURROUNDINGS 9

1.2. COMPLIANCE OF THE PROPOSED ACTIVITY WITH THE SPATIAL PLAN AND ENCUMBRANCES ON IMMOVABLE PROPERTIES 14

1.3. DESCRIPTION OF WIND CONDITIONS 16

1.4. WIND FARMS PLANNED IN THE SURROUNDING AREA 18

2. DESCRIPTION OF THE PROPOSED ACTIVITY 21

2.1. PLANNED LOCATIONS OF WIND TURBINES AND ALTERNATIVES 21

2.2. DESCRIPTION OF WIND TURBINES AND TECHNOLOGICAL ALTERNATIVES 25

2.3. WIND FARM CONSTRUCTION PROCESS 26

2.3.1. Change in traffic intensity during construction of wind farm 28

2.3.2. Site preperation 30

2.3.3. Construction of access roads and areas, melioration system 30

2.3.4. Wind turbine foundation construction 35

2.3.5. Area of land required for the wind farm 36

2.3.6. Construction of engineering communications 37

2.3.7. Wind turbine delivery and installation 40

2.4. RESTRICTIONS, SUPERVISION AND CONTROL OF THE TERRITORY DURING AND AFTER CONSTRUCTION OF WIND TURBINES 41

2.5. PROPOSED ACTIVITY IMPLEMENTATION SEQUENCE AND PLANNED DEADLINES 41

2.6. WIND TURBINE RELATED UTILITY BUFFER ZONES 42

3. DESCRIPTION OF THE ENVIRONMENTAL SITUATION AND ASSESSMENT OF ENVIRONMENTAL IMPACT OF THE PROPOSED ACTIVITY 43

3.1. NOISE 43

3.1.1. Legislative framework 48

3.1.2. Impact assessment approach 50

3.1.3. Environmental noise 58

3.1.4. Low frequency 80

3.1.5. Mitigation measures 82

3.1.6. Assessment of alternatives 83

3.2. FLICKER EFFECT 84

3.2.1. Legislative framework 84
3.2.2. Impact assessment approach 85
3.2.3. Operational phase impacts 85
3.2.4. Mitigiation measures 89
3.2.5. Assessment of alternatives 90
3.3. BIODIVERSITY 91
3.3.1. Legislative framework 91
3.3.2. SPNTs and micro-reserves 93
3.3.3. Plants and habitats 99
3.3.3.1. Impact assessment approach 99
3.3.3.2. Description of the existing situation 100
3.3.3.3. Impact on specially protected plants, habitats and veteran trees 105
3.3.3.4. Mitigation measures 111
3.3.3.5. Assessment of alternatives 112
3.3.4. Bats 113
3.3.5. Ornithofauna 123
3.4. LANDSCAPE AND VISUAL IMPACT 161
3.4.1. Landscape protection policy and legislative framework 161
3.4.2. Impact assessment approach 165
3.4.3. Description of the existing situation 170
3.4.4. Impact on landscape of the wind farm 180
3.4.5. Cumulative effects 201
3.4.6. Aviation lighting assessment 206
3.4.7. Cross-border impact on the landscape 210
3.4.8. Mitigation measures 210
3.4.9. Assessment of alternatives 212
3.5. ENVIRONMENTAL RISKS AND EMERGENCY SITUATIONS 212
3.5.1. Regulatory framework 212
3.5.2. Impact assessment approach 213
3.5.3. Description of the project area 222
3.5.4. Results of environmental risks and emergency situations 223
3.5.5. Cumulative effects 237
3.5.6. Mitigation measures 238

3.5.7. Assessment of alternatives 243
4. PARTICIPATION OF THE PUBLIC 244
5. LIMITING FACTORS FOR THE INTENDED ACTIVITIES AND SOLUTIONS TO MITIGATE ENVIRONMENTAL IMPACTS 244
5.1. FACTORS LIMITNG THE INTENDED ACTIVITY 244
5.2. POTENTIAL SUBSTANTIAL IMPACTS AND MITIGATION SOLUTIONS 245
6. COMPARISON OF ALTERNATIVES OF THE PROPOSED ACTIVITY 256
6.1. ASSESSMENT OF SITE ALTERNATIVES 256
6.2. ASSESSMENT OF CABLELINE AND BESS ALTERNATIVES 259
6.3. ASSESSMENT OF TECHNOLOGICAL ALTERNATIVES 260
7. CONDITIONS FOR THE SUBSEQUENT MONITORING OF THE PROPOSED ACTIVITY IN THE CONTEXT OF THE ENVIRONMENTAL IMPACT 261

ANNEXES

1. Annex. Landscape visual impact changes

2. Annex. Report of a certified landscape architect on the impact on the landscape within the territory of Estonia

EXPERTS INVOLVED IN THE PREPARATION OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Name and surname	Education/expert certificate No.
Oskars Beikulis Project Manager	MSc in environmental science
Aleksandrs Novičonoks	BSc in environmental engineering
Alise Elksne	Expert, certificate No. 236
Anastasija Marmiša	MSc in wildlife health and conservation
Baiba Ozoliņa	MSc in environmental science
Gune Mīlgrāve	MSc in environmental science
Elza Marija Zacmane	Expert, certificate No. 259
Heiki Kalberg	Landscape Architect
Jānis Prindulis	Master's degree in comprehensive quality management
Jānis Rubinis	MSc in environmental science
Jānis Ukass	Expert, certificate No. 249
Kārlis Precinieks	BSc in environmental science
Keith Oras	Landscape Architect
Kristiāna Siliņa	MSc in environmental planning
Krišjānis Ralfs Veinbergs	MSc in environmental science
Laura Kurzemniece	MSc in environmental science
Margita Deičmane	Expert, certificate No. 024
Markuss Dāvis Albrehts	BSc in environmental science
Pēteris Daknis	Expert, certificate No. 22
Pēteris Lakovskis	Doctor of Geography
Ritvars Ritums	Master's degree in history
Toms Daniels Čakars	MSc in Geology, expert, certificate No. 182

ACRONYMS

Acronym	Description
AADT	Annual average daily traffic
BESS	Battery Energy Storage System
BLEVE	Boiling Liquid Expanding Vapour Explosion
CNG	Compressed natural gas
DVC	Degree of visible change
ECMWF	European Centre for Medium-Range Weather Forecasts
EIA	Environmental impact assessment

Acronym	Description
EU	European Union
GIS	Geographic information system
GPS	Global Positioning System
HiQBioDiv	High-resolution biodiversity quantification for nature conservation and management
JSC	Joint Stock Company
LEGMC	Latvian Environment, Geology and Meteorology Centre
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
NatureScot	Scottish Natural Heritage
NCA	Nature Conservation Agency
NCA	Nature Conservation Agency
NCHB	National Cultural Heritage Board
NVBR	North Vidzeme Biosphere Reserve
PLA	Protected Landscape Area
SEI	Solid electrolyte interphase
SES	State Environmental service
SJSC	Simplified Joint Stock Company
SLLC	Simplified Limited Liability Company
SPNT	Specially protected nature territories
SPS	Specially protected species
ST	Standard blades
STE	Aerodynamically improved blades (serrated trailing edges)
TEN-T	European Transport Network
TIAN	Spatial plan and the regulations on land use and building
WHO	World Health Organization
WTG	Wind turbine generators

INTRODUCTION

SIA "EWE Neue Energien 1" (hereinafter – the Developer) is developing its renewable energy production infrastructure in Latvia, and is carrying out investigations to assess the feasibility of constructing a wind farm in Valka Municipality. "Valka" wind farm project is one of several potential development projects in Latvia currently being assessed by the Developer. The main reasons for selecting the proposed location are related to the availability of electricity transmission infrastructure, favourable meteorological conditions for wind energy production, the interest of landowners in implementing the project, as well as a preliminary assessment indicating that the territory is suitable for a project of this scale.

The State Environmental Bureau, based on the Law "On Environmental Impact Assessment", has accepted Decision No. 5-02-1/33/2024 on the application of the environmental impact assessment (hereinafter – EIA) procedure and transboundary EIA for the "Valka" wind farm project. Programme No. 5-03/29/2024 for the implementation of the EIA was issued on 1 July 2024.

The EIA Report has been prepared by SIA "Estonian, Latvian & Lithuanian Environment", involving relevant experts. **This version of the EIA Report has been prepared specifically for the purposes of transboundary consultation with Estonia and provides information on the proposed activity and the key potential environmental impacts relevant in a transboundary context.**

The assessment has identified that certain impacts, such as environmental noise and shadow flicker effects, do not extend to the territory of Estonia. The most relevant potential transboundary impact identified is the impact on the landscape, particularly considering the visibility of the planned wind farm from locations within Estonia. Accordingly, this Report includes relevant information and appendices addressing landscape impacts, including the assessment of visual effects from the Estonian territory.

As other assessed environmental impacts do not extend to Estonian territory, the original supporting materials, including detailed calculation files, modelling data, expert assessments and other technical documentation, are available only as part of the original EIA Report prepared for the Latvian EIA procedure.

This document is intended to support the public consultation and transboundary consultation process and does not constitute a final decision-making document. The final EIA Report and associated decision-making documents will be prepared in accordance with the applicable Latvian regulatory requirements.

1. GENERAL DESCRIPTION OF THE PROPOSED ACTIVITY SITE AND JUSTIFICATION FOR SITE SELECTION

1.1. DESCRIPTION OF THE PROPOSED ACTIVITY AREA AND ITS SURROUNDINGS

The Developer, while developing its renewable energy generation infrastructure in Latvia, is carrying out studies to assess the possibilities for constructing a wind farm near the town of Valka. The construction proposal for the "Valka" wind farm is one of several potential development projects in Latvia currently being assessed by the Developer. The main reasons for selecting the

site of the proposed activity are related to the availability of grid infrastructure, favourable meteorological conditions for wind-based electricity generation, the interest of landowners in project implementation, and an area that, at first sight, is suitable for implementing a project of this scale. Taking into account the scale of the proposal, the State Environmental Bureau, pursuant to the Law "On Environmental Impact Assessment", has adopted Decision No. 5-02-1/33/2024 on the application of the EIA procedure and transboundary EIA to the construction proposal for the "Valka" wind farm. Programme No. 5-03/29/2024 for carrying out the EIA was issued on 1 July 2024.[1]

When commencing the study of the construction possibilities for the "Valka" wind farm, the Developer carried out a desk-based analysis of several possible development sites in the North Vidzeme region and concluded that a potentially suitable area for implementing the proposal is located south of the town of Valka. The key factors that initially indicated the suitability of the area for implementing such a proposal were the availability of electricity transmission infrastructure, a relatively large area without individual farmsteads typical of rural settlement patterns in Latvia, wind conditions suitable for efficient electricity generation, and the fact that the data on natural values accumulated before the start of the study did not indicate any excluding factors for implementing the proposed activity. When commencing detailed planning of the proposal, the Developer assessed both the technical capacity of the area and the electricity transmission infrastructure and approached local landowners regarding their possible involvement in implementing the proposal. Having received consent from some of the landowners, the Developer decided to start an in-depth study of the area, one step of which is the EIA. For the purposes of the EIA process, the Developer defined a wider study area (see Figure 1.1) within which the siting options for both wind turbine generators (hereinafter – WTG) and infrastructure would be assessed in detail.

The "Valka" wind farm is planned to be constructed in the north-eastern part of Latvia, in the North Vidzeme lowland. The study area of the planned wind farm includes both larger agricultural land areas and separate, relatively small forest patches. The study area is crossed by the Seda river, around which marshy floodplain grasslands were once found, however, the Seda river has been drained, and an extensive drainage network has been constructed in the nearby agricultural lands to drain the wet grasslands. South of the planned wind farm there is an extensive forest massif crossed by the Gauja river. The forest massif contains both dry forests that have developed on inland dunes and wet forest stands and extensive bog areas. To the east and west of the wind farm study area, in a mosaic-type landscape, larger agricultural land areas alternate with forest patches, and the area is characterised by a network of individual farmsteads.

In the north, the study area borders the territory of the town of Valka, while the Latvian border with Estonia is located approximately 1.2 km from the study area. The town of Valga is located on the other side of the border. Two villages, Sēļi and Lugaži, are located near the study area. Other densely populated areas are located more than 10 km from the boundary of the study area. According to information published by the State Land Service, there are 162 residential buildings

[1] As of 1 October 2025, the functions are performed by the State Environmental Service (SES). Available: https://www.vvd.gov.lv/lv/jaunums/energetikas-un-vides-agentura-ar-1-oktobri-tiek-pievienota-valsts-vides-dienestam

within 1 km of the boundary of the study area, most of which are located in the town of Valka and in Sēļi. There are relatively few isolated farmsteads in the immediate vicinity of the wind farm study area.

In the east, the study area borders the state regional road P24 Smiltene – Valka. To the north-west of the study area is the state main road A3 Inčukalns – Valmiera – Estonian border. On the north-western side of the study area are the Rīga – Valka railway line and the "Lugaži" railway station. Several roads owned or managed by the municipality and JSC "Latvia's State Forests" are located in the surrounding area.

The northern part of the wind farm study area is crossed by the 110 kV high-voltage electricity transmission line Valmiera – (EST) Tsirguliina, while the 330 kV high-voltage electricity transmission line Valmiera – (EST) Tsirguliina is located along the eastern edge of the study area. The closest substation to the planned wind farm has been constructed within the territory of the town of Valka on the 110 kV high-voltage line.

According to information published by the National Cultural Heritage Board (hereinafter – NCHB), the nearest state-protected cultural monument is located in Valka, approximately 0.96 km from the study area; it is a cultural monument of regional significance and the site of a historical event, the "Vidzeme Teachers' Seminary" (protection No. 97). Approximately 1.2 km from the study area is the cultural monument of local significance "Planči Hillfort" (protection No. 2394), while approximately 2 km from the study area is the cultural monument of national significance "Lugaži Lutheran Church" (protection No. 6883). Other state-protected cultural monuments are located more than 2 km from the study area. A relatively large number of protected cultural monuments are located in the town of Valga, the nearest of which are situated approximately 2 km from the boundary of the study area.

According to information published in the "OZOLS" nature data management system of the Nature Conservation Agency (hereinafter – NCA), the specially protected nature areas closest to the wind farm study area that are included in the European network of protected areas Natura 2000 are the protected landscape area "Ziemeļgauja", located approximately 1.5 km from the study area, the micro-reserve "Bulvāra riests", located approximately 2 km from the study area, and the nature reserve "Burgas pļavas", located approximately 2 km from the study area. The nature reserve "Sedas purvs" is located approximately 7 km from the study area, while the nearest Natura 2000 site in Estonia, "Karula – Pikkjärve", is located approximately 15 km from the study area. The protected landscape area "Ziemeļgauja", the nature reserve "Burgas pļavas", and the nature reserve "Sedas purvs" are included in the list of Important Bird Areas. The study area of the planned wind farm partially overlaps with the North Vidzeme Biosphere Reserve. Several micro-reserves are also located near the planned wind farm.[2]

According to information available in the Subsoil Information System maintained by the Latvian Environment, Geology and Meteorology Centre (hereinafter – LEGMC), the sand deposit "Sedaskalni" (No. B2713) is located within the wind farm study area. The area of the deposit is 11.36 thousand m²; the reserves were explored in 2010, and the estimated volume of reserves in

[2] Available: https://ozols.gov.lv/pub

the deposit is 102.3 thousand m^3. At the time of preparing the EIA, the mineral deposit passport was not active.

According to information published in the register of polluting activities maintained by the State Environmental Service (hereinafter – SES), there are no other large-scale industrial facilities in the vicinity of the planned wind farm. The list of permits issued for polluting activities indicates that the industrial facilities closest to the wind farm are engaged in wood processing and agriculture-related activities, wastewater treatment, as well as vehicle maintenance or comparable services.

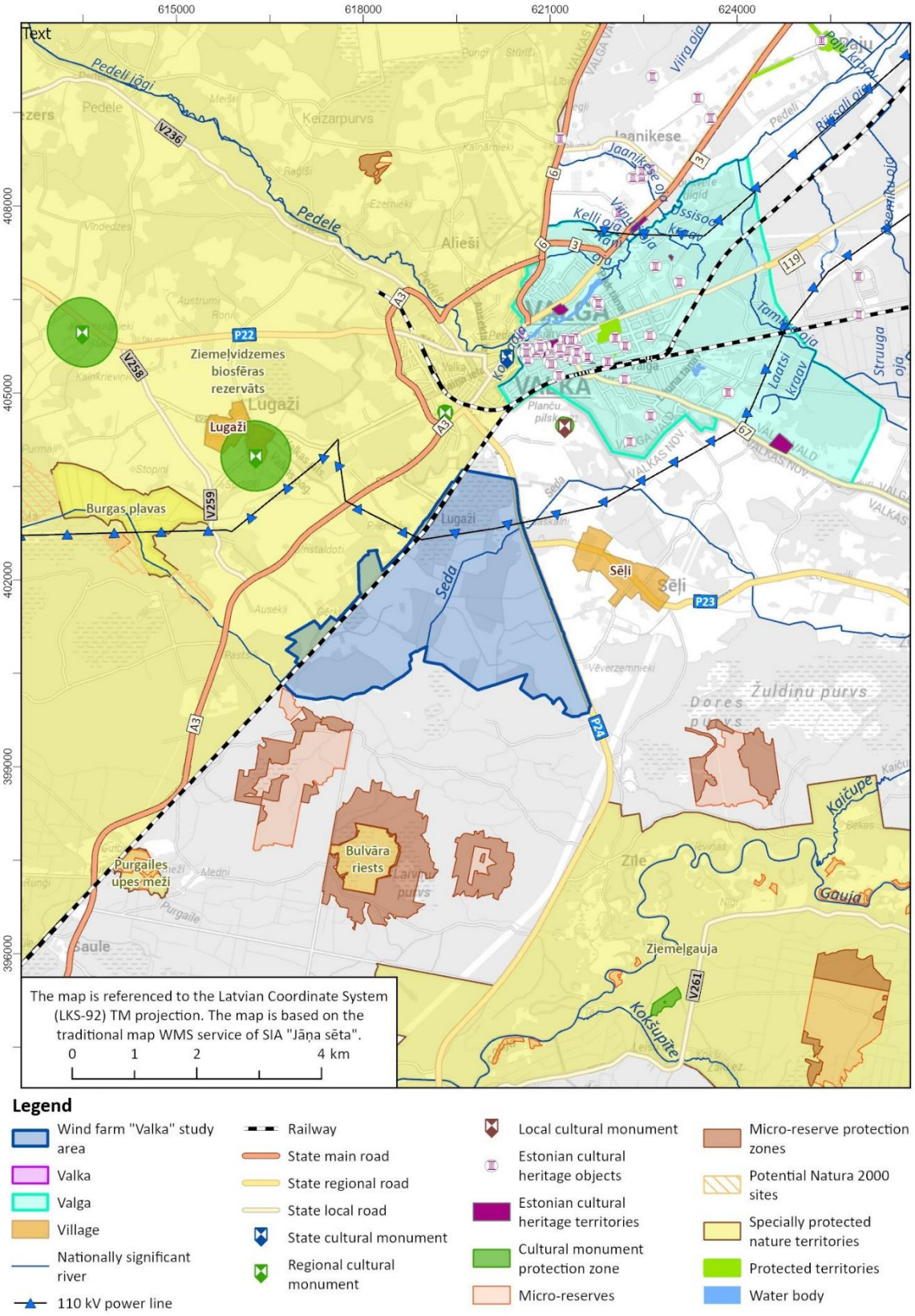


Figure 1.1. Location of the EIA study area

1.2. COMPLIANCE OF THE PROPOSED ACTIVITY WITH THE SPATIAL PLAN AND ENCUMBRANCES ON IMMOVABLE PROPERTIES

By the decision of the Council of Valkas Municipality of 28 October 2021, amendments to the Valkas Municipality Spatial Plan of 2017 (hereinafter – the spatial plan in force) were approved, with Binding Regulations No. 28 approving the graphical part of the spatial plan and the regulations on land use and building (hereinafter – TIAN).[3]

According to the spatial plan in force, the study area consists of land units whose designated functional zoning is agricultural territory (L), forest territory (M), waters territory (Ū), transport infrastructure territory (TR), and industrial development territory (R1) (see Figure 1.2). Part of the land unit included in the study area with cadastral number 94880100058 is designated as a territory with special use conditions (TIN8) applicable to degraded areas. The spatial plan and its explanatory memorandum do not provide justification for the designation of this territory. In the wind farm study area, the following protection zones have been established around infrastructure and natural objects and are shown in the graphical part of the spatial plan in force:

- Protection zone of surface water bodies;
- Chemical protection zone for the environment and natural resources around a groundwater abstraction site;
- Sanitary protection zone around a wastewater treatment plant with open wastewater treatment and open sludge fields;
- Operational protection zone along an overhead electricity line with a nominal voltage from 10 to 20 kilovolts;
- Operational protection zone along an overhead electricity line outside towns and villages with a nominal voltage up to 20 kilovolts;
- Operational protection zone along an overhead electricity line with a nominal voltage of 110 kilovolts;
- Operational protection zone of a drainage channel (a regulated section of a watercourse and a specially excavated channel), as well as the hydraulic structures and equipment located on it;
- Operational protection zone along state main and regional roads;
- Operational protection zone along the railway.

According to the spatial plan in force, new WTGs with a maximum capacity above 20 kW may be located in industrial development territories (R), technical development territories (TA), agricultural territories (L), and forest territories (M). Paragraph 127 of the TIAN stipulates that WTG construction is permitted no closer than 500 m from residential and public buildings (for power plants with a capacity from 20 kW to 2 MW) and no closer than 800 m (for power plants with a capacity above 2 MW). The distance is measured from the WTG tower. The spatial plan in force does not set any other specific requirements for WTG construction.

[3] Available: https://geolatvija.lv/geo/tapis#document_22074

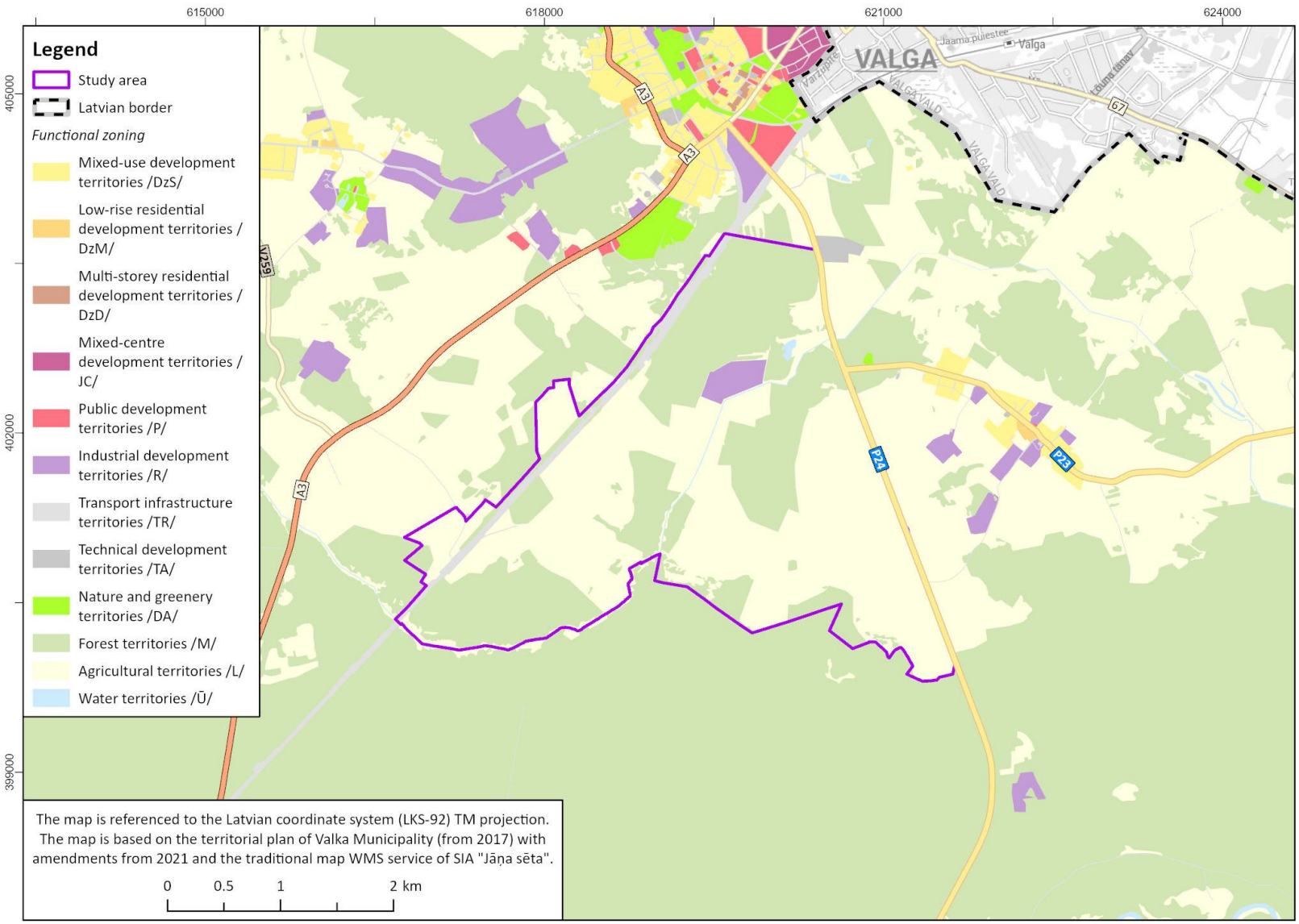


Figure 1.2. Functional zoning in the study area (spatial plan in force)

1.3. DESCRIPTION OF WIND CONDITIONS

One of the main criteria for selecting a suitable area for constructing a wind farm and appropriate WTG models is the wind conditions in the proposed activity area. To characterise the wind conditions in the proposed activity area and to assess impacts dependent on wind conditions within this EIA, data from the fifth-generation global climate weather reanalysis dataset ERA5, developed by the European Centre for Medium-Range Weather Forecasts, were used for the period from 1 January 2015 to 31 December 2024; data from the nearest LEGMC meteorological station were used to characterise maximum wind speed.[45]

Within the EIA process, data on wind conditions in the proposed activity area at a height of 200 m above ground level were used. According to the information on wind speed in the proposed activity area available in the ERA5 database for the last 10 years, it can be concluded that:

- the annual average wind speed in the proposed activity area is 7.87 m/s;
- the lowest average wind speed was recorded in 2018 – 7.44 m/s, while the highest was recorded in 2020, reaching 8.54 m/s (see Figure 1.4);
- wind speed in the proposed activity area varies over the course of the year: the highest average wind speed is observed in the cold months of the year, December and January, while the lowest wind speed is observed in the summer period, in June (see Figure 1.3);
- approximately 0.2% of the total annual time in the proposed activity area is characterised by calm conditions, when wind speed is below 0.5 m/s.
- The prevailing wind directions in the study area are westerly and south-westerly (see Figure 1.5).

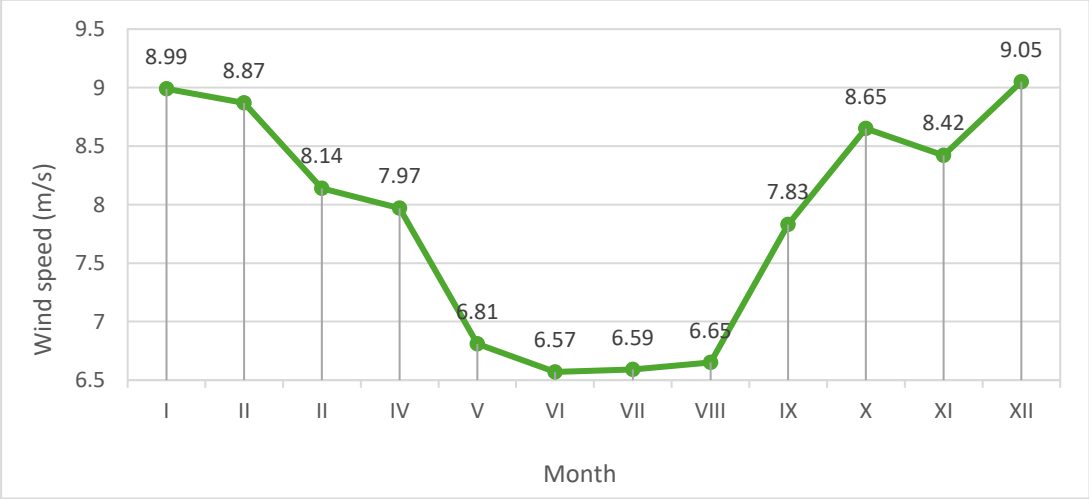


Figure 1.3. Monthly average wind speed in the proposed activity area (at a height of 200 m)

[4] The Copernicus Climate Change Service. S.a. Climate reanalysis. Accessed 28.11.2025. Available: https://climate.copernicus.eu/climate-reanalysis

[5] The ERA5 model is calibrated using real-time meteorological observation data from meteorological network stations, including those located in Latvia. Integration of ERA5 model data into the WindPRO software developed by EMD International A/S makes it possible to obtain calibrated long-term observation data on wind conditions in a given area at different heights above ground level.

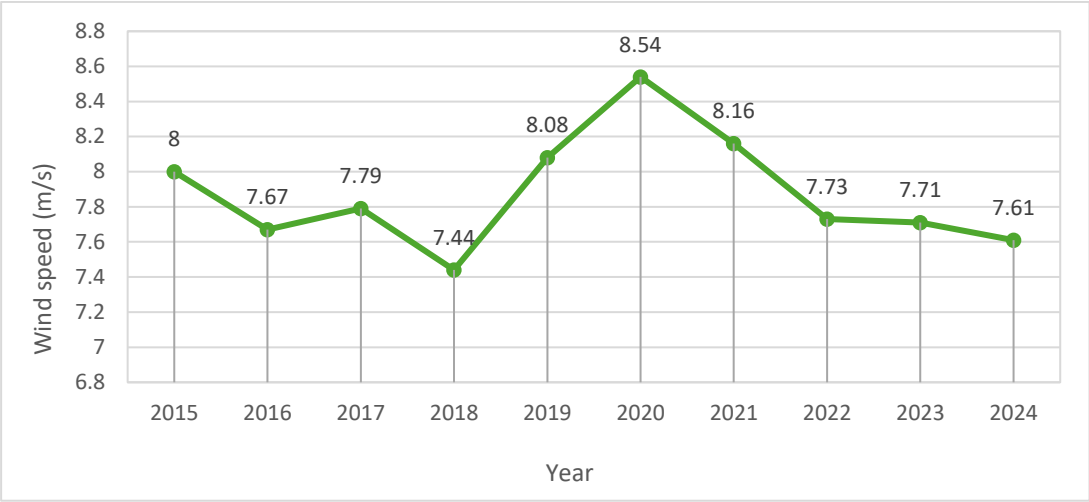


Figure 1.4. Annual average wind speed in the proposed activity area (at a height of 200 m)

When selecting a wind turbine model, not only the average wind speed but also the maximum wind speed is important, because certain classes of wind turbines are designed to withstand wind of a specified strength. According to information compiled by LEGMC, at the nearest meteorological network station, "Rūjiena", the highest wind speed in the period from 2015 to 2024 was recorded at 12:00 on 25 February 2022, reaching 24.30 m/s in gusts. Using ERA5 model calculations, it was determined that, at a height of 200 m, wind speed under such conditions may reach approximately 35 m/s.

Most wind turbines start operating when wind speed reaches 3 m/s, while, for safety reasons, wind turbine operation is stopped when wind speed exceeds 23 to 26 m/s. The results of the analysis of average and maximum wind speed in the study area indicate that the area is suitable for the installation of wind turbines corresponding to Classes III and S as defined in the international standard IEC 61400-1 "Wind turbines – Part 1: Design requirements" (designed for areas with low wind speeds). Class III and S wind turbines are suitable for installation in locations where the average wind speed at hub height reaches at least 6 m/s.

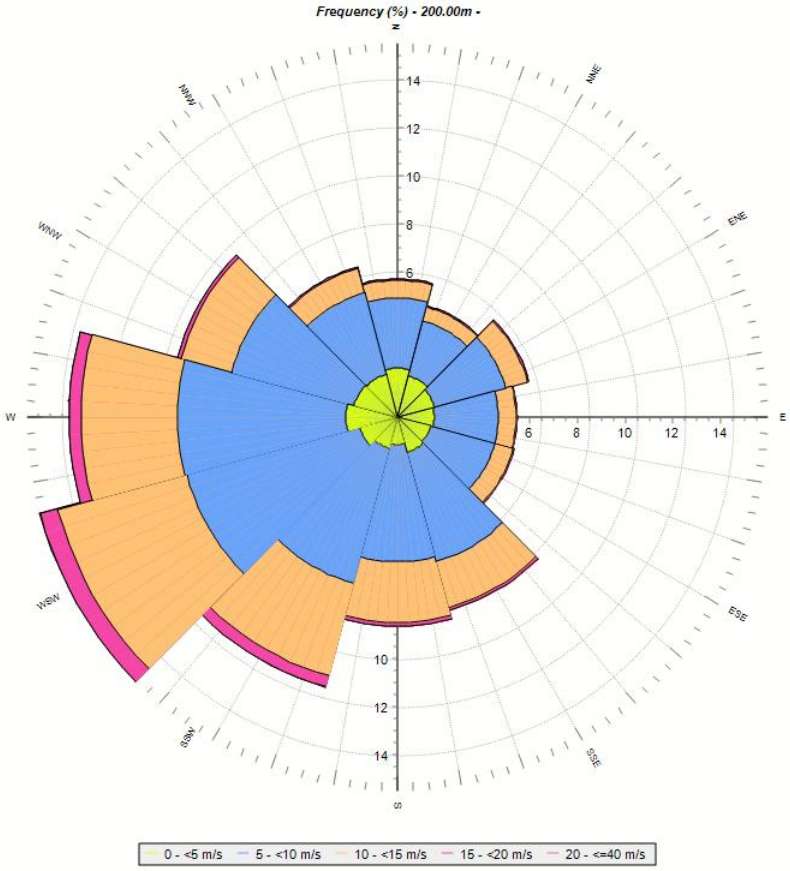


Figure 1.5. Prevailing wind directions

1.4. WIND FARMS PLANNED IN THE SURROUNDING AREA

For the assessment of cumulative impacts in the EIA Report, the location of the wind farm and the location of adjacent and planned wind farms are taken into account. According to the information available on the website of the Energy and Environment Agency, within a 15 km radius of the "Valka" wind farm EIA is being carried out for the activity proposed by SIA "Latvijas vēja parki": "Implementation of the 'Valmiera – Valka' wind farm and its associated infrastructure project in Plāņi Parish of Valmiera Municipality and in Vijciems and Valka parishes of Valka Municipality" (hereinafter – the "Valmiera – Valka" wind farm). The study areas of the wind farms border each other, and the "Valmiera – Valka" wind farm is planned to be constructed to the south and south-west of the Valka wind farm.[6]

According to the available information, public consultation on the EIA Report was completed at the beginning of 2025. Initially, two wind turbine layout alternatives (A and B) were proposed for the wind farm; however, the publicly available version of the EIA Report states that the NCA does not allow the construction of Alternative B due to significant adverse impacts on Natura 2000

[6] Available: 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

sites and capercaillie lekking sites. Layout Alternative A includes 27 wind turbines, while construction of only 25 wind turbines is planned (see Figure 1.6).

In 2024, the municipal administration of Tõrva Parish (Estonia) adopted Decision No. 1-3/2024/14 on the initiation of a local government designated spatial plan and a strategic environmental assessment to identify the most suitable locations for the construction of wind turbines and associated infrastructure. In total, 3 zones with a total area of 18.59 km^2 were identified. As of February 2026, the designated spatial plan and the strategic environmental assessment were still under preparation.[7]

In 2024, the Estonian Environment Agency (Keskkonnaagentuur) issued a document as part of which additional mapping of wind energy development areas in the territory of Estonia was carried out. The document was prepared on the basis of Reform 8.1 of Estonia's Recovery and Resilience Plan, "Acceleration of the deployment of renewable energy sources", which supports the objectives of the European Commission's REPowerEU plan, aimed at increasing the share of renewable energy sources and accelerating their deployment in order to reduce dependence on fossil fuels and improve security of energy supply. As part of the preparation of the document, the territory of Tõrva Parish was also analysed, assessing possible wind turbine construction locations. The areas identified as a result of the document preparation are shown in Figure 1.6. No EIA process has been initiated in the above-mentioned areas.[8]

[7] Available: https://kov.torva.ee/elukeskkond-teed-ja-ehitus/planeerimine-ja-ehitus/eriplaneeringud#kohaliku-omavalitsus--2

[8] Available: https://keskkonnaportaal.ee/sites/default/files/2024-10/REPowerEU_KAURi_uuringualad_l%C3%B5pparuanne_20241009_avalik.pdf

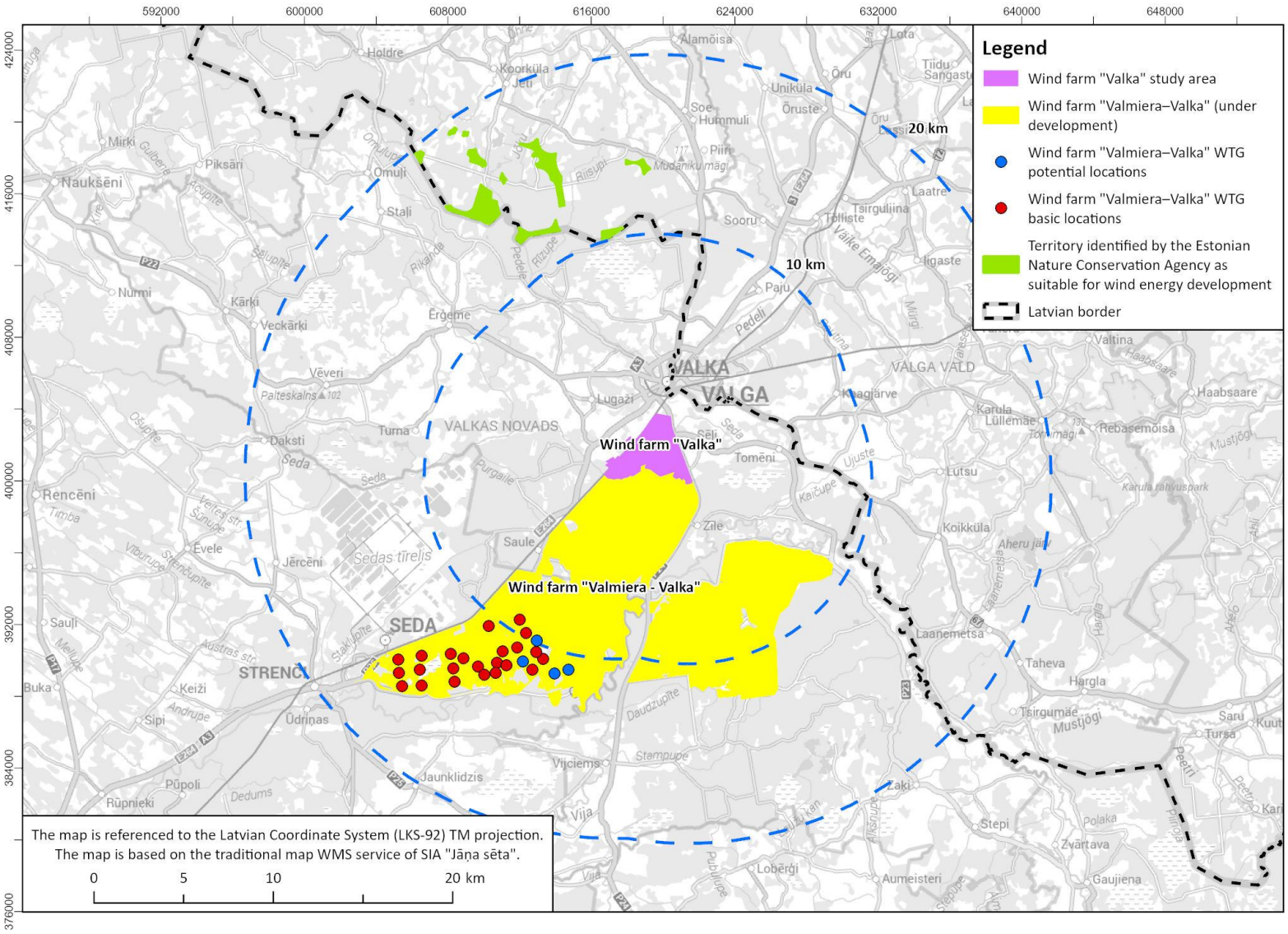


Figure 1.6. Wind farms planned in the vicinity of the "Valka" wind farm

2. DESCRIPTION OF THE PROPOSED ACTIVITY

2.1. PLANNED LOCATIONS OF WIND TURBINES AND ALTERNATIVES

The developer determined that the technical capacity of the survey area is up to 15 wind turbines. The possibility of constructing a wind farm of a certain capacity is influenced not only by restrictions related to nature and environmental protection, landowner requirements and efficient production requirements, but also by the available capacity of the transmission system.

As already mentioned in Chapter 1, the northern part of the wind farm survey area is crossed by the 110 kV high-voltage electricity transmission line Valmiera – (EST) Tsirguliina, while the 330 kV high-voltage electricity transmission line Valmiera – (EST) Tsirguliina is located along the eastern boundary of the survey area. According to the information published on the website of the transmission system operator JSC "Augstsprieguma tīkls", the available transmission system capacity under the flexible transmission system service is 56 MW for the 110 kV electricity transmission line and 717 MW for the 330 kV line. Although the available capacity of the 330 kV line appears, at first glance, sufficient for full implementation of the "Valka" wind farm concept, construction of a new substation connected to the 330 kV line for a wind farm of this size would be a disproportionately expensive solution. Therefore, the developer links the planned wind farm capacity with the available capacity of the 110 kV line. If the available capacity of the 110 kV high-voltage electricity transmission line Valmiera – (EST) Tsirguliina is not increased, the maximum number of wind turbines that could be constructed in the "Valka" wind farm could reach 8 – 9 wind turbines, using the maximum wind turbine capacity assessed within the EIA or reducing the operational capacity during operation. At the same time, it should be noted that a larger number of wind turbines could also be constructed in the wind farm (not exceeding 14 wind turbines) if the developer reaches an agreement with an existing or new large electricity consumer in the vicinity of Valka regarding direct sale of part of the generated electricity to the consumer.

To assess all possible wind turbine construction locations and identify a wind farm solution that results in lower environmental impacts, ensures higher production potential and is economically more favourable, following optimisation of the initial concept, the developer has submitted for detailed EIA a wind farm solution consisting of 14 wind turbines, where each wind turbine construction location is assessed as an alternative (see Figure 2.1). In other words, within the EIA process, the impact of each wind turbine is analysed to the extent that it can be quantitatively separated, providing both the developer and the decision-maker responsible for acceptance of the intended activity with detailed information regarding the benefits and risks associated with selecting a specific location. Information regarding the land units on which wind turbines are planned to be located is summarised in Table 2.1.

The potential wind turbine construction locations shown in Figure 2.1 should currently be considered indicative. If the number of wind turbines is reduced, their locations within the boundaries of the respective land units may be refined in order to improve production efficiency. Reviewing completed EIA for wind farms in Latvia and construction designs developed following EIA procedures demonstrates that various types of adjustments to wind turbine layouts apply to all planned wind farms. In the event of any changes, the developer is responsible for assessing the environmental impact of such changes. Therefore, in the opinion of the Report authors, there is already a basis for establishing the following condition for further planning of the intended activity: **Considering that the exact locations of the wind**

turbines to be constructed, the installed model and the structural design will be determined during the construction design development stage, any changes to the solutions that have not been assessed during preparation of the Report or that exceed the parameters assessed in the Report shall be evaluated by adding a repeated assessment of the relevant environmental aspects to the construction design. This assessment shall confirm compliance of the intended activity with the requirements of external regulatory acts and the conditions established in the EIA Report. Based on the documents attached to the construction design, the SES shall perform an assessment of the significance of such changes and approve changes to the construction design solutions if these changes do not significantly affect the assessment results, or shall apply an initial impact assessment procedure in accordance with Section 3.2, Paragraph one, Clause 3 of the Law "On Environmental Impact Assessment". When performing the significance assessment, changes to the construction design solutions shall also be coordinated with the Nature Conservation Agency.

Table 2.1. Potential wind turbine construction locations

Wind turbine No.	Cadastral designation of the land unit	Cadastral number	Property name
1	94880090095	94880090081	Kalnsaulieši
2	94880100319	94880100320	Kramiņi
3	94880100261	94880100331	Svīres
4	94880100008	94880100008	Rijsalas - 1
5	94880090083	94880090142	Dzenīši 3
6	94880090080	94880090080	Vecsaulieši
7	94880090187	94880090187	Dukāti
8	94880090082	94880090082	Jaunsaulieši
9	94880090081	94880090147	Kalnsaulītes
10	94880100005	94880100005	Dumpi
11	94880100044	94880100044	Zīlēni
12	94880100036	94880100036	Avēni
13	94880100150	94880100052	Vēverzemnieki
14	94880100004	94880100003	Lielkājas

The physical impacts generated by wind turbines – noise, shadow flicker and environmental risks – are assessed at nearby residential and public development areas or at residential and public buildings, as the magnitude of impacts in such areas and buildings is limited by threshold values established in legislation or guidelines. According to the information available in portal of State Land Service, the number of objects located in the vicinity of the planned "Valka" wind farm is as follows:

- 8 residential or public buildings are located within a distance of up to 1 km from the wind turbines;
- 69 residential and public buildings are located within a distance of up to 2 km from the wind turbines;
- 359 residential and public buildings are located within a distance of up to 3 km from the wind turbines.

According to Paragraph 163 of Regulation No. 240 of the Cabinet of Ministers of 30 April 2013 "General Regulations for the Planning, Use and Building of the Territory", for wind power

plants with a capacity exceeding 2 MW, the distance from the nearest planned wind turbine and the boundary of the wind farm to residential and public buildings shall be at least 800 m. Assessment of the location of residential buildings identified that currently one residential building, "Liepkalni" (building cadastral designation 94880090010001), is located closer than 800 m from the assessed wind turbines. The residential building "Liepkalni", which is registered in portal of State Land Service but is currently uninhabited, is located at a distance of 368 m from wind turbine No. 7 and 549 m from wind turbine No. 6. Within a distance of up to 900 m from the assessed wind turbines, there are four additional residential buildings (see Table 2.2).

Table 2.2. Residential and public buildings located within 900 m of wind turbines

Cadastral designation of residential building	Residential building name	Nearest WTG	Distance to the nearest WTG, m	Building type
94880090010001	Liepkalni	7	368	Single-apartment house
94880100148001	Dūmiņi	2	804	Single-apartment house
94880090006001	Lejas Ģērķi	7	819	Single-apartment house
94880090035001	Dzelzceļš 162. km	7	862	Single-apartment house
94880090057001	Pilēnieši	2	900	Single-apartment house

Not all residential buildings registered in portal of State Land Service have been instrumentally surveyed, and the distances determined during preparation of this Report are based on publicly available spatial data.

Considering the above-mentioned possibility of refining wind turbine locations during the design stage, as well as the need for instrumental surveying of buildings, in order to ensure that wind turbines are constructed at locations complying with the requirements of Regulation No. 240 of the Cabinet of Ministers of 30 April 2013 "General Regulations for the Planning, Use and Building of the Territory", the Report authors consider that there are grounds to establish the following condition for further planning and design of the planned wind farm: **During preparation of the construction design, for those wind turbines where the distance to residential buildings registered in portal of State Land Service is less than 900 m, precise surveying shall be performed to determine the distance from the planned wind turbine locations to the respective residential buildings. If it is determined that any of the surveyed distances is less than the minimum distance requirement for wind turbines to residential and public buildings specified in Sub-paragraph 163.2 of Regulation No. 240 of the Cabinet of Ministers of 30 April 2013 "General Regulations for the Planning, Use and Building of the Territory", construction of the respective wind turbine shall not be permitted without appropriate corrections to its location.**

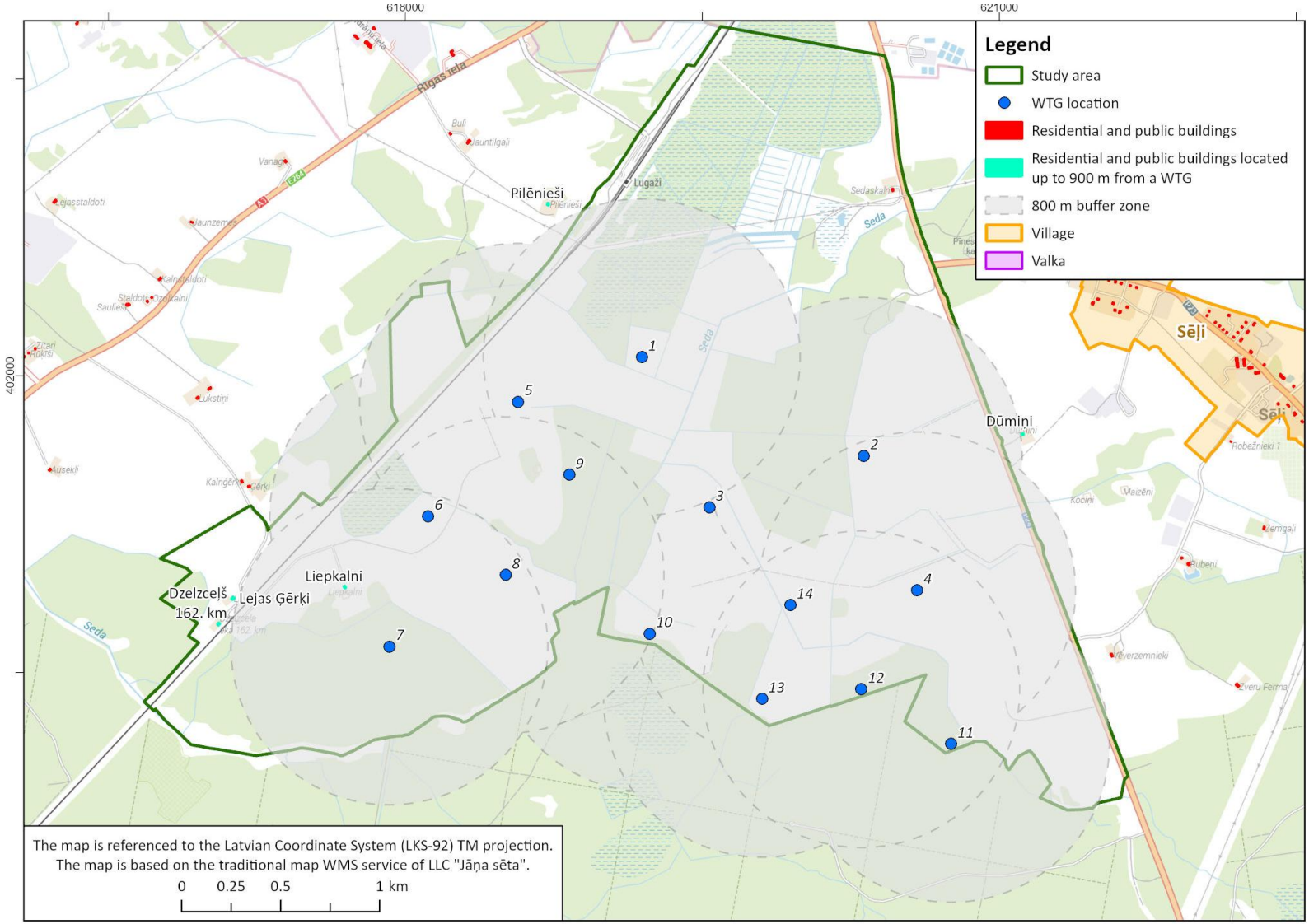


Figure 2.1. Wind turbine layout in the "Valka" wind farm

2.2. DESCRIPTION OF WIND TURBINES AND TECHNOLOGICAL ALTERNATIVES

Having assessed the wind turbine models available on the market, the developer has identified several potentially suitable latest-generation high-capacity wind turbines with a rated capacity exceeding 7 MW, which are suitable for installation in areas with low wind speeds corresponding to Class III and Class S defined in the international standard IEC 61400-1 "Wind turbines – Part 1: Design requirements". Within the EIA process, five wind turbine models are assessed (see Table 2.3).

Technologically, all five assessed models are similar. The towers are assembled from steel or reinforced concrete and steel sections (hybrid towers), the rotor consists of three fibreglass composite blades, and the nacelle contains a generator, brakes, transformer, power transmission equipment, as well as mechanisms for monitoring and controlling turbine operation. For all assessed models, manufacturers have developed environmental impact mitigation technologies, such as special operating modes for reducing noise levels, reducing shadow flicker impacts, and other measures.

Although specific wind turbine models are assessed within the EIA process, as the assessed technological alternative must be realistically implementable, the final decision regarding the specific wind turbine model will be made before preparation of the construction design. The decision will be based on the operational conditions established during the EIA process and an assessment of costs associated with construction and operation of the wind farm. It should be noted, however, that in addition to the wind turbine models assessed within this EIA process, other technological alternatives are available on the market, and development of new wind turbine models is also possible. From the perspective of environmental impacts, after completion of the EIA process, the developer has the right to replace the models assessed during this process with other models, provided that they ensure an equivalent or higher level of environmental protection. In such cases, the SES shall assess such changes in accordance with the Law "On Environmental Impact Assessment".

Table 2.3. Wind turbine models assessed within the EIA

Manufacturer/model	Rated generation capacity (MW)	IEC 61400-1 class	Planned hub height (m)	Rotor diameter (m)	Total wind turbine height (m)
Vestas V172	7,2	IEC (S)	166	172	252
Vestas V162	7,2	IEC (S)	166	162	247
Nordex N175	7	IEC (S)	162	175	249,5
Nordex N163	7	IEC (S)	164	163	245,5
Siemens SG 7.0-170	7	IEC (S)	165	170	250

Although the capacity of all wind turbines assessed within this EIA process may appear similar or even identical, the electricity production potential of each model differs. Figure 2.2 illustrates the electricity production potential of each wind turbine model at a specific wind speed. Using wind speed data from the planned wind farm area over a 10 year period (2015 – 2024), it was calculated that the lowest production potential is associated with the two wind turbines having the smallest

rotor diameter, namely Vestas V162 and Nordex N163, while the highest production potential is associated with the Nordex N175 wind turbine.

The calculation results indicate that one wind turbine of the planned "Valka" wind farm could generate approximately 24.5 – 27.5 GWh of electricity per year, while the total electricity generation from 14 wind turbines could reach 342 – 386 GWh per year (excluding technological downtime, losses caused by interaction between turbines, and reductions in production associated with mandatory turbine shutdowns for impact mitigation purposes).

A similar conclusion can be reached when considering other important wind turbine characteristics, such as noise levels generated by turbines, which are assessed in detail in Chapter 3.1 of the Report, and shadow flicker impact duration, which is assessed in detail in Chapter 3.2 of the Report. In other words, wind turbine models that appear similar at first glance may create significantly different impacts; therefore, they should be considered as technological alternatives.

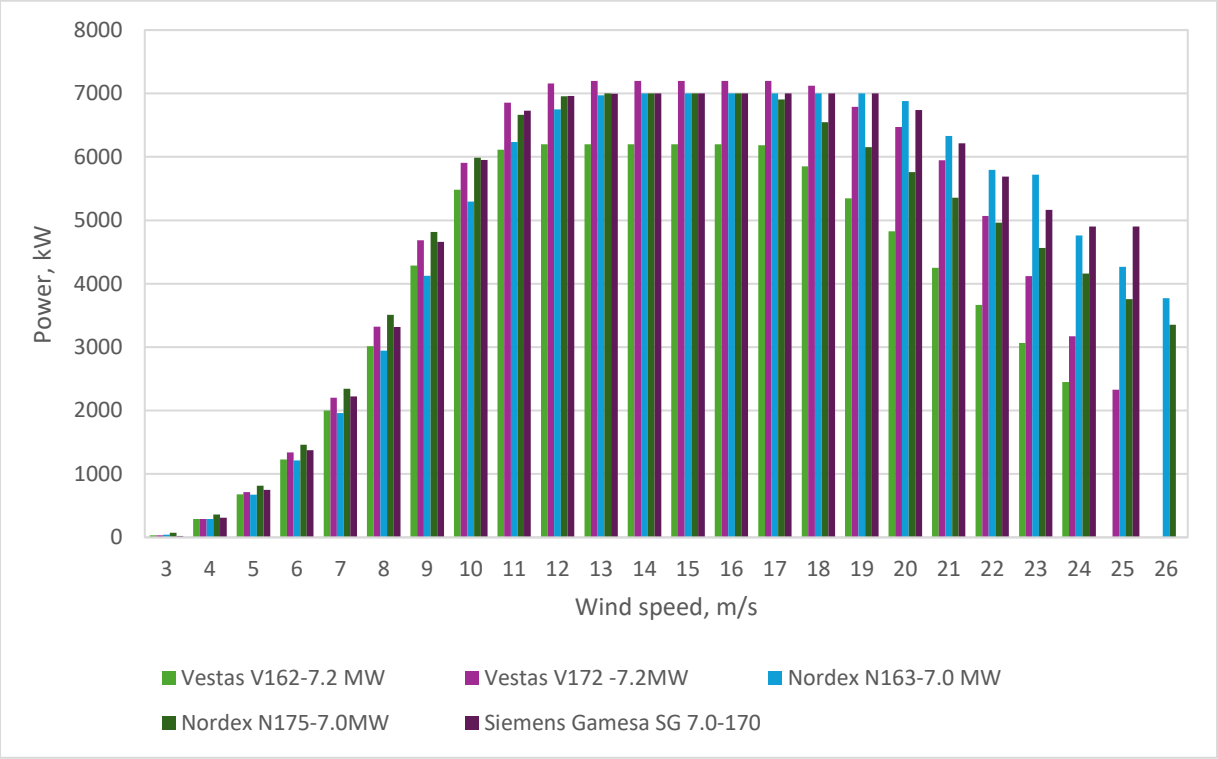


Figure 2.2. Electricity production potential (kW) at a specific wind speed

2.3. WIND FARM CONSTRUCTION PROCESS

Although the most significant factors causing environmental changes are related to operation of the wind farm, the construction process may also cause significant environmental changes if factors and activities affecting environmental conditions are not identified and properly managed in a timely manner. A detailed wind farm construction plan will be developed during the construction design stage, when the specific wind turbine model, wind turbine and infrastructure layout, construction solutions and logistics solutions related to delivery of materials, equipment and machinery required for construction are known. The information regarding the construction process of the "Valka" wind farm included in the Report is based on information provided by the

developer, as well as technical data and construction specifications provided by wind turbine manufacturers. At the current project development stage, it is possible to generally assess factors associated with construction works and to perform a more detailed analysis of construction locations from the perspective of nature conservation. The main stages of the construction process are shown in Figure 2.3.

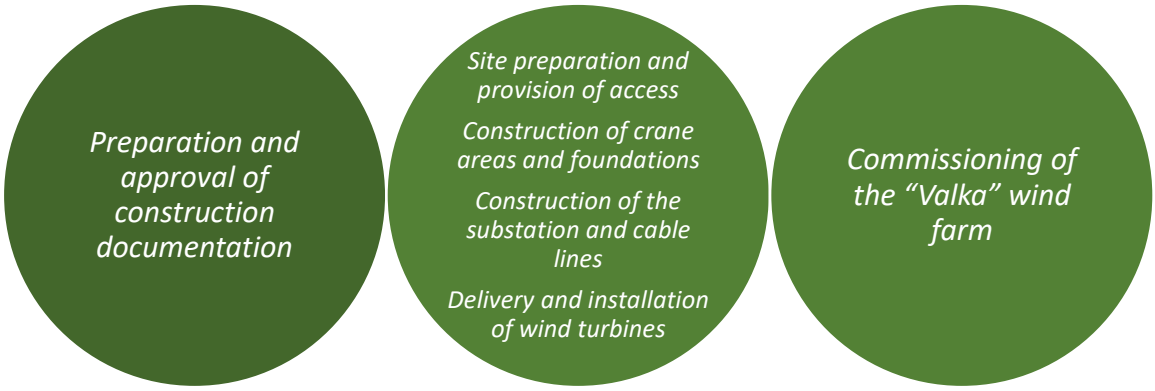


Figure 2.3. Main stages of the construction process

It is expected that preparation and approval of construction documentation may take approximately one to one and a half years, while construction of the wind farm may take approximately one and a half to two years. More detailed information regarding the main stages of the construction process is provided in the following chapters. Considering the currently available general information regarding the construction process, the Report authors consider that there are grounds to establish the following conditions for wind farm construction from the perspective of environmental and nature protection:

- **Construction and reconstruction of wind turbines and associated infrastructure objects shall require obtaining technical regulations from the SES, specifying the specific solutions and environmental protection requirements applicable to implementation of activities at the respective location.**
- **During construction works, temporary storage areas for machinery and construction materials shall not be located within areas containing specially protected species or specially protected habitats. At construction sites, solutions shall be ensured, as far as possible, for movement of machinery within areas designated for construction, and measures shall be implemented to prevent negative impacts on locations of specially protected species and specially protected habitats.**
- **During construction works, restrictions on activities within surface water body protection zones established by the Protection Zone Law shall be complied with. Construction solutions and methods shall be selected to prevent pollution of surface waters, groundwater horizons, soil and ground. Solutions shall also be selected that do not cause significant impacts on the hydrological regime and water quality of watercourses.**
- **After completion of construction works, restoration of areas no longer required for operation shall be ensured, including locations of temporary structures.**

In Letter No. 3.9/26/523 submitted by the Municipality of Valka during the public consultation process, the Valka Local Government Council requires that, prior to the commencement of construction, a condition survey be carried out for households that will be directly or very directly affected by the construction works. The survey shall assess the structural condition of buildings within the households and identify any potential changes that could result from the construction process (e.g. vibrations caused by construction traffic). Furthermore, discussions shall be held with the affected residents to agree on appropriate noise mitigation measures aimed at reducing noise generated by transport and construction activities. The EIA Report shall describe the measures that will be implemented to reduce or prevent potential adverse effects on residents and their property arising from the construction of the wind farm.

2.3.1. Change in traffic intensity during construction of wind farm

During construction of the "Valka" wind farm, a significant temporary increase in traffic intensity is expected to ensure the required delivery of materials and equipment. The precise transport plan, as well as the volume of transported materials and delivery routes, will be determined during preparation of the construction design. However, approximate estimates of the increase in traffic intensity, based on information provided by wind turbine manufacturers and the developer, can already be made at this stage. As indicated above, the wind farm construction process is expected to take approximately one and a half to two years; however, significant periods in terms of heavy transport involvement will not cover the entire construction period of the wind farm.

A significant number of heavy vehicles will be required for construction of new roads. The developer has proposed two alternative solutions for road construction (see Figures 2.5 and 2.6), where the total road length, if all 14 wind turbines are constructed, would be 13.9 km (Alternative A) or 14.7 km (Alternative B). Reducing the number of wind turbines would also make it possible to reduce the total length of roads to be constructed; however, the selected wind turbine construction locations would have a significant influence on the total road length. If the number of wind turbines is reduced to 9, which currently represents the maximum available capacity for connection to the 110 kV transmission system, the total road length to be constructed would range from 8.8 km (constructing wind turbines No. 1, 3, 5, 6, 7, 8, 9, 10 and 14) to 12.7 km (constructing wind turbines No. 2, 4, 7, 8, 9, 10, 11, 12 and 14). The volume of road construction materials to be delivered depends on the road construction solution, engineering geological conditions, as well as whether a new road is being constructed or an existing road is being improved. For construction of new access roads, the required materials can be delivered by approximately 30 heavy trucks per 100 m of new road on average. If Alternative A or Alternative B is implemented in full, the required materials could be delivered by approximately 4,170 – 4,410 heavy truck trips.

The volume of material required for construction of wind turbine assembly areas also depends on engineering geological conditions and the construction technology used. However, on average, approximately 140 heavy truck trips per wind turbine may be required for material delivery. To construct all wind turbine assembly areas in the "Valka" wind farm, the total number of required trips would be approximately 1,960.

A significant volume of material is also required for construction of wind turbine foundations, including delivery of concrete and reinforcement materials. The total number of trips for the

largest foundation volume, assuming construction of gravity foundations, is approximately 200 heavy truck trips per wind turbine. To construct all wind turbines in the "Valka" wind farm, the total number of required trips would be approximately 2,800.

The number of trips required for construction of the wind turbines themselves is relatively small – approximately 20 trips per wind turbine on average. However, unlike the previously described transport of materials for roads, assembly areas and foundations, where standard heavy trucks are used, delivery of wind turbines is carried out using specialised transport for oversized and extremely heavy loads. The total number of specialised transport trips for construction of 14 wind turbines in the "Valka" wind farm could reach approximately 280 trips.

Construction of the wind farm will also require delivery of various other types of machinery, materials and equipment not described above. The total delivery volume may vary significantly depending on the specific construction solution; however, the additional number of heavy truck trips could range from 40 to 150 trips per wind turbine, or up to 2,100 trips for the entire wind farm.

During wind farm construction, additional load on transport infrastructure will be caused not only by heavy vehicle movement but also by employee transport. This indicator may also vary between wind farms; however, it is estimated that it could range from 150 to 300 passenger vehicle trips per wind turbine during construction.

Overall, construction of the "Valka" wind farm may require up to 11,550 heavy truck trips and up to 4,200 passenger vehicle trips during the one and a half to two year construction period. While passenger vehicle traffic intensity is expected to be relatively uniform throughout the construction period, heavy transport movements will be characterised by both low- and high-intensity periods. The highest traffic intensity is expected during construction of wind turbine foundations and roads. Assuming the shortest possible construction period, the annual average daily traffic (hereinafter – AADT) on roads surrounding the wind farm could increase by approximately 42 heavy truck trips and 15 passenger vehicle trips per day. At this stage, when a detailed transport plan has not yet been developed, it is not possible to predict the distribution of heavy and passenger vehicle traffic routes. It is assumed that wind turbine delivery could be carried out via the national main road A3 Inčukalns – Valmiera – Estonian border, while delivery routes for other materials and equipment may be associated both with the above-mentioned national main road and the regional road P24 Smiltene – Valka.

According to information published by the SLLC "Latvijas Valsts ceļi", the AADT on the national main road A3 Inčukalns – Valmiera – Estonian border section near the wind farm in 2025 was 2,065 vehicles, of which 28% or 587 vehicles were heavy vehicles. The AADT on the regional road P24 Smiltene – Valka section near the wind farm in 2025 was 1,191 vehicles, of which 15% or 178 vehicles were heavy vehicles. Assuming that all heavy vehicles use only one of the roads, which is an unlikely scenario, heavy vehicle traffic intensity during wind farm construction would increase by approximately 7% on national main road A3 and 24% on regional road P24. The increase in passenger vehicle traffic intensity would be considerably lower, approximately 1% on road A3 and 1.5% on road P24.

2.3.2. Site preperation

Construction of the "Valka" wind farm will commence with site preparation works, including establishment of equipment, construction machinery and material storage areas, removal of topsoil and ground layers in locations where new roads, wind turbines and the substation are planned, and preparation of foundation pits for wind turbine foundations. Topsoil is planned to be temporarily stored along the boundary of the construction site or transported to specially established material storage areas and used for site restoration at the end of the construction process.

One or two temporary storage areas for machinery, equipment and materials will be established within the proposed activity area during the construction process. It is expected that the area of each storage site will be up to 1 ha, and the sites will be constructed using gravel/crushed stone material. The exact location and area of the storage sites will be determined during preparation of the construction design, when the number and model of wind turbines to be constructed, as well as their locations, have been determined. As part of site preparation works, a construction coordination centre will be established. Its exact location will be determined during preparation of the construction design; however, it is expected that it will be located within one of the previously mentioned storage areas.

2.3.3. Construction of access roads and areas, melioration system

To ensure access to wind turbine construction locations during both the construction and operation phases, access roads and assembly areas shall be constructed, and, where necessary, existing roads shall be reconstructed. Considering that the existing railway crossing cannot be used for delivery of wind turbine components, construction of a new railway level crossing is planned. To ensure drainage of roads and areas, construction of new drainage structures or reconstruction of existing drainage systems may be required in the vicinity of infrastructure objects.

Use and reconstruction of existing roads

Access to the planned "Valka" wind farm will be ensured using state and municipal roads. The roads closest to the planned wind farm that are intended to be used for access to wind turbine construction locations are: the national main road A3 Inčukalns – Valmiera – Estonian border (Valka); the regional state road P24 Smiltene – Valka; the municipal road Ausekļi – Liepkalni.

During preparation of the construction design, the suitability of existing roads will be assessed against the requirements established by the wind turbine manufacturer for transportation of construction materials and wind turbine components (road width, load-bearing capacity, bends, slopes). Where necessary, reconstruction of road sections or parts thereof will be planned to improve transport conditions, including widening of road curves. As part of reconstruction works for the municipal road, construction of a new single level railway crossing over the railway line Rīga – Valka is planned. In Letter No. 4.5/8326, the SLLC Latvian State Roads states that the Developer shall conclude an agreement regarding the use of state roads, including their maintenance during the transportation period, as well as the reconstruction of state roads where the existing road parameters are not suitable for oversized and heavy-load transport. It is recommended that heavy-load transport operations be scheduled during the summer period,

from May to September, or during periods of prolonged frost, when the load-bearing capacity of the roads is at its highest.

Construction of new access roads

During construction of the wind farm, new access roads shall be constructed to ensure access to wind turbines during both construction and operation phases. Two layout alternatives have been defined for construction of access roads:

- under Alternative A, the length of new access roads is 13.9 km (see Figure 2.5);
- under Alternative B, the length of new access roads is 14.7 km (see Figure 2.6).

According to general wind turbine manufacturer requirements, access roads shall comply with certain technical parameters: the minimum road width shall be at least 6 m (at least 4.5 m on flat and straight sections); the road load-bearing capacity shall exceed 100 MPa; the axle load capacity shall be at least 12 tonnes per axle. It should be noted that specific technical parameters may differ depending on the requirements of the wind turbine manufacturer and the specific characteristics of the construction location.

All new access roads will be constructed using gravel and crushed stone material. The necessity for installation of drainage ditches along roads will be determined during preparation of the construction design. The locations of newly constructed roads, similarly to other infrastructure objects related to the wind farm, shall be coordinated with the respective landowners. Construction of road connections to higher-category roads shall be coordinated with the respective road owner or manager.

Construction of assembly areas

Before construction of each wind turbine, an assembly area shall be established at each planned wind turbine construction location (see example in Figure 2.7). The assembly area solutions assessed within the EIA process include both: areas that will be used only during the construction process, for example, temporary storage of blades; and areas considered as developed areas throughout the entire wind farm operation period, such as the main crane area and foundation area. Construction of assembly areas is required to ensure: delivery of oversized cargo to the construction location; temporary storage of components; construction of wind turbines. The size and configuration of the assembly area depend on: the selected wind turbine model; machinery used during assembly; location of the construction area; changes in ground elevation; logistics solutions; rotor assembly solutions; other limiting factors, such as preservation of individual trees. The infrastructure of the assembly area, access roads and the main crane working area will be constructed using gravel and crushed stone material with a load-bearing capacity of at least 100 MPa. Depending on assembly area specifications, its area may range from 1 to 2 ha, of which approximately 45% will continue to be used for wind farm operation after completion of construction works.

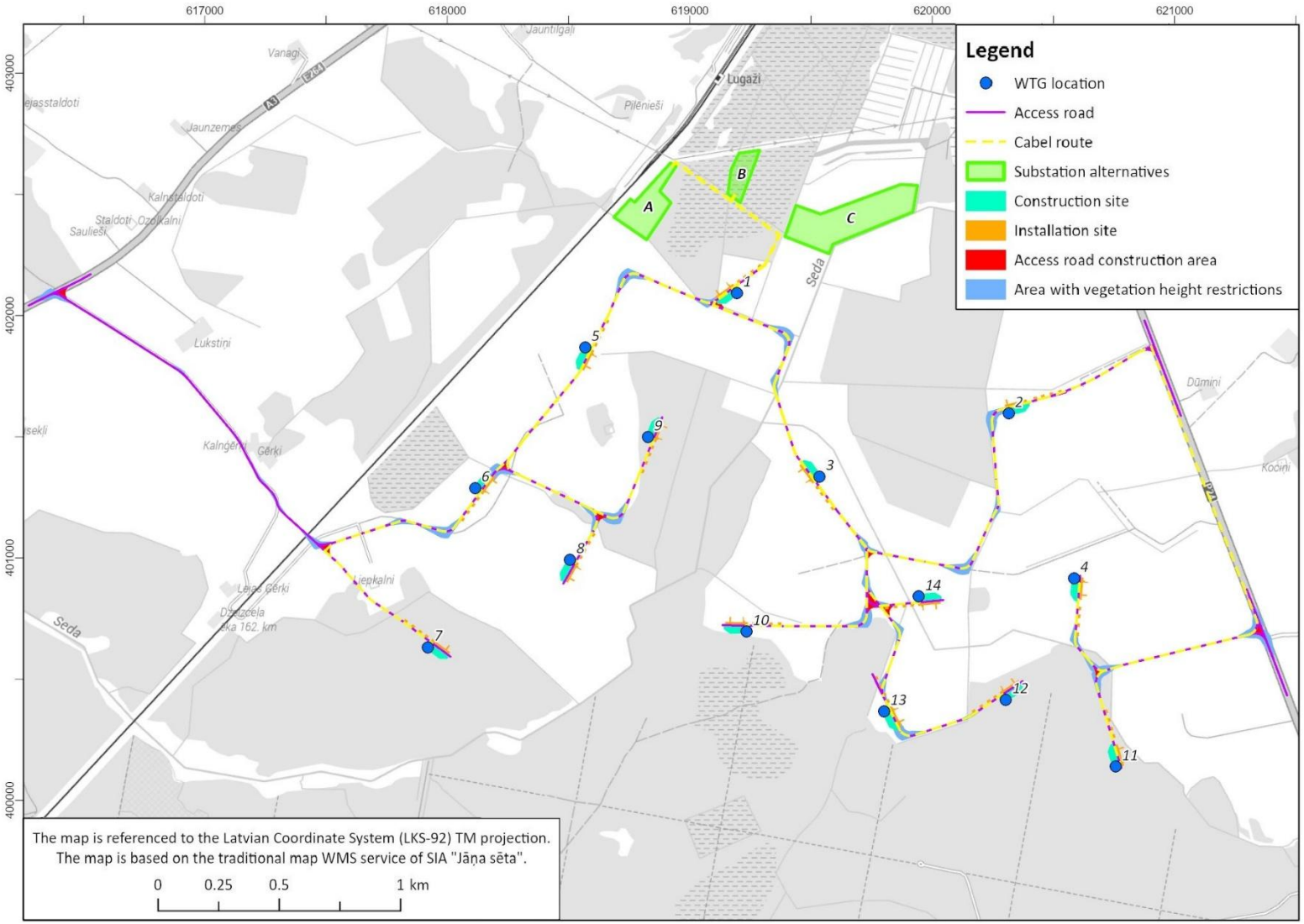


Figure 2.5. Location of wind turbines and associated infrastructure of the planned "Valka" wind farm (Alternative A)

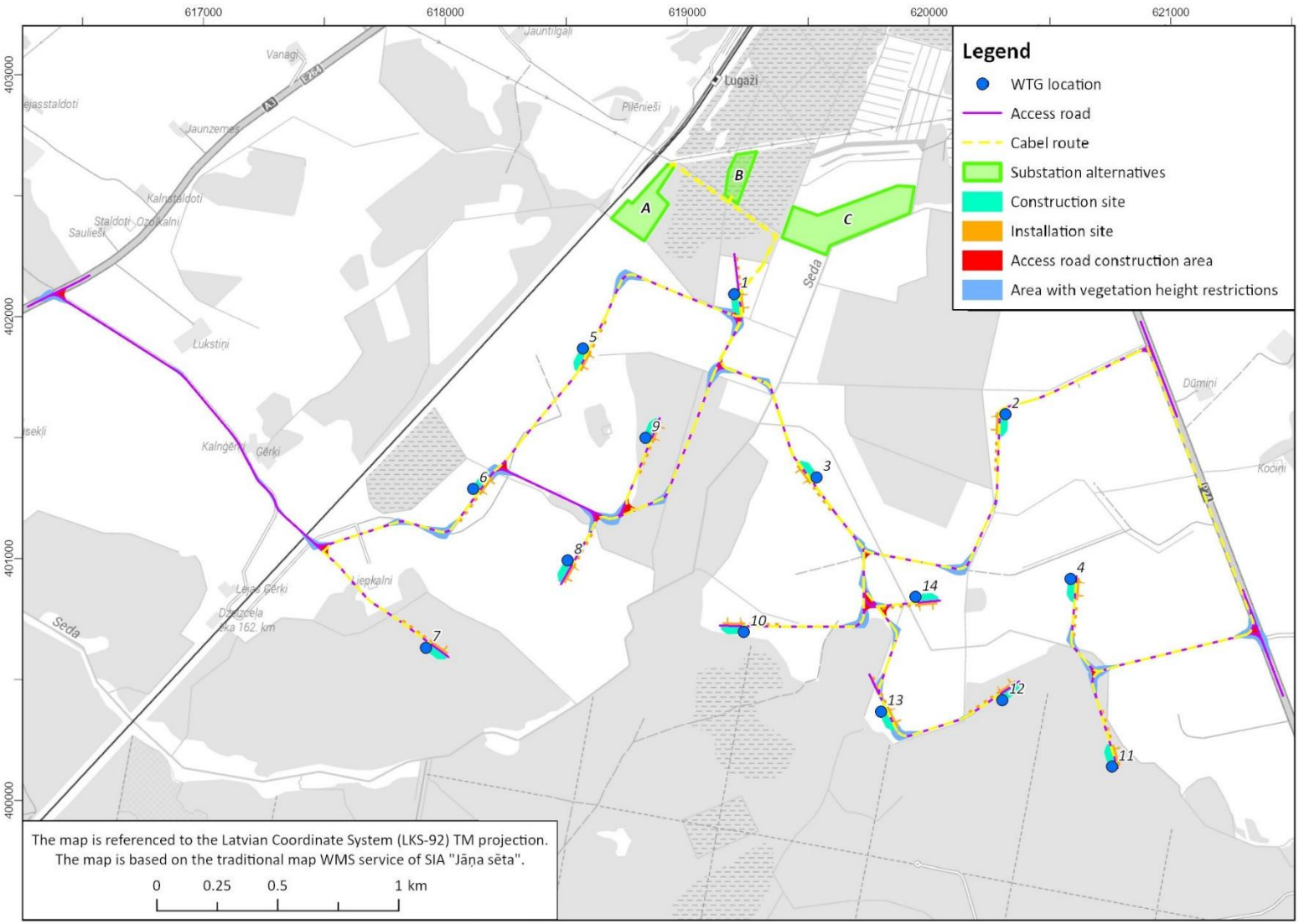


Figure 2.6. Location of wind turbines and associated infrastructure of the planned "Valka" wind farm (Alternative B)

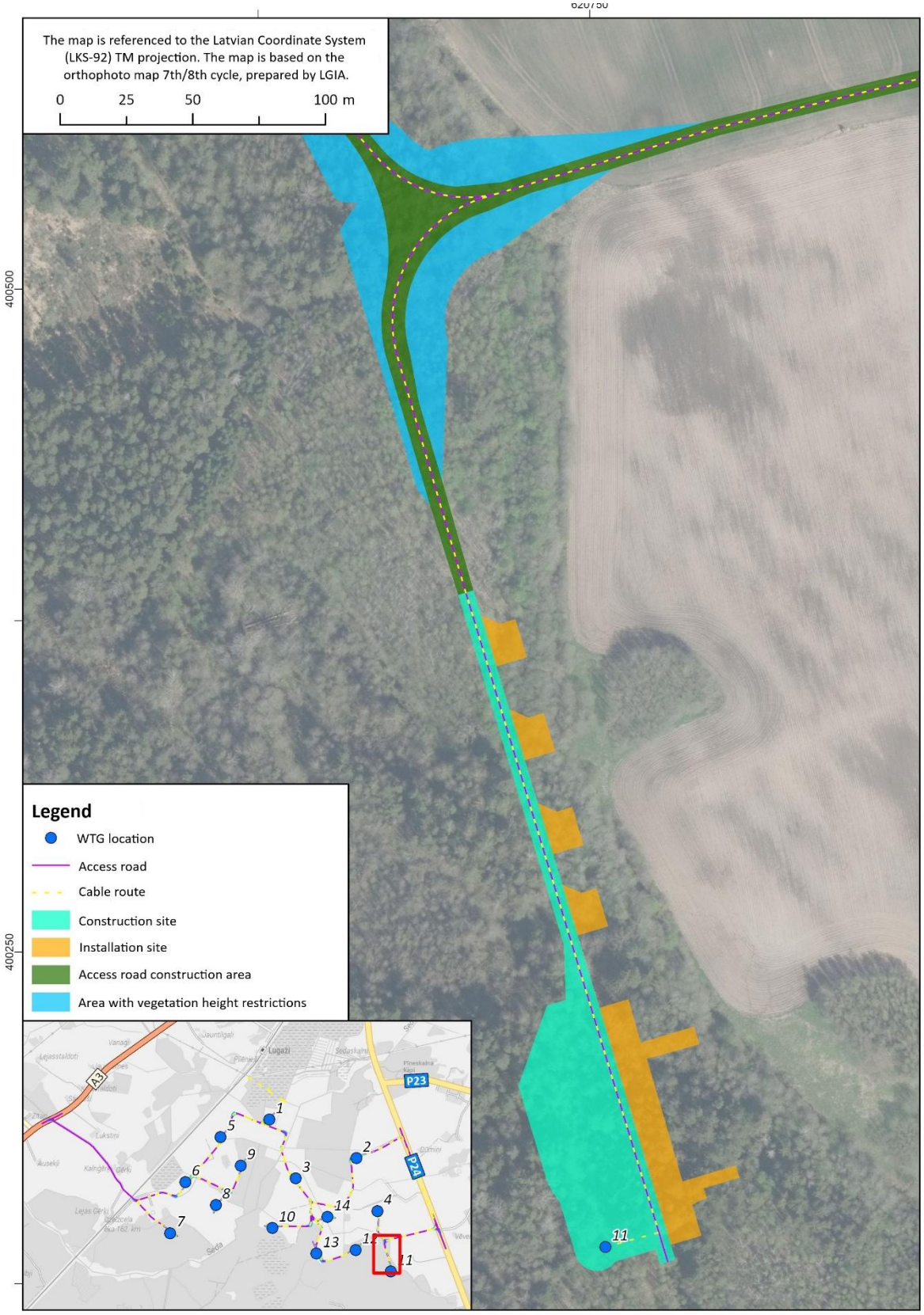


Figure 2.7. Example of wind turbine construction area and access road layout

Construction of a new railway crossing

Initially, transportation of wind turbine components was planned by crossing the railway tracks managed by the SJSC "Latvijas Dzelzceļš" on the Saule – Lugaži railway section. However, during consultations held with SJSC "Latvijas Dzelzceļš" on 10 October 2024, it was determined that the existing railway crossing No. 239 (km 162, section 2) cannot be used for this purpose, as its configuration does not allow transportation of 90 m long wind turbine blades across the railway. As a result, construction of a new railway crossing will be implemented as part of wind farm construction. The planned location of the future railway crossing is situated on a straight railway section of the Saule – Lugaži railway line at km 162, section 6. The crossing is planned to be available also for other road users. The SJSC "Latvijas Dzelzceļš" commission has decided that, after commissioning of the new crossing, closure of railway crossing No. 239 on the Saule – Lugaži section (km 162, section 2) shall be ensured.

Construction and reconstruction of drainage systems

It is expected that construction and reconstruction of drainage systems will be carried out simultaneously with construction of access roads and assembly areas. At present, it is not expected that construction of the wind farm will require development of a completely new drainage network, as drainage systems have already been constructed across most of the proposed activity area for drainage of agricultural and forest land. The project proponent shall take into account that drainage systems have been installed on most agricultural lands within the planned wind farm area, and these systems will need to be reconstructed or rearranged at locations where wind turbines and associated infrastructure are constructed.

Considering that the drainage network is located not only within land units where wind turbines and infrastructure construction are planned, reconstruction shall also be coordinated with landowners whose drainage systems may be affected by the reconstruction process. As a result of construction and reconstruction of drainage systems, the project proponent shall ensure that hydrological conditions are not deteriorated both within land units where wind turbine construction is planned and within adjacent land units.

2.3.4. Wind turbine foundation construction

Wind turbines are planned to be constructed on monolithic reinforced concrete foundations, in accordance with technical specifications prepared by wind turbine manufacturers and taking into account the ground bearing capacity parameters within the proposed activity area. It is expected that the foundation area of one wind turbine may occupy up to 0.1 ha. The foundation diameter will be approximately 25 – 28 m, with a depth of approximately 3 – 4 m. For construction of one wind turbine foundation, approximately 1,000 – 1,200 m^3 of concrete and 115 – 135 tonnes of reinforcement steel are expected to be required.

After completion of the EIA process, a detailed engineering geological survey will be carried out. If the engineering geological investigations identify areas where ground bearing capacity parameters are insufficient for construction of the selected wind turbines, the foundation structure at these locations will be supported by piles. The need to use piles or other construction technology solutions shall be determined during preparation of the construction design.

2.3.5. Area of land required for the wind farm

Information regarding the land area required for construction of the wind farm is summarised in Table 2.6, based on technical specifications provided by wind turbine manufacturers. According to calculations, construction of 14 wind turbines will require an area of 17.38 ha under Alternative A and 18.07 ha under Alternative B. Approximately half of the total area initially used during the construction phase is also planned to be required for long-term operation after installation of the wind turbines. No permanent restrictions or prohibitions on future economic activities are planned for the remaining part of the area. The distribution of areas requiring deforestation according to forest stand age is shown in Figures 2.8 and 2.9.

Table 2.6. Land area required for construction of the wind farm

Object	Required area (ha)	
	Alternative A	Alternative B
Long-term developed areas		
New access roads	8,2	8,89
Wind turbine foundation areas	1,4	1,4
Main crane working areas	4,82	4,82
Temporary construction site areas		
Blade and tower element storage areas, main crane assembly areas	2,96	2,96
Areas requiring deforestation		
Assembly areas	2,82	2,85
Construction of new access roads and improvement of municipal roads	0,51	1,04
Areas where vegetation height restrictions are required for equipment transportation		
Areas with vegetation height restrictions (areas at bends)	0,77	1,03

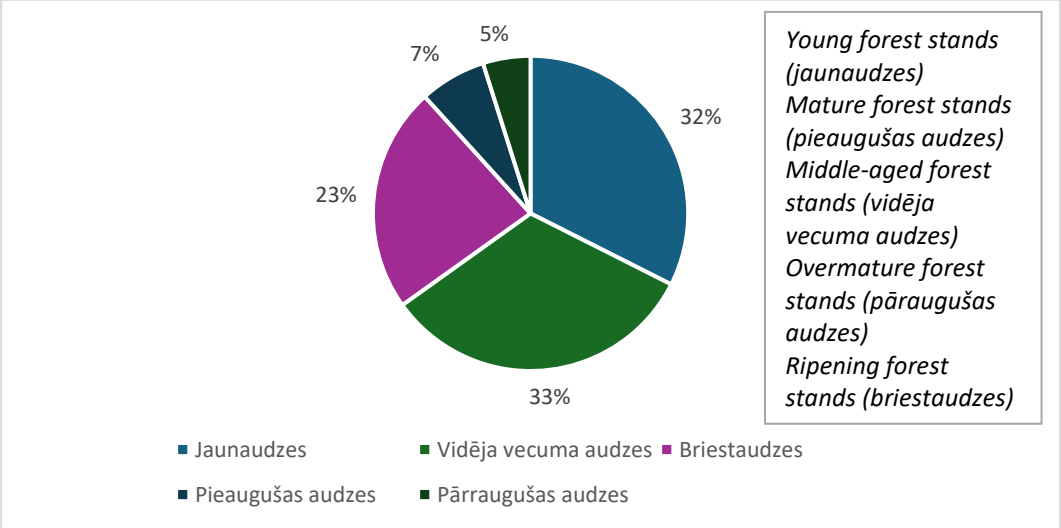


Figure 2.8. Distribution of areas requiring deforestation by forest stand age, percentage (Infrastructure Alternative A)

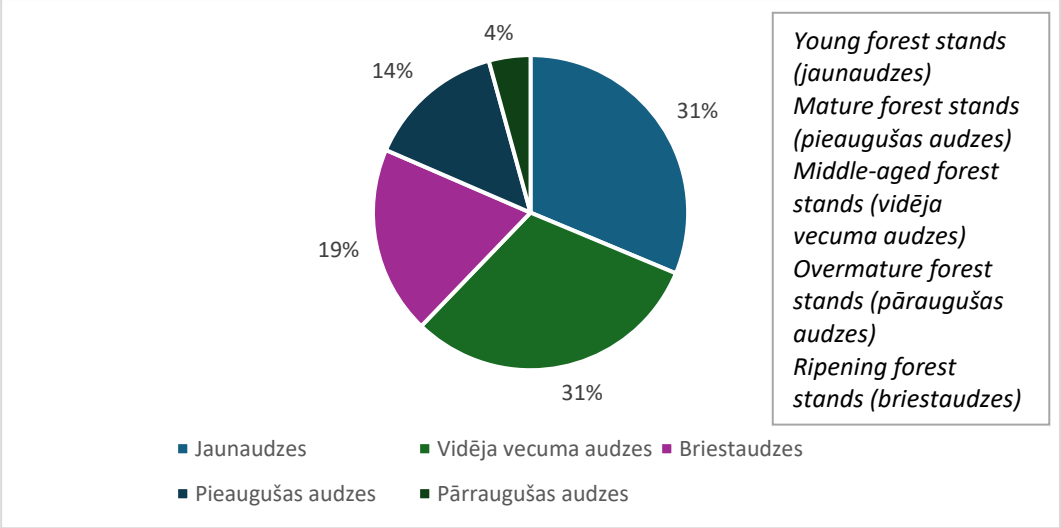


Figure 2.9. Distribution of areas requiring deforestation by forest stand age, percentage (Infrastructure Alternative B)

2.3.6. Construction of engineering communications

It is expected that construction of engineering communications required for wind farm operation, including electricity transmission lines and optical networks, will commence simultaneously with construction of access roads and assembly areas. The developer has planned to transfer electricity generated by the "Valka" wind farm to the common grid using the existing Valmiera – (EST) Tsirguliina 110 kV electricity transmission line. The planned wind farm will be connected to the high-voltage electricity transmission line by constructing medium-voltage electricity transmission cable lines. Within the EIA process, two cable route alternatives are assessed:

- Alternative A: cable route with a length of 21.51 km;
- Alternative B: cable route with a length of 20.38 km.

In Letter No. 4.5/8326, the SLLC Latvian State Roads states that new utility infrastructure proposed to run parallel to state roads shall be designed at least 1 metre outside the state road right-of-way and beyond the boundaries of the road formation and its structural elements (such as drainage ditches, pedestrian paths, etc.), without interfering with road maintenance activities. The design shall ensure that the protection zone of the utility infrastructure does not overlap with the state road land area. Furthermore, any construction proposal within the state road right-of-way shall be coordinated with the Ministry of Transport Republic of Latvia.

To ensure the required voltage increase, the construction of a substation is necessary. During the EIA process, up to the public consultation stage, two potential substation locations were assessed. Following the public consultation and based on the recommendations of habitat experts, a third substation location (Alternative C) was additionally evaluated:

- Alternative A: land unit "Jaunolīši", cadastral designation 94880100262;
- Alternative B: land unit "Jaunpilēnieši", cadastral designation 94880100070;
- Alternative C: land unit Jaunosīši, cadastral designation 94880100262.

As part of the proposed activity, an electricity storage facility (Battery Energy Storage System, hereinafter – BESS) is planned to be constructed within the "Valka" wind farm to store

electricity generated by the wind farm. The BESS will use lithium-ion battery modules, specifically lithium iron phosphate ($LiFePO_4$) technology. It is planned that the storage facility will consist of up to 80 ISO-type containers with a total storage capacity of up to 400 MWh. Each container is planned to contain an average of 48 battery modules, with a capacity of approximately 0.1042 MWh per module, providing approximately 5 MWh capacity per container. Since three alternative substation locations were assessed during the EIA process following the public consultation, the potential development of a BESS was evaluated for each location, referred to as Alternatives A/1, B/1 and C/1 (see Figure 2.10).

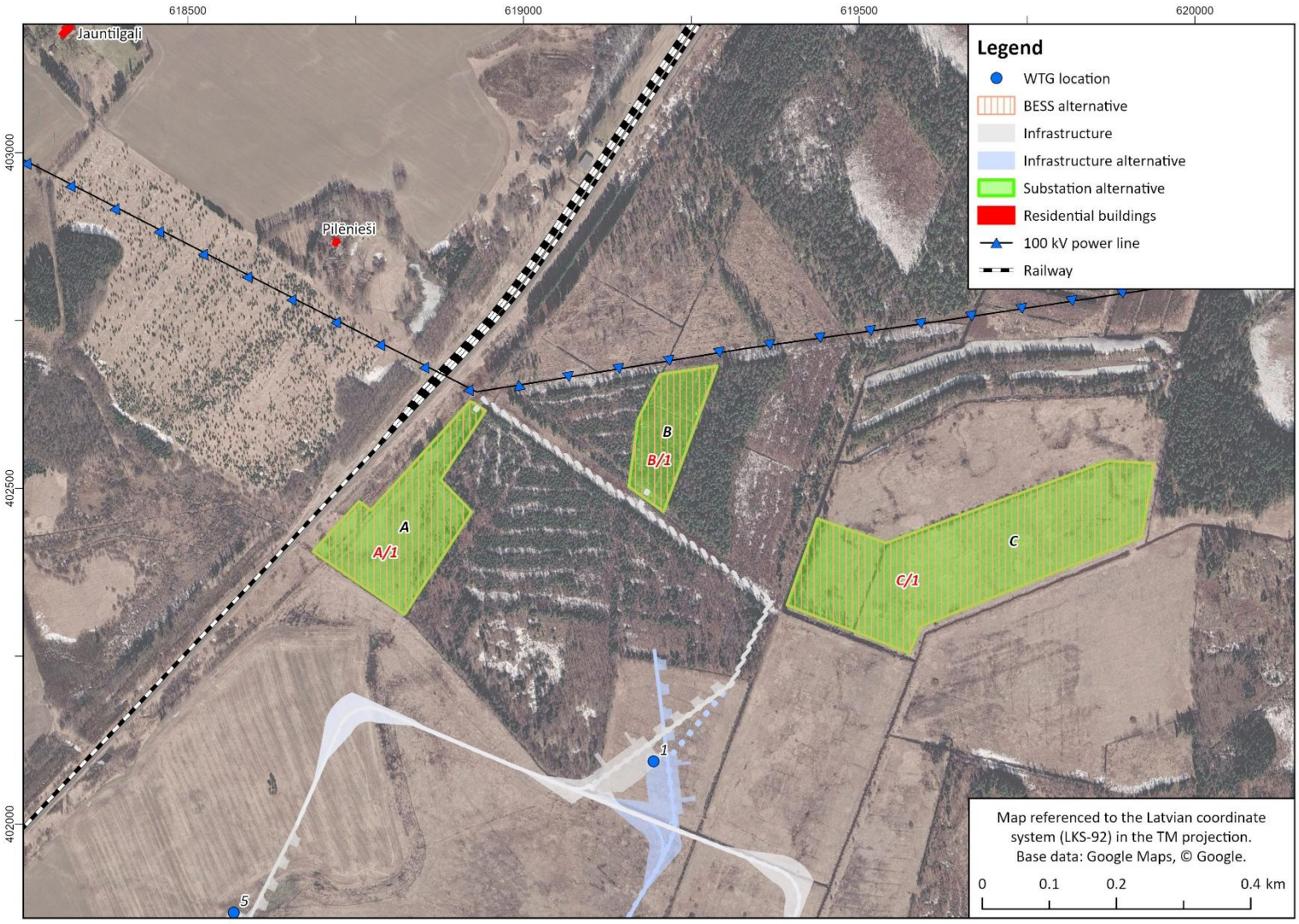


Figure 2.10. Alternative substation and BESS locations

2.3.7. Wind turbine delivery and installation

The precise wind turbine delivery plan will be developed during preparation of the construction design, taking into account the selected wind turbine model, construction location and technical parameters of transported components. Currently, the developer is assessing three possible delivery routes for transportation of wind turbines.

Option 1 Wind turbine components would be delivered to Paldiski Port in Estonia, from where they would be transported using specialised road transport along the following routes: Estonian national road No. 8 Paldiski–Keila; No. 11 Tallinn bypass, both sections forming part of the European route E265; continuing along road No. 8 Tallinn–Tartu–Võru–Luhamaa maantee (European route E263) to Tartu; turning onto Põhimaantee 3; crossing the Latvian border and continuing along road A3 Inčukalns–Jõhvi (both roads forming part of European route E264); reaching the municipal road Ausekļi–Liepkalni, which provides access to the survey area.

Option 2 Wind turbine components would be delivered to Salacgrīva Port, from where they would be transported using specialised road transport along: national main road A1 Rīga (Baltezers)–Estonian border (Ainaži) (European route E67); continuing along roads A2 Rīga–Sigulda–Estonian border and A3 Inčukalns–Valmiera–Estonian border (Valka) (European route E264); reaching the survey area via the municipal road Ausekļi–Liepkalni.

Option 3 Wind turbine components would be delivered to Skulte Port, where, similarly to Option 2, they would be transported using specialised transport vehicles along: national main road A1 Rīga (Baltezers)–Estonian border (Ainaži) (European route E67); continuing along roads A2 Rīga–Sigulda–Estonian border and A3 Inčukalns–Valmiera–Estonian border (Valka) (European route E264); reaching the survey area via the municipal road Ausekļi–Liepkalni.

Crossing of railway lines shall be coordinated with the SJSC "Latvijas Dzelzceļš", and transportation of oversized cargo across railway crossings shall be carried out in accordance with the requirements of Regulation No. 343 of the Cabinet of Ministers "Regulations Regarding Large Dimension and Heavyweight Carriage" (adopted on 6 April 2010), including organisation of temporary interruptions of train traffic where necessary.

Considering that transportation of wind turbine components may restrict other road traffic along the transport routes, delivery of wind turbine components may also be carried out during night-time hours when traffic intensity is lower. Oversized cargo transport routes shall be coordinated in accordance with the procedures established by legislation governing oversized and heavyweight cargo transportation.

Delivered components will be stored at the wind turbine construction area or in specialised storage areas until installation of the wind turbine. Transportation and installation of wind turbine components will be carried out by the selected wind turbine manufacturer or a construction company authorised by the manufacturer.

Installation of one wind turbine normally requires 5 – 7 days. However, at high wind speeds, which limit the ability to safely perform installation works, the required installation period may be longer. The construction work schedule shall be coordinated with the local municipality.

2.4. RESTRICTIONS, SUPERVISION AND CONTROL OF THE TERRITORY DURING AND AFTER CONSTRUCTION OF WIND TURBINES

To carry out site preparation works, construct access roads and areas, reconstruct drainage systems, install engineering communications, construct wind turbine foundations, deliver and install wind turbine components, as well as carry out restoration of construction areas, the project proponent will engage construction companies specialising in the relevant fields. These companies will ensure restriction, supervision and control of the construction area during construction works.

Detailed information regarding construction organisation and associated restrictions will be included in the construction work organisation plan, which will form an integral part of the construction design and will be binding for all construction contractors.

It is expected that access to the wind farm areas will remain unrestricted both during construction and operation, except for individual areas where construction works are being carried out. Solutions for reconstruction of existing roads will be coordinated with the road manager SLLC "Latvijas Valsts ceļi", municipalities and landowners to ensure alternative routes for road users in cases where traffic restrictions on certain road sections are required during construction works.

Upon commencement of wind farm operation, information signs will be installed along roads crossing the wind farm territory. During operation of the wind farm, supervision and operational control of wind turbines will be carried out remotely on a 24 hour basis. During wind farm operation, economic activities outside the wind turbine construction locations will not be restricted. Therefore, it is expected that landowners will be able to continue using adjacent areas for forestry activities after construction of the wind turbines.

2.5. PROPOSED ACTIVITY IMPLEMENTATION SEQUENCE AND PLANNED DEADLINES

Decision No. 5-02-1/33/2024 regarding application of the EIA procedure and transboundary EIA was adopted on 14 June 2024. It is expected that the EIA process will be completed in 2026. After completion of the EIA procedure and receipt of the Cabinet of Ministers acceptance decision, preparation and approval of the wind farm construction design will commence, followed by construction works lasting approximately one year, with completion of construction and commissioning of the wind farm planned for 2030 (see Figure 2.11.).



Figure 2.11. Development stages of the "Valka" wind farm project (source: Eurowind Energy)

The typical operational lifetime of wind turbines is 20 to 25 years[9,10]; however, with appropriate maintenance, the operational lifetime may be extended, and within the wind energy sector, operation of wind turbines for 30 – 40 years after construction is increasingly being considered. It should be noted, however, that the actual operational lifetime may be affected by technological development or changes in sectoral policies. Upon reaching the end of the operational period of the wind turbines, the wind farm is planned to be fully dismantled or reconstructed. In the case of dismantling, wind turbines, including their foundations, are removed, whereas during reconstruction existing wind turbines are generally replaced with new and technologically more efficient technologies.

2.6. WIND TURBINE RELATED UTILITY BUFFER ZONES

The Protection Zone Law does not establish safety protection zones around wind turbines; however, protection zones are established around the electricity transmission system infrastructure associated with the wind farm, including transformer substations and electrical and electronic communication networks:

1) Around transformer substations – a protection zone with a width of 1 m;
2) Along electrical network cable lines – a protection zone with a width of 1 m:
   a) a protection zone with a width of 1.5 m applies if the cable crosses a forest area;
   b) if the cable is located closer than 1 m from a building or structure, the protection zone on that side of the cable is established only up to the foundation of the building or structure;
3) Along underground electronic communication network lines – a protection zone with a width of 1 m:
   a) if the line is located within the road land strip and closer than 1 m from the boundary of the road land strip, the protection zone on that side of the electronic communication network line is established up to the boundary of the road land strip;
   b) if the line is located closer than 1 m from a building or structure, the protection zone on that side of the electronic communication network line is established up to the foundation of the building or structure;
   c) if the line is located within the boundaries of red lines of a road, street or access road (including engineering communication corridors) and is located closer than 1 m both from the red line and from the foundation of a building or structure, the protection zone on that side of the electronic communication network line is established up to the red line or the foundation of the building or structure (depending on which is closer).

According to Regulation No. 982 of the Cabinet of Ministers of 5 December 2006 "Methodology for the Determination of Protection Zones for Energy Infrastructure Objects",

[9] Vestas Wind Systems A.S. 2023. Life Cycle Assessment of Electricity Production from an onshore EnVentus V162-6.2 MW Wind Plant. Available: https://www.vestas.com/content/dam/vestas-com/global/en/sustainability/reports-and-ratings/lcas/LCA%20of%20Electricity%20Production%20from%20an%20onshore%20EnVentus%20V162-6.2.pdf.coredownload.inline.pdf

[10] Nordex SE. 2024. EPD of a Nordex wind farm with Delta4000 N163/6.Xturbines LCA Report. Available: https://www.nordex-online.com/wp-content/uploads/sites/2/2024/10/LCA_Report_-_EPD_of_a_Nordex_wind_farm_with_Delta4000_N163-6.X_turbines_without_Annex_B.pdf

maintenance and control of the condition of protection zones includes the following requirements:

- maintaining protection zones in proper condition;
- clearing protection zones from vegetation;
- tree cutting and pruning;
- informing and coordinating activities with landowners.

These requirements ensure that protection zones around energy infrastructure objects are maintained in an appropriate condition, guaranteeing safe and uninterrupted energy supply, while also protecting the surrounding environment and human safety.

3. DESCRIPTION OF THE ENVIRONMENTAL SITUATION AND ASSESSMENT OF ENVIRONMENTAL IMPACT OF THE PROPOSED ACTIVITY

3.1. NOISE

This chapter of the EIA Report evaluates the impact of the planned "Valka" wind farm on environmental and low-frequency noise levels in the vicinity of the wind farm. Noise is undoubtedly the most significant physical impact associated with the operation of wind farms. The effects of noise generated by wind turbines have been analysed over the past decades in numerous studies, the majority of which were carried out in European countries and North America. Although wind turbine noise has seemingly been studied since the earliest stages of their construction, at least at an industrial scale, one of the most commonly cited statements in various discussions in Latvia regarding wind farm noise impact and previous studies is that older studies are not applicable, because modern turbines are significantly larger and produce higher noise levels. The Report authors do not agree with this claim, as confirmed by practical measurements conducted on turbines of different sizes during certification, as well as data from multiple studies.

For example, Frits van den Berg et al.[11], analysing the relationship between wind turbine sound power and rotor diameter, concluded that turbines with very small rotors produce substantially lower noise, whereas for modern turbines this difference is negligible. The technical design of the blade has a much greater influence on noise than rotor diameter (see Figure 3.1.1.). Turbines constructed 10 – 15 years ago with rotor diameters around 100 m had rotor areas of approximately 8,000 m², whereas current turbines have rotor areas exceeding 20,000 m². Of course, it should be noted that as wind speed increases, wind turbine noise also increases, and turbines installed on taller towers have access to higher wind energy resources; that is, they operate for longer periods at higher wind speeds compared to lower turbines. However, this factor is accounted for in the calculation of wind turbine noise levels.

Based on the above, it can be clearly stated that even older studies on wind turbine noise impact are relevant, and that the effect on human health is associated not with turbine size but with the noise level it generates.

[11] Van den Berg F., Koppen E., Boon j., Ekelschot-Smink M. Sound power of onshore wind turbines and its spectral distribution. Sound & Vibration. 59. 2025

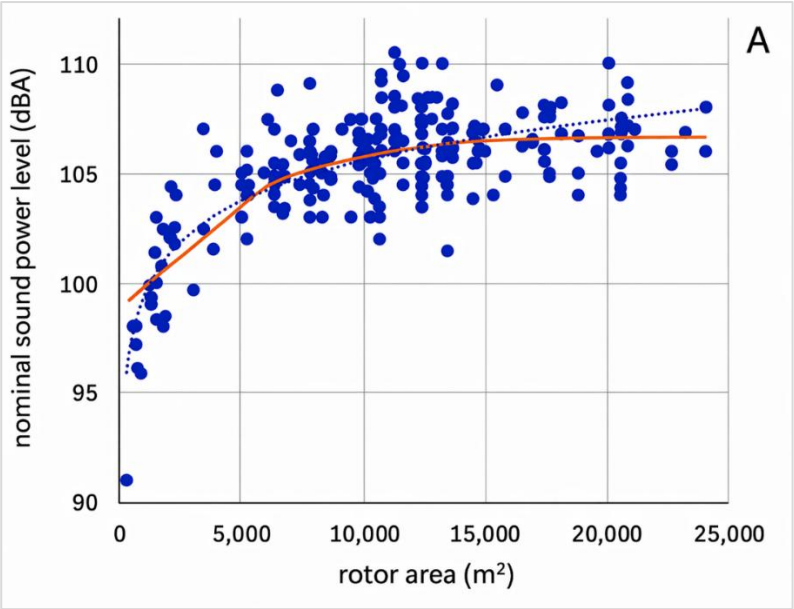


Figure 3.1.1. Sound power generated by wind turbine depending on rotor (Frits van den Berg et.al, 2025)

There is a close relationship between noise-induced health effects, noise level, and exposure duration; specifically, the higher the noise level and the longer the exposure, the greater the probability of various health disturbances occurring. In the context of wind turbine noise, it should be noted that noise generated by wind turbines at the same level is in most cases more irritating than noise from transport sources or other industrial sources[12,13,14]. This phenomenon is related to the amplitude modulation, or pulsing characteristic, of wind turbine noise.

In addition to these physical factors, several studies have confirmed that sensitivity to wind turbine noise may also be related to an individual's subjective attitude toward wind farms, regardless of the actual sound exposure level. This aspect was given significant attention in the 2018 World Health Organization (WHO) guidelines, part of which includes studies on self-reported annoyance and sleep disturbances. Research shows that people who benefit from having wind turbines in their vicinity, or who have a positive attitude toward them, generally report less noise-related annoyance. Conversely, people who perceive wind turbines as an intrusion into their privacy or as harmful to their quality of life generally report higher levels of noise-related annoyance.

Similarly, a 2018 study conducted in Poland[15] found that reported annoyance increases sharply as wind turbine noise rises from 35 to 53 dB, with an even steeper increase among

[12] Janssen, S.A., Vos, H, Eisser AR, Pedersen E. A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources. J Acoust Soc Am. 2011
[13] Michaud DS, Keith SE, Feder K, Voicescu SA, Marro L, Than J, et al Personal and situational variables associated with wind turbine noise annoyance. The Journal of the Acoustical Society of America. 2016
[14] Klaeboe R, Sundfor HB. Windmill Noise Annoyance, Visual Aesthetics, and Attitudes towards Renewable Energy Sources. International journal of environmental research and public health. 2016
[15] Pawlaczyk-Łuszczyńska, M., Zaborowski, K., Dudarewicz, A., ZamojskaDaniszewska, M., Waszkowska, MResponse to noise emitted by wind farms in people living in nearby areas. International journal of environmental research and public health. 2018

people with a negative attitude toward wind farms. Haac et al. in their study[16], emphasise not only the importance of attitude but also the visual impact of the wind farm; that is, higher visual impact amplifies the perceived effect of noise. Although larger wind turbines do not always correspond to greater visual impact – which may be significantly influenced by micro- and meso-scale structures in the observer's surroundings – the distance to the turbines, the total size of the wind farm, and the farm's design (discussed in more detail in the Report section on landscape changes) nevertheless mean that, under similar conditions, a larger turbine will have greater visual impact, potentially increasing resident dissatisfaction, which may in turn affect their perception of wind turbine noise.

In the 2017 report[17], Dutch scientists indicated that low-frequency sounds can be heard in everyday life from road and air traffic, as well as from many other sources. Low-frequency noise is defined as sound within a relatively narrow frequency range in the human audible spectrum. Infrasound, by contrast, is less well understood, and perception of infrasound is not as widespread as that of low-frequency or "normal" sound. However, infrasound is not exclusive to wind turbines; it is also generated by natural sources (storms, waves), as well as by transport and human-made machinery, at levels comparable to those produced by wind turbines. Due to the high auditory threshold, humans generally do not perceive the presence of infrasound.

There are strong hypotheses suggesting that infrasound and low-frequency noise from wind turbines affect human health differently from audible sound, although there is limited scientific evidence to support this. Laboratory experiments have shown other effects, such as bodily vibrations, nausea, or dizziness, but only at levels of infrasound significantly higher than those produced by wind turbines. In a study conducted in Finland, which included surveys of residents living near wind turbines, infrasound measurements, and laboratory tests, approximately 5% of respondents reported various health issues associated with infrasound. However, in laboratory tests, the same respondents were unable to distinguish periods when wind turbine infrasound was played from periods when it was absent.

The Finnish study[18] also confirmed a correlation between self-reported annoyance and attitude toward wind farms. Several studies analysing disruptive effects of infrasound have found impacts on sleep quality, brain activity, and heightened sensitivity to other sounds. These studies indicate that when sound levels approach or exceed the auditory threshold, the human body responds, and long-term exposure to high sound levels may act as a catalyst for various health disorders, similar to audible sound.

This allows the conclusion that low-frequency noise and infrasound are part of the total noise from wind turbines and have similar effects to audible noise: they can be annoying, affect sleep onset, and, if chronic, may produce additional health effects. This also applies to other noise sources, such as road, rail, or air traffic. Due to low attenuation, lower-frequency sound

[16] Haac T. R., Kaliski K., Landis M., Hoen B., Rand J., Firestone J., Elliott D., Hubner G., Pohl J. Wind turbine audibility and noise annoyance in a national U.S. survey: Individual perception and influencing factors. The Journal of the Acoustical Society of America. 2019

[17] Van den Berg, F., Van Kamp, I. Health effects related to wind turbine sound. Commissioned by the Swiss Federal Office for the Environment (FOEN). 2017

[18] Maijala P, A Turunen, I Kurki, L Vainio,S Pakarinen, C Kaukinen, K Lukander, P Tiittanen, T Yli-Tuomi, P Taimisto, T Lanki,,K Tiippana, J Virkkala, E Stickler, M Sainio. Infrasound does not explain symptoms related to wind turbines. Report of the Prime Minister's Office, Helsinki 2020

becomes relatively more important at greater distances and inside residential buildings. Infrasound is attenuated even less, but the infrasound produced by wind turbines at typical distances to residences is too weak to be perceived by humans[19].

It should be noted that much of the research on the effects of wind turbine noise, low-frequency noise, and infrasound on public health has been relatively small in scale, with laboratory studies rarely exceeding a few dozen participants, and in-situ studies, which combine surveys, noise measurements, and modelling, generally including no more than a few thousand respondents. Similarly, during the development of WHO guidelines[20], it was concluded that evidence on wind turbine noise effects is limited, and the quality of existing studies does not allow reliable generalisation of exposure – effect relationships that could serve as a basis for objective limit values[21]. Nevertheless, the WHO decided in its 2018 guidelines to include a provisional exposure – effect relationship and, based on it, recommended a 45 dB day – night limit for audible wind turbine noise, assuming that no significant health effects are expected below this level.

In recent years, several larger-scale studies have been conducted on the impact of wind turbine noise on public health. Cohort studies, analysing changes in health conditions in significant population groups, have been carried out in Denmark, Canada, and the Netherlands. In these studies, it is not possible to separately isolate audible noise from infrasound; the impact of all wind turbine noise is considered collectively.

National-scale epidemiological studies on the impact of wind turbine noise on public health have been conducted in Denmark, analysing the effects of wind turbine noise on cardiovascular diseases, pregnancy outcomes, and diabetes. The results of these studies were published in 2018[22,23,24,25]. In these studies, which examined health-related aspects for populations living near all wind turbines in Denmark (up to 40 turbines, with approximately 615,000 residents during the study period) over the years 1982 – 2013, no confirmation was found for the initial hypotheses that wind turbine noise, including low-frequency noise, negatively affects public health. The study authors note that some observations indicate that relatively higher risk factors could potentially occur in areas where wind turbine noise levels exceed 42 dB(A).

In the Danish Nurses' Cohort Study[26], researchers initially observed a possible association between long-term exposure to wind turbine sound and atrial fibrillation among female

[19] Van Kamp I., Van den Berg F. Health Effects Related to Wind Turbine Sound: An Update. International Journal of Environmental Research and Public Health. 2021
[20] WHO, Environmental Noise Guidelines for the European Region. WHO, Bonn. 2018
[21] Guski, Rainer Dirk Schreckenberg and Rudolf Schuemer WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance Int. J. Environ. Res. Public Health 2017
[22] A. H. Poulsen et al., Long-term exposure to wind turbine noise and redemption of antihypertensive medication: A nationalwide cohort study. Environment International 121 (Pt.1), September 2018
[23] A. H. Poulsen et al., Pregnancy exposure to wind turbine noise and adverse birth outcomes : A nationalwide cohort study, Environment International 167, September 2018
[24] A. H. Poulsen et al., Long-term exposure to wind turbine noise at night and risk for diabetes: A nationwide cohort study, Environmental Research 165, April 2018
[25] A. H. Poulsen et al., Short-term nighttime wind turbine noise and cardiovascular events: A nationwide case-crossover study from Denmark, Environment international 114, March 2018
[26] Bräuner, E. V., Jørgensen, J. T., Duun-Henriksen, A. K., Backalarz, C., Laursen, J. E., Pedersen, T. H., Andersen, Z. J. Long-term wind turbine noise exposure and the risk of incident atrial fibrillation in the Danish Nurse cohort. Environment international. 2019

nurses. Among 28,731 nurses included in the cohort, 1,413 developed atrial fibrillation. Nurses who were exposed over a long period (average of 11 years) to indoor noise levels ≥20 dB(A) at night had a statistically significantly increased risk of atrial fibrillation (95% CI: 1.05–1.61) compared to nurses exposed to noise levels <20 dB(A). The researchers also emphasise other confounding factors in their conclusions, such as smoking, higher consumption of high-fat foods, lower levels of physical activity, and other factors, which were higher in the affected group than in the control group.

Epidemiological studies on the effects of wind turbine noise on sleep quality[27], stress levels[28], and other health-related factors[29] (e.g., elevated blood pressure, migraines, tinnitus) have also been conducted in Canada, where it was found that wind turbine noise below 46 dB(A) is not considered a cause of sleep disturbances, stress, or self-reported health problems among residents, although residents living near wind turbines frequently associate health complaints with turbine operation.

A national-scale study on the impact of wind turbines on public health has been conducted in the Netherlands[30]. Similar to the study in Denmark, this cohort study assessed wind turbine noise on a national scale and analysed long-term changes in health indicators for the population living, or having lived, in proximity to wind turbines. The study period covers the years 2012 – 2021 and includes a population of 350,000 – 560,000 residents living within 5 km of wind turbines.

The study examined a wide range of health symptoms and conditions diagnosed in primary care, as well as prescribed medications. Similar to the Danish study, a statistically non-significant increase in certain symptoms potentially related to wind turbine noise, and in the use of medications for mitigation of these symptoms, was observed for the population living directly within 500 m of wind turbines, where the highest average noise levels exceeded 42 dB(A). Multilevel regression analyses indicated a lack of consistent and significant correlation between distance to wind turbines (0 – 500 m, 500 – 1000 m, and 1000 – 2000 m) and the prevalence of health problems, after accounting for demographic and socio-economic factors.

No studies on the impact of wind turbine noise on public health have been conducted in Latvia. The regulatory limits in force in Latvia apply to all types of industrial noise sources and do not account for the different perception of amplitude-modulated noise from wind turbines. The authors of this Report consider it appropriate to analyse not only compliance of the proposed activity with national regulatory limits, but also conformity with scientifically based noise limits, even if they are not directly binding.

In preparing this assessment, the compliance of the proposed activity with the WHO guideline value for wind turbine noise and with the Danish guideline for wind turbine low-frequency noise has been evaluated. Although the WHO-recommended 45 dB(A) day – night value may initially appear equivalent to the stricter night-time limit in Latvia, the WHO value is 5 dB(A)

[27] Michaud et al., Effects of Wind Turbine Noise on Self-Reported and Objective Measures of Sleep, Sleep. 2015
[28] Michaud et al., Self-reported and measured stress related responses associated with exposure to wind turbine noise, The Journal of the Acoustical Society of America. 2016
[29] D. Michaud, Health and well-being related to wind turbine noise exposure: Summary of results, Journal of the Acoustical Society of America. 2015)
[30] Baliatsas B., Yzermans C.J., Hooiveld M., Kenens R., Spreeuwenberg P., Van Kamp I., Dückers M., Health problems near wind turbines: A nationwide epidemiological study based on primary healthcare data, Renewable and Sustainable Energy Reviews, Volume 216, 2025

lower than the Latvian night time limit when accounting for the day – night indicator calculation, which includes corrections for evening and night periods.

3.1.1. Legislative framework

Environmental noise

Environmental noise indicators, their application, and assessment methods are established in the Regulation No. 16 of the Cabinet of Ministers of January 7, 2014 "Procedures for Environmental Noise Assessment and Management" (hereinafter – Regulation No. 16). The regulation was issued under the Law "On Pollution" and was last amended in 2023.

According to point 9 of Annex 1 of Regulation No. 16, predictive calculations must be used to assess environmental noise generated by planned facilities, while point 6.1 of Annex 1 stipulates that noise generated by industrial activities should be assessed using calculation methods included in section 2.1 of Annex 5 "General provisions – road traffic, railway, and industrial noise", section 2.4 "Industrial noise", and section 2.5 "Calculation: propagation of noise from road traffic, railway traffic, and industrial sources".

Point 6 of Regulation No. 16 establishes indicators for the assessment of environmental noise outdoors, while Annex 2 specifies environmental noise limit values for the above indicators. According to the regulation, environmental noise limits are defined for annual average noise indicators during day, evening, and night periods. Compliance with environmental noise limits is assessed within areas that include residential developments registered in portal of State Land Service as building land or land under residential courtyards, as well as 2 m from the facade most exposed to noise. When evaluating environmental noise limit compliance, the main land use type specified in the municipal spatial plan is taken into account, corresponding to the land-use function for built-up areas indicated in point 1 of Annex 2 of the Regulation.

Applicable environmental noise limits for the development areas near the planned wind farm are determined based on the functional zoning of the current Valka Municipality spatial plan, taking into account information in portal of State Land Service of the Republic of Latvia regarding residential building locations and information in the Building Information System on ongoing construction. According to the current spatial plan, a 2 km zone around the potential wind turbine locations covers:

- Areas in the town of Valka designated for detached private house buildings (DzS) and public buildings (P);
- Areas in Sēļi village designated for detached private house buildings (DzS) and Low-storey residential buildings (DzM);
- Single-family houses in rural areas, registered in portal of State Land Service as residential buildings;
- Multi-unit residential buildings in rural areas, registered in portal of State Land Service.

According to information available in the Building Information System (as of 26 February 2026), within 2 km of the planned wind turbine locations, no residential or public building construction is currently registered.

According to the amendments to Regulation No. 16, effective 3 November 2023, different noise limit values apply to noise from traffic and industrial sources. Wind turbines are classified as industrial-type facilities, and therefore, in noise assessment, the environmental noise limit values applicable to industrial sources are applied (see Table 3.1.1.).

Table 3.1.1. Applicable noise limit values – noise generated by industrial sources

Land use function	Noise limit values		
	L_{day} (dB(A))	$L_{evening}$ (dB(A))	L_{night} (dB(A))
Private house, educational and scientific institutions, health protection institutions, social care institutions building territory	55	50	45
Public (cultural institutions, educational and scientific institutions, office buildings for local government authorities and state administrative institutions) building territory	60	55	55

According to Regulation No. 16, traffic-related environmental noise limits for residential areas are applied uniformly, regardless of the functional zoning specified in the spatial plan. Information on the applicable noise limit values for traffic noise is summarised in Table 3.1.2.

Table 3.1.2. Traffic-related environmental noise limit values[31]

Noise limit values		
L_{day} (dB(A))	$L_{evening}$ (dB(A))	L_{night} (dB(A))
65	60	55

Considering that different noise limit values apply to traffic and industrial noise sources, and that no limit values are defined for the cumulative noise from multiple source types, each source group can be assessed separately, but only sources from a single group can be used for cumulative impact evaluation. In this EIA, the noise level generated by industrial sources – specifically wind turbines – is evaluated; therefore, the traffic noise assessment included in the Report is for informational purposes only.

According to point 2.8 of Regulation No. 16, environmental noise limit values do not apply to construction works that are coordinated with the local municipality. Consequently, the impact of construction activities on environmental noise levels in the vicinity of the proposed project area has not been quantitatively assessed in this noise evaluation.

Environmental noise limit values in Latvia for industrial sources apply to all sources, regardless of the nature of their operation. Although a similar approach is used in most other European countries, the impact of noise on public health may depend not only on quantitative values, i.e., sound levels in decibels, but also on the type of noise source. WHO has developed guidelines according to which the recommended limit value for the day – night environmental noise indicator (L_{den}) generated by wind turbines is 45 dB(A)[32]. Although the WHO recommended limit value is advisory in nature, it has been used in this assessment for evaluating the impact of the planned wind farm, as it provides a higher level of protection.

Low-Frequency Noise

Currently, there are no regulations in Latvia specifying specific limit values or assessment procedures for low-frequency noise that could be used to identify a sufficiently safe distance

[31] Within protection zones along roads (including roads where traffic intensity is less than three million vehicles per year), protection zones along railways, and areas located closer than 30 m to stationary noise sources, environmental noise limit values shall be considered as target values.
[32] Available: https://cdn.who.int/media/docs/default-source/who-compendium-on-health-and-environment/who_compendium_noise_01042022.pdf?sfvrsn=bc371498_3

from residential buildings for wind turbine placement without posing a risk to public health. Therefore, within the framework of the EIA process, the experience of other countries was examined.

Reviewing the experience of other European countries, it was found that specific indoor limit values for wind turbine-generated low-frequency noise have been established only in Denmark (Ministry of Environment and Food Order No. 995[33], updated on 26 August 2024). This order establishes both the procedure for assessing low-frequency noise and a limit value binding on all wind farm developers. The order stipulates that the cumulative low-frequency noise level (10 – 160 Hz) from wind turbines inside residential buildings must not exceed 20 dB at wind speeds of 6 m/s and 8 m/s (at 10 m above ground).

Compliance with the indoor noise limit for existing or planned operations is determined by calculation, since measurements are significantly affected by natural and other anthropogenic sources of low-frequency noise. The calculation method used in Denmark has also been adapted in other countries in our region, including Finland and Estonia. Although these countries apply different evaluation procedures, defining limits for each frequency band, the core assessment method is considered internationally recognised and applied in multiple countries.

The calculation methodology and limit values established in Denmark for evaluating the impact of wind farms are also recommended by the SES in its 2023 Guidelines for conducting an initial EIA for wind turbine construction[34]. In preparing this noise assessment, the low-frequency noise generated by the planned "Valka" wind farm has been evaluated according to the calculation methodology developed in Denmark, applying the Danish limit values to the interiors of residential buildings.

3.1.2. Impact assessment approach

Environmental Noise Calculations

Environmental noise calculations were carried out using the IMMI 2025 software (developer: Wölfel Engineering GmbH & Co. KG) (License number S001/00757), applying the calculation methods specified in Regulation No. 16:

- Noise from road traffic was assessed using the calculation method developed in France, "NMPB-Routes-96 (SETRA-CERT ULCPC-CSTB)";
- Noise from railways was assessed using the calculation method developed in the Netherlands, "RMR";
- Noise from wind turbines and substations was assessed using the methods specified in section 2.1 of Annex 5 "General provisions – road traffic, railway, and industrial noise", section 2.4 "Industrial noise", and section 2.5 "Calculation: propagation of noise from road traffic, railway traffic, and industrial sources".

Information on the noise indicators applicable for environmental noise assessment is summarised in Table 3.1.3. In accordance with the regulation, environmental noise limits are

[33] Available: https://www.retsinformation.dk/eli/lta/2024/995

[34] Available:https://www.vvd.gov.lv/lv/jaunums/izstradatas-vadlinijas-veja-parku-ietekmes-uz-vidi-sakotnejo-izvertejumu-veiksanai

defined for annual average noise indicators. Noise indicator values on the maps are presented in 5 dB(A) steps.

Table 3.1.3. Noise indicators applicable for environmental noise assessment

Noise indicator	Period	Explanation
Daytime noise indicator – L_{day}	7:00 - 19:00 (12 hours)	Characterises annoyance during daytime. The A-weighted long-term average sound level (dB(A)) describing the annual average noise level during the daytime period, determined taking into account all days (as part of the day) throughout the year.
Evening noise indicator – $L_{evening}$	19:00 - 23:00 (4 hours)	Characterises annoyance during evening hours. The A-weighted long-term average sound level (dB(A)) determined taking into account all evenings (as part of the day) throughout the year.
Night-time noise indicator – L_{night}	23:00 - 7:00 (8 hours)	Characterises annoyance during night-time. The A-weighted long-term average sound level (dB(A)) determined taking into account all nights (as part of the day) throughout the year.
Day-evening-night noise indicator – L_{den}	24 hours	Characterises overall annoyance during a 24-hour period. The A-weighted long-term average sound level (dB(A)) determined taking into account all daily periods throughout the year, applying corrections for evening and night periods in accordance with Regulation No. 16.
Noise indicator $L_{Aeq,T}$	-	Equivalent continuous A-weighted sound pressure level.

According to the guidelines published by SES for evaluating the environmental impacts of wind turbine construction[35], environmental noise was assessed for residential areas located within 2 km of the potential wind turbine construction sites.

Within the framework of the EIA process, several possible technological alternatives are evaluated – different wind turbine models (see Section 2.2), as well as turbines with different blade designs – standard blades (ST) and aerodynamically improved blades (serrated trailing edges (STE)), the use of the latter providing a significantly lower environmental noise emission level. Although all analysed turbine models offer special operational modes to achieve lower noise emissions, the possibilities for applying such modes have not been evaluated in this assessment, because all manufacturer-provided modes are associated with significantly reduced turbine efficiency.

Considering that the selected turbine model for the wind farm design may differ from those assessed in this EIA Report, the approach chosen for the technological alternatives was to evaluate the worst-case scenario; that is, the noisiest turbine, if necessary, establishing emission limits to ensure compliance with regulatory requirements regardless of the selected turbine model.

To determine which turbine model generates the highest noise exposure, i.e., to identify the potentially most adverse situation, the noise emission levels of all turbine models evaluated in this assessment were compared. For the preparation of the EIA Report, information on

[35] Available: https://www.vvd.gov.lv/lv/media/9969/download?attachment

turbine noise emission levels in 1/3-octave frequency bands provided in technical specifications by the turbine manufacturers was used.

Comparing noise emission data from different turbine models, it can be concluded that the characteristics are similar – as wind speed and turbine electricity generation potential increase, the noise level produced by the turbine increases; however, once the turbine reaches nominal power, the noise level no longer rises. More detailed information on turbine models that could be installed in the "Valka" wind farm is provided in Section 2.2 of the EIA Report, while information on sound power levels of the turbine models at specified wind speeds is summarised in Tables 3.1.4 – 3.1.8. For Vestas V172 – 7.2 MW, Vestas V162 – 7.2 MW, and Siemens Gamesa SG170 – 7.0 MW, the sound power level is given at hub height wind speed, whereas for Nordex N175 – 7.0 MW and Nordex N163 – 7.0 MW, the sound power level is given at 10 m above ground.

Table 3.1.4. Sound power level of Vestas V172 – 7.2 MW, dB(A)[36]

Blade type	Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)						
	3 - 4	5	6	7	8	9	≥10
Standard (ST)	100,8	100,9	102,7	105,4	108,2	110,3	111,1
Enhanced aerodynamics (STE)	97,6	97,7	99,5	102,2	105,0	107,1	107,8

Table 3.1.5. Sound power level of Vestas V162 – 7.2 MW, dB(A)[37]

Blade type	Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)					
	3 - 5	6	7	8	9	≥10
Standard (ST)	99,2	101,2	103,5	106,0	108,3	109,5
Enhanced aerodynamics (STE)	96,0	98,0	100,3	102,8	105,1	106,3

Table 3.1.6. Sound power level of Siemens Gamesa SG170 – 7.0 MW, dB(A)[38]

Blade type	Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)				
	3 - 5	6	7	8	≥9
Standard (ST)*	96,0	98,9	102,3	105,2	106,5

**Information on STE is not available*

Table 3.1.7. Sound power level of Nordex N175 – 7.0 MW, dB(A)[39]

Blade type	Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)			
	3	4	5	≥6
Standard (ST)	98,2	102,3	107,4	109,7
Enhanced aerodynamics (STE)	96,2	100,3	105,4	107,7

Table 3.1.8. Sound power level of Nordex N163 – 7.0 MW, dB(A)[40]

Blade type	Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)				
	3	4	5	6	≥7
Standard (ST)	97,8	100,2	105,1	109,2	109,4
Enhanced aerodynamics (STE)	95,8	98,2	103,1	107,2	107,4

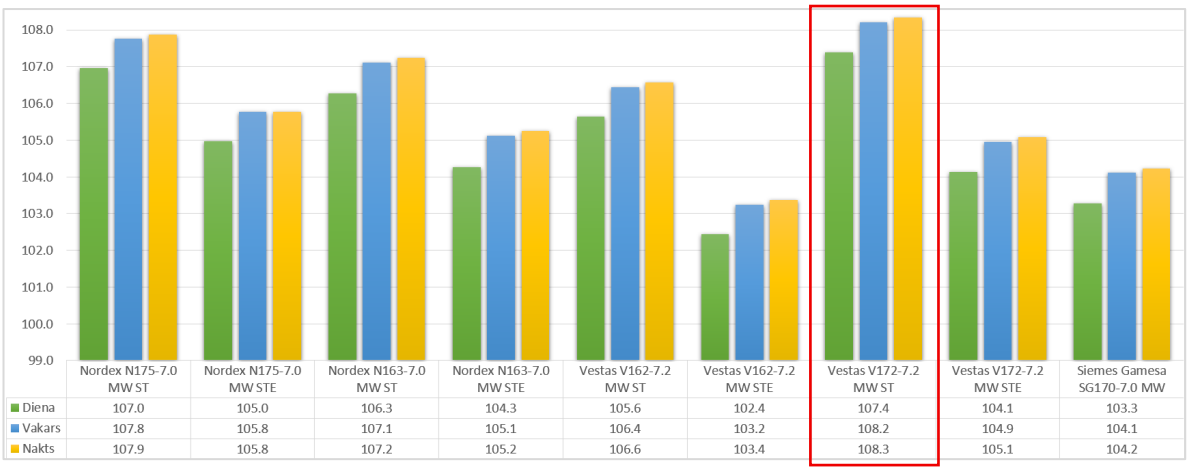
[36] Technical specification No. T05 0128-4336 Ver 02
[37] Technical specification No. T05 0116-1715 Ver 04
[38] Technical specification No. 110000116443_R00
[39] Technical specification No. F008_278_A17_EN
[40] Technical specification No. F008_277_A17_EN

Significant influence on the long-term indicators of wind turbine noise exposure is determined not only by the turbine's sound emission levels but also by the duration of turbine operation at a given wind speed. To calculate the approximate operating time of the turbines, data from the ERA5 model, developed by the European Centre for Medium-Range Weather Forecasts (ECMWF), were used for wind speeds in the proposed project area during the period from 1 January 2015 to 31 December 2024. Using detailed information on wind speeds at 200 m above ground level (average over the 10-year period), the potential turbine operating time was calculated for day, evening, and night periods. Information on the calculated average annual operating time is summarised in Table 3.1.9.

Table 3.1.9. Calculated turbine operating time at a given wind speed

Wind speed at 200 m above ground level, m/s	Average wind turbine operating time during the day period throughout the year, h		
	Daytime (07:00 - 19:00)	Evening (19:00 - 23:00)	Night-time (23:00 - 07:00)
3	332	67	133
4	418	98	185
5	482	127	249
6	505	150	278
7	477	184	330
8	426	177	368
9	385	167	374
≥ 10	1009	421	861
Total:	4035 (92 % of the year)	1391 (95 % of the year)	2779 (95 % of the year)

Information on the annual average noise emissions generated by each wind turbine model evaluated in the EIA process, according to wind speed and time of day, is presented in Figure 3.1.2. When determining turbine operating time for modeling purposes, technological shutdowns of the turbines, as well as the need to switch off turbines in the context of other environmental aspects – for example, to reduce flicker effect exposure or to protect bats – were not taken into account. Based on the calculation results, it was concluded that the highest noise emissions would be generated by the Vestas V172 – 7.2 MW turbine model installed on a 166 m tall tower with standard blades. Therefore, this model was used to assess the potential environmental noise levels in the vicinity of the planned Valka wind farm.



	Nordex N175-7.0 MW ST	Nordex N175-7.0 MW STE	Nordex N163-7.0 MW ST	Nordex N163-7.0 MW STE	Vestas V162-7.2 MW ST	Vestas V162-7.2 MW STE	Vestas V172-7.2 MW ST	Vestas V172-7.2 MW STE	Siemes Gamesa SG170-7.0 MW
Diena	107.0	105.0	106.3	104.3	105.6	102.4	107.4	104.1	103.3
Vakars	107.8	105.8	107.1	105.1	106.4	103.2	108.2	104.9	104.1
Nakts	107.9	105.8	107.2	105.2	106.6	103.4	108.3	105.1	104.2

Figure 3.1.2. Comparison of noise levels generated by the wind turbine models evaluated in the EIA Report, based on actual wind speed during different periods of the day

In the EIA Report, environmental noise calculations were carried out assuming that wind turbines could be installed in all 14 evaluated locations within the wind farm, assessing the worst-case scenario. As indicated in Section 2 of the Report, the number of turbines could be reduced if the transmission network capacity is insufficient to connect all turbines. If the number of turbines is reduced, the noise level in the surrounding area could be lower; however, the impact in each specific residential area will depend on the placement of the remaining turbines.

To assess potential cumulative impacts with other economic activities, information from public registers on other potentially significant environmental noise sources located near the planned Valka wind farm (within 2 km of the planned turbine locations) was compiled for the Report. According to SES system "Contaminated and Potentially Contaminated Sites Register" and the Geological Information System of LEGMC, the following facilities are located near the planned wind farm:

- JSC "Latvijas valsts meži" sand and gravel site "Zīles (Dores)";
- Valkas Parish farm "Kelnieši" grain dryer (C.cat. certificate No. AP23IC0203);
- Incineration facility (boiler house) in Sēļi village (C.cat. certificate No. VA15IC0113);
- SIA "Ķeizari" incineration and wood processing facility in Sēļi village (C.cat. certificate No. VA15IC0096);
- Valka city wastewater treatment plant and sewage sludge composting area (B.cat. pollution activity permit No. VA14IB0054);
- SJSC "Latvijas autoceļu uzturētājs" production base and warehouse in Valka (B.cat. pollution activity permit No. VA16IB0005);
- SIA "Ligumss" motor vehicle repair and maintenance workshop (C.cat. certificate No. VA15IC0068);
- JSC "Virši-A" fuel station (B.cat. pollution activity permit No. VA19IB0008);
- State Social Care Centre "Zemgale" boiler house (C.cat. certificate No. VI21IC0004).

Evaluating the information included in the permits and certificates regarding noise sources in economic activity facilities, the conditions imposed, and their location, no significant noise sources were identified that, together with noise generated by the wind turbines, could pose a risk of exceeding environmental noise limit values.

Although Latvian regulations distinguish traffic noise from industrial noise, setting different environmental quality standards for both source groups and thereby preventing cumulative impact assessment, traffic noise modeling was carried out for this Report to provide information on the existing, or background, noise level in the vicinity of the proposed project area. Information on traffic noise sources was obtained from:

- The traffic intensity report prepared by SLLC "Latvijas Valsts ceļi" [41];
- The network overview prepared by SJSC "Latvijas dzelzceļš" [42];
- The train timetable of JSC "Pasažieru vilciens" [43];
- The Estonian statistics database – section on train traffic intensity within the European Transport Network (TEN-T) [44].

To characterise road traffic speeds, data on the legally permitted speed limits were used. For train traffic speeds, the order of SJSC "Latvijas dzelzceļš" No. D-1.14./51-2021 "On determining train movement speeds" was applied. Information on traffic intensity is summarised in Tables 3.1.10 and 3.1.11.

Table 3.1.10. Road traffic intensity

Road	Average daily traffic intensity (AADT)	
	Passenger cars	Heavy vehicles
A3 Inčukalns - Valmiera - Igaunijas robeža	1670	587
P23 Valka - Vireši	246	24
P24 Smiltene - Valka	1012	207
V258 Valka - Dadži	185	21
V259 Ausekļi - Burga	178	22

Table 3.1.11. Train traffic intensity

Train type	Total number of trains per year	Average number of wagons
Passenger	2404[45]	5
Freight	837	57

Environmental Noise Measurements

During the EIA process, the developer organised four meetings with local residents, one of which included a broader discussion on noise pollution. During the meeting, residents requested not only an assessment of environmental noise levels using calculation methods but also measurements of the existing environmental noise to obtain more comprehensive information on the current environmental conditions. Residents expressed concerns about how noise generated by wind turbines could affect the residents of the State Social Care Centre "Zemgale"; therefore, they recommended that noise measurements be carried out specifically near the social care centre.

Responding to this request, the developer, within the framework of the EIA process, organised environmental noise measurements near the social care centre. The

[41] Available: https://lvceli.lv/celu-tikls/statistikas-dati/satiksmes-intensitate/
[42] Available: https://www.ldz.lv/lv/tikla-parskats-2025
[43] Available: https://www.vivi.lv/lv/
[44] Available: https://www.stat.ee/en
[45] Six round trips on weekdays and eight round trips on weekends

measurements were conducted by representatives of the Environmental Research Laboratory of SIA "Estonian, Latvian & Lithuanian Environment", accredited by the Latvian National Accreditation Bureau (LATAK accreditation No. T-399).

Long-term environmental noise measurements were conducted over a period of 60 days (from 11 December 2025 to 9 February 2026). Measurements were carried out in accordance with the standard LVS ISO 1996-2:2018 "Acoustics – Description, measurement and assessment of environmental noise. Part 2: Determination of environmental noise levels."

Environmental noise measurements were performed using a Smart Noise Monitor CUBE monitoring station (serial number 12045, developer: ACOEM, calibration certificate number K-0050810, issued on 20 October 2025), equipped with a GRAS 40CD microphone (serial number 627473). For meteorological data registration, a VAISALA WXT 536 station was used (serial number R4840617, manufacturer: VAISALA). A test report on the environmental noise measurements, No. 240B01-1, was prepared and is attached in original EIA Report (Appendix 3).

Low-Frequency Noise Calculations

For the assessment and modeling of low-frequency noise, the WindPro software (developer: EMD International) was used. This program is designed for evaluating the impacts of wind turbines and includes a dedicated module for calculating low-frequency noise in accordance with the requirements of the Danish Ministry of Environment and Food Order No. 995. The input and output data of the calculation models prepared by the software are provided in original EIA Report (Appendix E.2).

According to Danish Ministry of Environment and Food Order No. 995, the low-frequency noise level for each 1/3-octave band tone in a building is predicted using the following equation:

$$L_{pALF} = L_{WA,ref} - 10 * \log(l^2 + h^2) - 11\ dB + \Delta L_{gLF} - \Delta L_{\sigma} - \Delta L_{a},$$

where:

L_{pALF} - noise level for the 1/3-octave band tone (dB);
$L_{WA,ref}$ - sound power level generated by the wind turbine (dB);
l - distance from the turbine base to the receiver point (m);
h - height of the turbine nacelle (m);
Δ_{gLF} - ground surface correction;
ΔL_{σ} - sound insulation correction;
ΔL_{a} - atmospheric absorption correction ($a_a * \sqrt{l^2 + h^2}$).

Information on the applicable ground surface, sound insulation, and atmospheric absorption corrections is summarised in Table 3.1.12.

Table 3.1.12. Corrections used for low-frequency noise calculations

Corrections	1/3 octave band centre frequency, Hz												
	10	12,5	16	20	25	31,5	40	50	63	80	100	125	160
Δ_{gLF}	6,0	6,0	5,8	5,6	5,4	5,2	5,0	4,7	4,3	3,7	3,0	1,8	0,0
ΔL_{σ} typical residential building	4,9	5,9	4,6	6,6	8,4	10,8	11,4	13,0	16,6	19,7	21,2	20,2	21,2
L_a (dB/km)	0,0	0,0	0,0	0,0	0,02	0,03	0,05	0,07	0,11	0,17	0,3	0,38	0,55

To assess the total low-frequency noise level generated by each source across the entire low-frequency spectrum, the calculated noise level for each 1/3-octave centre frequency is summed using the following equation:

$$L_{pALF,tot} = 10 * log \sum 10^{\frac{L_{pALF,i}}{10}}$$

The total noise level from multiple wind turbines is calculated using the following equation:

$$L_{total} = 10 * \log(10^{\frac{L_{p1}}{10}} + 10^{\frac{L_{p2}}{10}} + \ldots)$$

Information on the noise emission data is summarised in Tables 3.1.13 – 3.1.17.

Table 3.1.13. Low-frequency noise emission data of Vestas V172 – 7.2 MW, dB(A)[46]

Blade type	Wind speed	1/3 octave band centre frequency, Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
ST	6 m/s	51.3	56.1	61.0	65.8	71.1	75.9	80.0	85.5	89.7	91.6	93.4	95.3	96.7
ST	8 m/s	53.1	57.8	62.6	67.4	72.7	77.5	81.3	86.5	90.5	92.2	93.7	95.4	96.8
STE	6 m/s	47.5	52.1	56.7	61.3	66.7	71.3	74.9	79.1	82.8	85.2	88.1	90.6	92.1
STE	8 m/s	48.8	53.4	58.1	62.7	67.9	72.6	76.4	81.0	84.9	87.2	89.7	92.0	93.6

Table 3.1.14. Low-frequency noise emission data of Vestas V162 – 7.2 MW, dB(A)[47]

Blade type	Wind speed	1/3 octave band centre frequency, Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
ST	6 m/s	47.9	52.7	57.6	62.4	67.7	72.5	76.7	82.5	87.5	89.0	90.7	92.3	93.6
ST	8 m/s	50.2	55.0	59.8	64.5	69.8	74.6	78.5	83.7	87.6	89.3	91.6	93.2	93.9
STE	6 m/s	44.4	49.4	54.3	59.2	65.1	70.0	73.6	82.0	87.6	88.8	90.7	92.2	91.9
STE	8 m/s	46.8	51.6	56.4	61.2	67.0	71.8	75.2	78.9	86.4	87.7	91.6	93.2	92.9

Table 3.1.15. Low-frequency noise emission data of Siemens Gamesa SG170 – 7.0 MW, dB(A)[48]

Blade type	Wind speed	1/3 octave band centre frequency, Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
ST*	6 m/s	50.8	54.5	58.6	62.3	66.2	69.7	74.0	77.6	80.5	82.5	84.4	88.5	87.5
ST*	8 m/s	50.2	54.4	59.0	63.2	67.7	71.5	76.1	80.7	83.6	85.8	87.6	90.2	89.5

**Information on STE is not available*

Table 3.1.16. Low-frequency noise emission data of Nordex N175 – 7.0 MW, dB(A)[49]*

[46] WindPRO Technical Specification No. 0180-4980_V01
[47] WindPRO Technical Specification No. 0180-4981 V00
[48] WindPRO Technical Specification No. REV.1
[49] Technical Specification No. F008_278_A17_EN

Blade type	Wind speed	1/3 octave band centre frequency, Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
ST	6 m/s	59.9	64.7	69.3	72.6	76	77.9	79.1	81.1	85.4	88.1	89.7	92.3	94.3
ST	8 m/s	59.9	64.7	69.3	72.6	76	77.9	79.1	81.1	85.4	88.1	89.7	92.3	94.3
STE	6 m/s	59.4	64.2	68.8	72.1	75.5	77.4	78.6	80.6	84.9	87.6	89.2	91.8	93.8
STE	8 m/s	59.4	64.2	68.8	72.1	75.5	77.4	78.6	80.6	84.9	87.6	89.2	91.8	93.8

**Information on the specific model is not available in WindPRO; therefore, the emission levels used for the calculations were defined based on the technical specifications provided by the manufacturer*

Table 3.1.17. Low-frequency noise emission data of Nordex N163 – 7.0 MW, dB(A)[50]

Blade type	Wind speed	1/3 octave band centre frequency, Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
ST	6 m/s	56.5	61.3	65.9	70.2	73.6	75.9	77.9	79.9	82.9	85.9	88.9	93.9	93.9
ST	8 m/s	56.8	61.6	66.2	70.5	73.9	76.2	78.2	80.2	83.2	86.2	89.2	94.2	94.2
STE	6 m/s	56.5	61.3	65.9	70.2	73.6	75.9	77.9	79.9	82.9	85.9	88.9	91.9	91.9
STE	8 m/s	56.8	61.6	66.2	70.5	73.9	76.2	78.2	80.2	93.2	86.2	89.2	92.2	92.2

In the EIA Report, low-frequency noise calculations were carried out assuming that wind turbines could be installed at all 14 evaluated locations within the wind farm area, assessing the worst-case scenario. As indicated in Section 2 of the Report, the number of turbines could be reduced if the capacity of the transmission network is insufficient to connect all turbines. If the number of turbines is reduced, the noise levels in the vicinity of the park could be lower; however, the impact on each individual residential area will depend on the placement of the remaining turbines.

3.1.3. Environmental noise

3.1.3.1. Description of the existing situation

Although the regulatory framework does not specify a method for assessing compliance with environmental noise limits in areas where both industrial and traffic sources are present, the noise assessment nevertheless evaluated the noise levels generated by traffic sources.

Analysis of the calculation results indicates that in residential areas located directly adjacent to traffic infrastructure, the situation is similar to that observed throughout Latvia, i.e., elevated noise levels are present in these areas. According to the calculations, noise levels exceeding the target values specified in Regulation No. 16 are currently observed in five residential areas located within the railway operational protection zones or "red lines" designated in the territory of Valka city:

- Dzelzceļš 162 km (cadastral number 94880090035) – at night;
- Ezernieki 2 (cadastral number 94880090054) – all day periods;
- Rīgas iela 75 (cadastral number 94010030337) – all day periods;
- Rīgas iela 80 (cadastral number 94010040222) – all day periods;
- Stacija (cadastral number 94880090055) – all day periods.

[50] WindPRO Technical Specification No. F008_277_A06_R12, F008_277_A12_R11, F008_277_A13_R11, F008_277_A14_R11, F008_277_A15_R11, F008_277_A17_R11, F008_277_A19_R11, F008_277_A20_R11, F008_277a_A12_R08, F008_277a_A13_R08, F008_277a_A14_R08, F008_277a_A15_R08,F008_277a_A17_R08, F008_277a_A19_R08, F008_277a_A20_R08

Information on the calculated highest existing environmental noise levels in residential areas located up to 2 km from the potential turbine locations is compiled in original EIA Report (Appendix 2). Noise propagation maps are presented in Figures 3.1.3 – 3.1.5, while original EIA Report Appendix 4 contains noise propagation maps for Sēļi village.

Noise measurement results near the State Social Care Centre "Zemgale" indicate a relatively low noise level. Over a 60-day measurement period, the average noise level during the daytime was 44.4 dB(A), in the evening 41.5 dB(A), and at night 39.2 dB(A). Although there are significant noise sources near the social care centre – the national primary road A3 and the Riga – Valka railway line – the average noise level is not high and remains well below the applicable noise limits for social care facility areas. Based on the measurement results, the day – night equivalent noise level (L_{den}) was also calculated, reaching 46.9 dB(A) when assuming continuous noise source activity throughout the year.

A detailed analysis of the data and audio signals clearly indicates that the main source of noise at the measurement site is traffic on the national primary road A3. Periodically, noise from other local sources and railway traffic can also be identified, but these additional sources are overall considered minor. Noise level modeling similarly indicates that the dominant environmental noise source near the social care centre is the A3 road, while noise from other sources is substantially lower. Comparison of the calculated results with the measured data shows that the calculated noise levels are slightly higher than the measurements; specifically, at the measurement point, the calculated noise level during the daytime is 45.8 dB(A), in the evening 43.9 dB(A), and at night 41.1 dB(A).

It should be noted that during the measurement period, conditions were observed that suggest background noise levels could be higher at other times. A stable snow cover formed around Valka at the beginning of 2026. Measurement results during periods with snow are on average 3 – 5 dB(A) lower than during snow-free periods. Low wind speeds also affected the measurement results; during snow-free periods, the average wind speed was approximately 0.75 m/s higher than during periods with snow. Overall, it should be noted that the average wind speed during the measurements was low. These two factors are the main reason why noise levels measured in December were higher than those in January and February. Analysis of the results in the context of economic activity periods – weekdays and weekends – did not reveal significant differences. It should also be noted that measurements were taken during periods with low animal-generated noise. During the vegetation season, background noise levels would clearly be higher due to sounds generated by birds and insects.

A detailed data analysis revealed an overall close correlation between wind speed and noise levels in the low-frequency range. Specifically, as wind speed increases, the noise level in the low-frequency range also increases, while the correlation between high-frequency noise levels and wind speed is weak. From the collected measurement data set, periods were selected when the wind speed at the nearest meteorological observation station was 6 and 8 m/s, with particular attention paid to low-frequency noise levels. Table 3.1.18 presents the measured noise levels in the low-frequency range at specific wind speeds.

Table 3.1.18. Measured noise levels in the low-frequency range

Balance	Wind speed	1/3 octave band centre frequency, Hz												
		10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
LIN	6 m/s	64.4	63.4	62.2	60.9	59.4	57.5	55.4	53.2	50.0	46.4	43.8	41.4	40.1
LIN	8 m/s	69.6	68.4	67.2	65.9	64.5	62.7	60.7	58.2	55.2	51.8	48.7	45.8	43.5
A	6 m/s	-6.0	0.0	5.5	10.4	14.7	18.1	20.8	23.0	23.8	23.9	24.7	25.3	26.7
A	8 m/s	-0.8	5.0	10.5	15.4	19.8	23.3	26.1	28.0	29.0	29.3	29.6	29.7	30.1

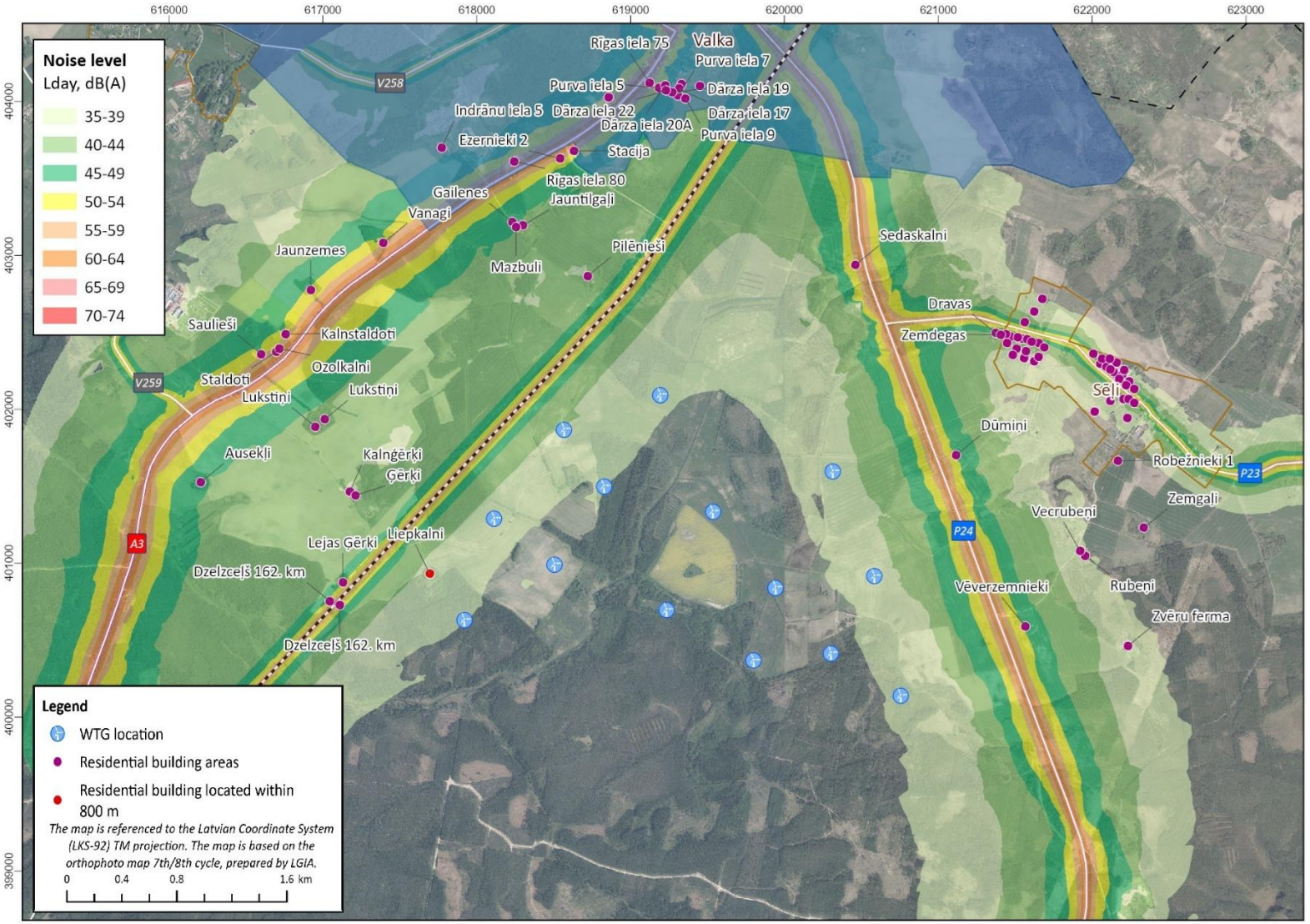


Figure 3.1.3. Traffic-generated noise levels in the vicinity of the planned project area for the daytime environmental noise indicator (L_{day})

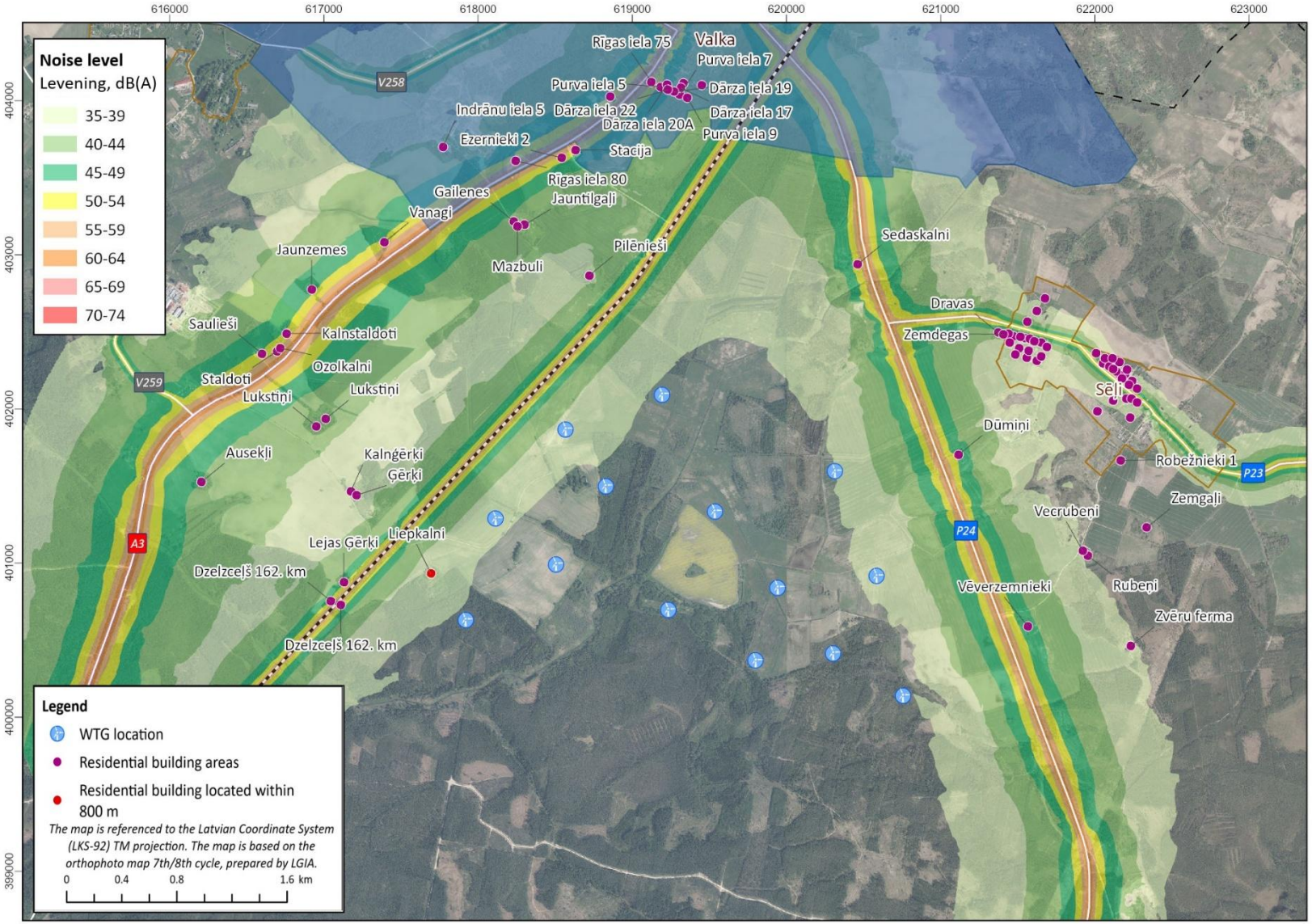


Figure 3.1.4. Traffic-generated noise levels in the vicinity of the planned project area for the evening environmental noise indicator ($L_{evening}$)

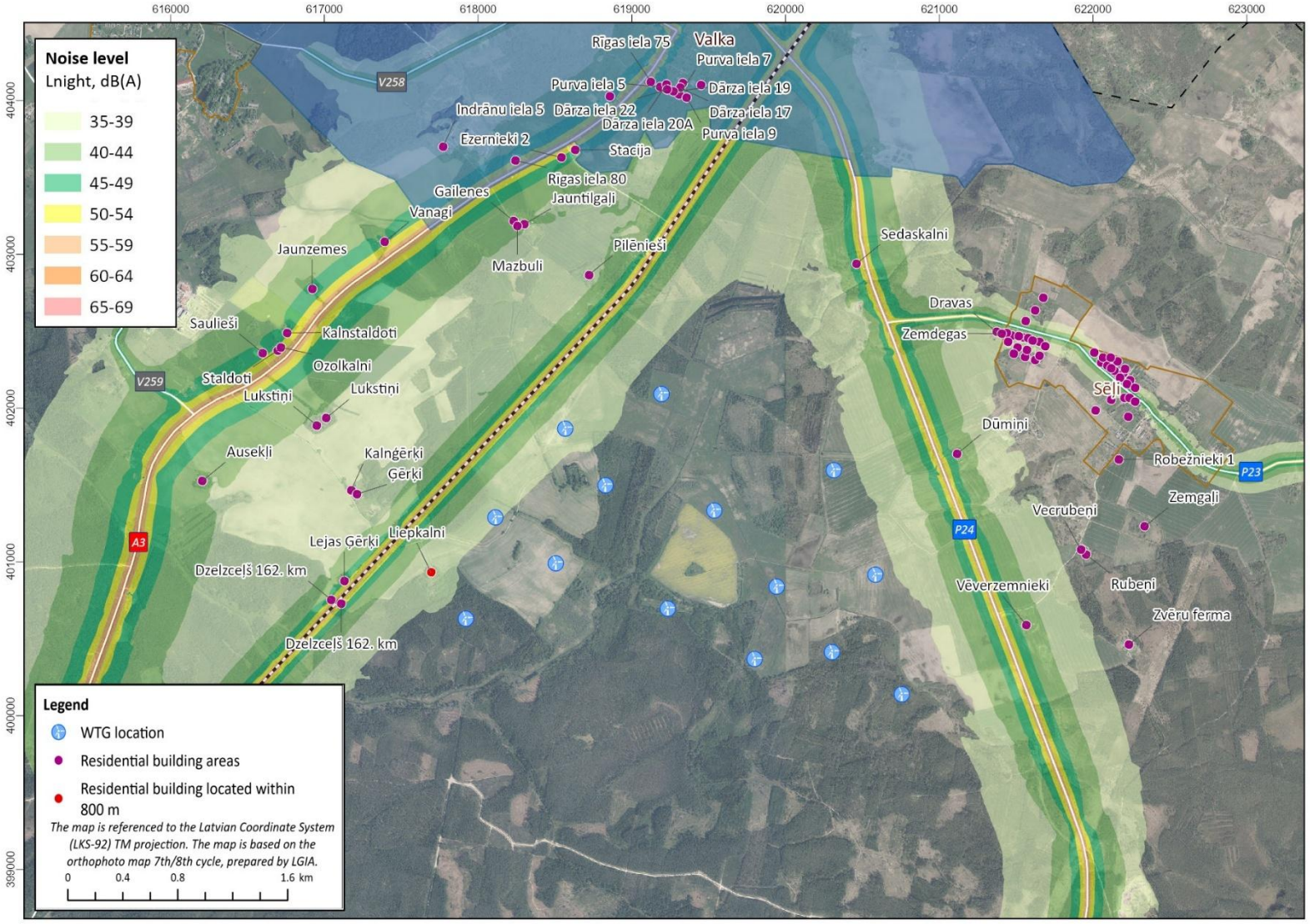


Figure 3.1.5. Traffic-generated noise levels in the vicinity of the planned project area for the night environmental noise indicator (L_{night})

3.1.3.2. Impact during wind turbine construction

The construction of the "Valka" wind park is planned to be completed over approximately two years. Considering that the park construction is planned to be carried out gradually in stages, the noise associated with the wind park construction processes can be described as intermittent. Since no regulatory noise limits apply to construction noise in Latvia, and given the significant uncertainties related to the planned works, construction volumes, and the emissions and characteristics of the noise sources involved, the environmental noise generated during construction is not quantitatively assessed in the EIA Report. Instead, the Report provides an assessment of the most significant noise sources or processes and their potential impacts.

During the assessment of the planned wind park construction process, the following construction stages were identified as associated with increased noise levels:

- Site preparation;
- Access road and assembly area construction;
- Rearrangement of drainage systems;
- Installation of utility lines;
- Wind turbine foundations construction;
- Wind turbine delivery;
- Wind turbine installation;
- Site reclamation.

The stages of site preparation, drainage system rearrangement, installation of utility lines, wind turbine installation, and site reclamation are primarily related to the operation of specific machinery units at designated construction sites. Conversely, access road and assembly area construction, wind turbine foundations construction, and wind turbine delivery are associated with a significant increase in traffic intensity in the vicinity of the planned project area.

According to the information provided by the developer, in order not to disturb residents at night, construction works within the planned project area are mostly planned to be carried out during daytime (the exact construction schedule will be coordinated with the building authority during the design phase). Although the majority of construction works are planned to be carried out without disturbing residents at night, there is still a possibility that some activities may be performed at night. For example, wind turbine installation is possible only under certain wind conditions. Therefore, if the installation of wind turbines under suitable meteorological conditions is not possible during daytime, it may be carried out at night. It should be noted that conducting construction works at night will be an activity in exceptional circumstances, rather than a general practice for park construction. Likewise, the delivery of certain wind turbine components will most likely be performed at night to minimize disruptions from transporting oversized loads on regular traffic.

The developer anticipates that the noise emission limit values of the equipment used during construction works will not exceed the noise emission limit for equipment specified in Annex 2 of the Cabinet of Ministers Regulation No. 163 of 23 April 2002 "Regulations Regarding the Emission of Noise from Equipment Used Outdoors".

Considering the overall planned duration of construction works, the location of the most significant construction sites relative to residential areas, the timing of construction works, and the noise emission limits of the machinery used, the noise generated during construction works within the planned project area or related to the installation of power transmission lines is assessed as a temporary or intermittent disturbance, which is not expected to cause a significant impact on public health.

According to the information provided in Section 2 of the Report, during the construction of the wind park, AADT of trucks could reach up to 42 trucks and 15 passenger cars (assuming all material transport is carried out along a single route). It should be noted that traffic intensity will not be uniform; on some days it may be significantly lower, whereas on days when a substantial volume of material deliveries is carried out, it may be higher.

The increase in traffic intensity associated with the construction of the wind park will clearly temporarily increase noise levels in the vicinity of roads near the planned wind park. Evaluating the information on existing traffic intensity and the traffic intensity related to the construction process, it is expected that both the A3 main road (Inčukalns – Valmiera – Estonian border) and the regional road P24 (Smiltene – Valka) near the construction site (assuming all transportation is carried out on one of these roads) could experience an increase in the long-term average daytime noise level of approximately 0.5 dB(A) during the construction period. A higher increase in noise levels would be observed near regional road P24 if all cargo were transported via that road, as the traffic intensity on the regional road is currently significantly lower than on the main road; therefore, a significant increase in traffic intensity quantitatively results in a larger change in noise levels.

3.1.3.3. Impact during wind turbine operation

The environmental noise level generated by the wind turbines has been calculated for 83 residential areas located within 2 km of the planned "Valka" wind park. According to the calculation results, in the planned wind park, installing the loudest WTG model assessed in the EIA process, Vestas V172 – 7.2 MW with standard blades, the noise level generated during park operation will not exceed the environmental noise limits set out in Regulation No. 16. According to the calculation results, the highest noise level is expected to occur in the residential building area "Dūmiņi" (cadastral designation of residential building 94880100148001), where during the daytime period it could reach 41 dB(A), and during the evening and night periods 42 dB(A). Information on the calculated maximum WTG generated noise level for the park area when installing the Vestas V172 – 7.2 MW with standard blades is compiled in Table 3.1.20, while noise dispersion maps are shown in Figures 3.1.6 – 3.1.10.

The assessment also evaluated the L_{AeqT} noise indicator, which was used in this assessment to characterize the noise level with all WTG operating at nominal power. According to the calculation results, at maximum load, regardless of the time of day, the highest noise level in the residential building area "Dūmiņi" would reach 44 dB(A).

Evaluating compliance with the WHO recommended limit for environmental noise L_{den}, it was concluded that when the loudest WTG model Vestas V172 – 7.2 MW with standard blades is installed, the WHO recommended limit would be exceeded in eight residential areas:

- Dūmiņi (cadastral designation of residential building 94880100148001);

- Dzelzceļš 162 km (cadastral designation of residential building 94880090035 and 94880090123);
- Ģērķi (cadastral designation of residential building 94880090023001);
- Kalnģērķi (cadastral designation of residential building 94880090011001);
- Lejas Ģērķi (cadastral designation of residential building 94880090006001);
- Pilēnieši (cadastral designation of residential building 94880090057001);
- Vēverzemnieki (cadastral designation of residential building 94880100052001).

To ensure the delivery of electricity generated by the wind park to the grid, a high-voltage substation and BESS are planned to be built along the 110 kV transmission line Valmiera – (EST) Tsirguliina. The developer has not yet selected the technical solution for the substation and BESS but has identified two potential construction site alternatives:

- Alternative A: land plot "Jaunolīši" (cadastral designation 94880100262);
- Alternative B: land plot "Jaunpilēnieši" (cadastral designation 94880100070);
- Alternative C: land plot "Jaunosīši" (cadastral designation 94880100262).

Within the EIA process, based on the current land use plan and information on the distance to residential buildings registered in portal of State Land Service, the permissible noise level at the boundary of the substation and BESS has been determined, taking into account the tonal nature of the transformer noise (+5 dB(A) correction). Information on the calculation results is compiled in Table 3.1.19.

3.1.19. Table. Permissible substation and BESS noise levels

Parameter	Substation alternative		
	A	B	C
Distance to the nearest residential development area, m	302	512	648
Permissible noise level, dB(A)	59	65	64

When choosing the construction site, as well as planning the substation and BESS technical solution, the developer must take into account that the calculation performed within the EIA process is indicative, and the actual noise emission level may depend on the location of sources within the site. To ensure that the noise level generated by the substation and BESS does not exceed the national environmental noise limit values, detailed environmental noise modeling must be carried out during the design phase, when the exact location of noise sources and their generated noise levels are known. This should include taking into account the planned operation of the wind turbines and other industrial-type objects in the surrounding area.

3.1.20. Table. Highest calculated noise level in residential areas located near the "Valka" wind park

Cadastral designation of the land unit	Property name	Noise assessment location	Noise limit value (traffic)			Existing noise level			Noise limit value (industrial sources)			Noise level generated by wind turbines				
			L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	$L_{AeqT\ (NOM)}$***	L_{den}
94880090025001	Ausekļi	F	65	60	55	47	45	42	55	50	45	32	33	33	36	40
94880100185	Bajāri	TP - DZs				42	40	36				36	36	36	39	43
94010030209	Cimzes iela 28	TP - DZs				44	42	41				31	32	32	35	38
94010030216	Dārza iela 15	TP - DZs				46	44	42				31	32	32	35	38
94010030215	Dārza iela 17	TP - DZs				47	45	43				31	32	32	35	39
94010030214	Dārza iela 19	TP - DZs				47	45	43				32	33	33	35	39
94010030334	Dārza iela 20A	TP - DZs				53	50	46				31	32	32	35	38
94010030335	Dārza iela 22	TP - DZs				50	48	45				32	33	33	35	39
94880100054	Dārziņi	TP - DZs				37	36	33				35	36	36	38	42
94880100029	Dravas	TP - DZs				54	52	46				36	37	37	40	44
94880100148001	Dūmiņi	F				52	49	45				41	42	42	44	48
94880090035	Dzelzceļš 162. km	AT				59	58	57				39	40	40	43	47
94880090123	Dzelzceļš 162. km	AT				57	56	55				40	40	41	43	47
94880100197	Dzeņi	TP - DZs				41	39	35				35	36	36	39	43
94880090092	Gailenes	AT				47	45	42				37	37	37	40	44
94880090023001	Ģērķi	F				41	39	38				40	41	41	43	47
94880100193	Gravas	TP - DZs				53	50	45				36	37	37	40	43
94880090122	Jauntilgaļi	AT				46	44	41				37	38	38	41	44
94880090063001	Jaunzemes	F				51	50	47				34	34	35	37	41
94880090011001	Kalnģērķi	F				41	39	37				39	40	40	43	47
94880090062001	Kalnstaldoti	F				56	53	50				34	35	35	37	41
94880100189	Kastaņas	TP - DZs				57	55	49				35	36	36	39	42
94880100219	Ķirši	TP - DZs				54	51	46				33	34	34	37	40
94880100188	Kristāli	TP - DZs				53	51	45				35	36	36	39	43

Cadastral designation of the land unit	Property name	Noise assessment location	Noise limit value (traffic)			Existing noise level			Noise limit value (industrial sources)			Noise level generated by wind turbines				
			L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{AeqT} (NOM)***	L_{den}
94880100214	Lati	TP - DZs				41	39	35				33	33	34	36	40
94880100196	Latiņi	TP - DZs				53	51	45				36	37	37	39	43
94880090006001	Lejas Ģērķi	F				52	51	50				40	41	41	43	47
94880090010001	Liepkalni	F				39	38	37				46	47	47	50	53
94880100217	Līvas	TP - DZs				57	55	49				33	34	34	37	41
94880090014001	Lukstiņi	F				44	42	40				37	38	38	40	44
94880090014002	Lukstiņi	F				44	42	39				37	38	38	40	44
94880100279	Māja 13	TP - DZs				56	53	48				32	33	33	36	39
94880100259	Māja 18	AT				59	57	51				33	34	34	36	40
94880100118	Māja 20	TP - DzM				59	57	51				33	34	34	37	40
94880100254	Māja 22	TP - DzM				53	50	44				33	34	34	37	41
94880100213	Mālkalni	TP - DZs				57	55	49				33	34	34	37	41
94880100305	Mālkalni	TP - DZs				58	55	50				34	34	34	37	41
94880090101	Mazbuli	AT				46	44	41				37	38	38	40	44
94880100220	Mediņi	TP - DZs				55	53	47				33	34	34	37	40
94880100229	Mežvīni 1	TP - DZs				55	53	47				33	34	34	37	40
94880100228	Mežvīni 2	TP - DZs				47	44	39				32	33	33	36	39
94880100221	Niedras	TP - DZs				56	54	48				33	34	34	37	40
94880100194	Noras	TP - DZs				40	38	35				36	37	37	40	43
94880100009	Oši	TP - DZs				57	55	49				35	36	36	39	43
94880090120001	Ozolkalni	F				60	58	53				34	35	35	37	41
94880100181	Paksīši	TP - DzM				45	42	37				34	35	35	37	41
94880090057001	Pilēnieši	F				40	39	38				40	41	41	44	47
94880100013	Pīnas	TP - DZs				54	52	46				35	36	36	39	42
94880100218	Plūmes	TP - DZs				56	54	48				33	34	34	37	41

Cadastral designation of the land unit	Property name	Noise assessment location	Noise limit value (traffic)			Existing noise level			Noise limit value (industrial sources)			Noise level generated by wind turbines				
			L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{AeqT} (NOM)***	L_{den}
94010030336	Purva iela 5	TP - DZs				55	52	48				32	33	33	35	39
94010030213	Purva iela 7	TP - DZs				45	43	42				32	33	33	36	39
94010030212	Purva iela 9	TP - DZs				44	43	41				32	33	33	36	39
94880100169	Riekstiņi	TP - DZs				54	51	46				35	36	36	39	42
94010030337	Rīgas iela 75	TP - DZs				69	66	61				32	32	33	35	39
94010040221	Rīgas iela 90	AT				62	59	55				32	33	33	36	39
94880100186	Ritas	TP - DZs				53	50	45				36	36	36	39	43
94880100123001	Robežnieki 1	F				34	33	31				34	35	35	38	41
94880100053007	Rubeņi	F				37	35	32				37	37	37	40	44
94880100216	Rudzīši	TP - DZs				45	43	37				33	33	33	36	40
94880090027001	Saulieši	F				56	53	49				33	34	34	37	40
94880100013016	Saulītes	F				36	35	32				33	34	34	37	41
94880100255001	Sedaskalni	F				57	55	50				37	38	38	41	44
94880100311	Sēļi	TP - DzS				60	57	51				34	35	35	38	41
94880100040	Sieti (pagasta)	TP - DZs				42	40	36				36	37	37	40	43
94880100184	Sietiņi	TP - DZs				53	50	45				36	37	37	40	43
94880090104001	Staldoti	F				60	57	52				34	34	34	37	41
94880100265	Starpgabals	TP - DZs				46	44	39				33	34	34	37	40
94880100215	Sviestiņi	TP - DZs				41	39	35				32	33	33	36	39
94880100222	Taigas	TP - DZs				55	52	47				33	34	34	37	40
94880090028001	Vanagi	F				57	55	50				34	35	35	38	42
94880100053001	Vecrubeņi	F				37	35	32				37	38	38	40	44
94880100052001	Vēverzemnieki	F				50	48	43				40	41	41	43	47
94880100314	Vidiņi	TP - DZs				39	37	35				36	36	37	39	43
94880100195	Vīteņi	TP - DZs				42	39	36				36	37	37	40	43

Cadastral designation of the land unit	Property name	Noise assessment location	Noise limit value (traffic)			Existing noise level			Noise limit value (industrial sources)			Noise level generated by wind turbines				
			L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	$L_{AeqT\ (NOM)}$***	L_{den}
94880100187	Zeltiņi	TP - DZs				58	55	50				35	36	36	39	43
94880100096	Zemdegas	TP - DZs				53	50	45				36	37	37	40	43
94880100025001	Zemgaļi	F				32	30	28				34	35	35	37	41
94880100199	Zemītes	TP - DZs				40	38	35				36	37	37	40	43
94880100154	Zvēru ferma	AT				39	37	34				36	36	37	39	43
94880090054	Ezernieki 2	TP - P				68	66	60				35	36	36	38	42
94010040224	Indrānu iela 5	TP - P				46	44	41	60	55	55	33	34	34	37	40
94010040222	Rīgas iela 80	TP - P				66	63	58				34	35	35	38	41
94880090055	Stacija	TP - P				68	66	60				35	35	35	38	42

**The noise level was determined as follows: (TP) – according to the functional zoning of the territory plan; (F) – at a distance of 2 m from the facade; (AT) – noise level measured in the development area.*

***Residential development areas located closer than 800 m to the wind turbine construction locations assessed within the EIA are highlighted in grey.*

**** $L_{Aeq,T\ (NOM)}$) – noise level in dB(A) with all wind turbines operating at nominal power*

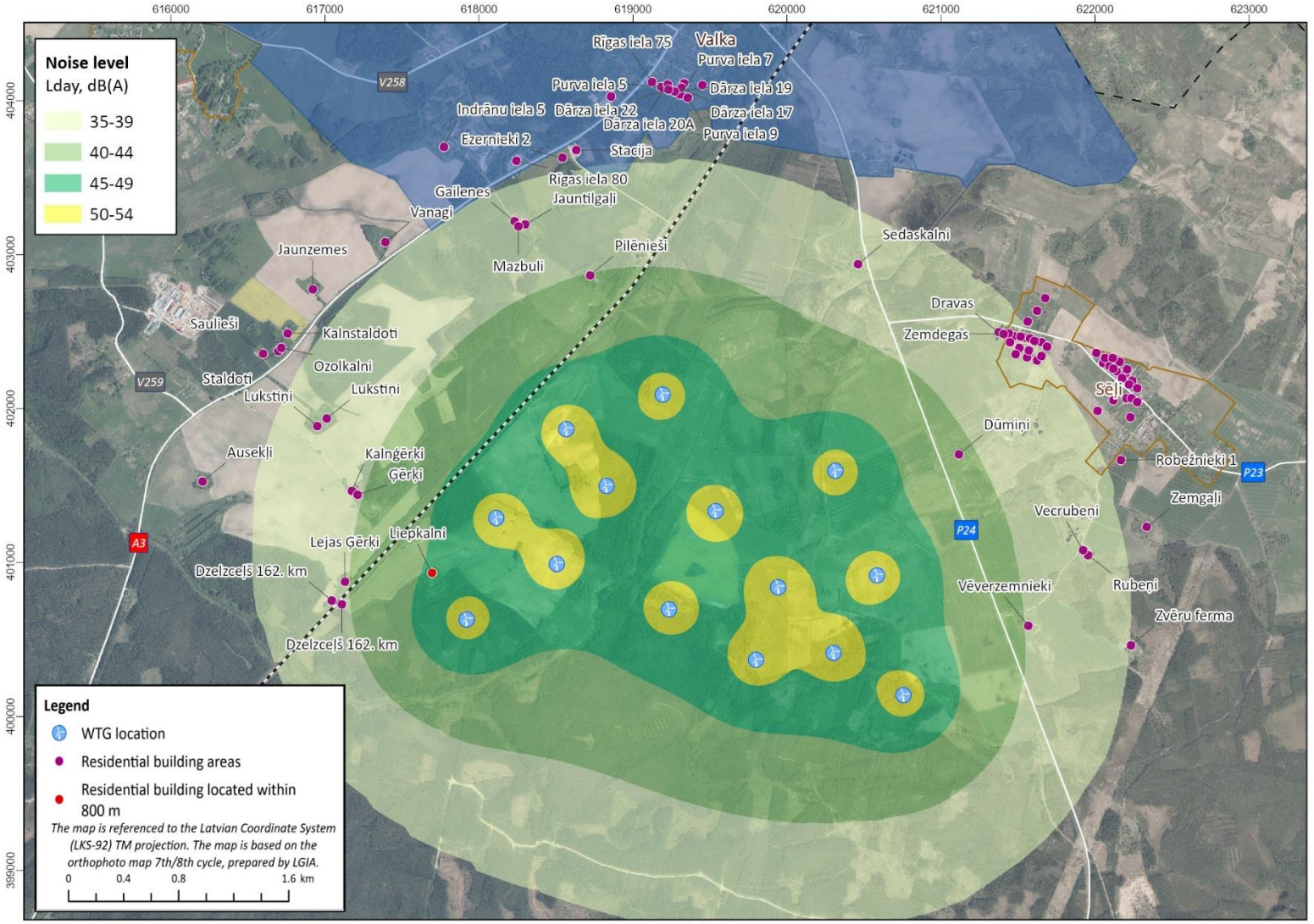


Figure 3.1.6. Noise level generated by Vestas V172 – 7.2 MW wind turbines in the vicinity of the planned project area for the daytime environmental noise indicator L_{day}

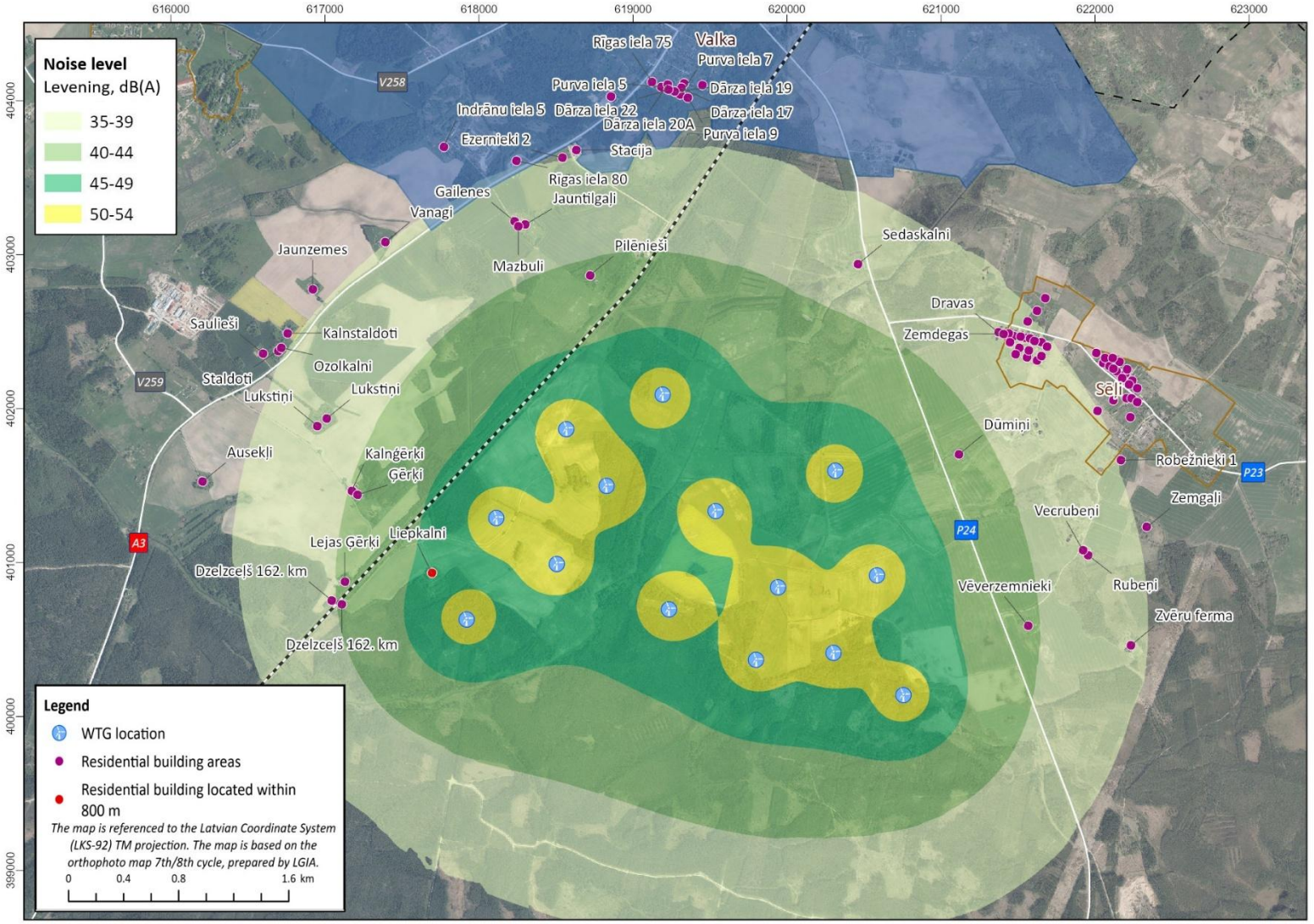


Figure 3.1.7. Noise level generated by Vestas V172 – 7.2 MW wind turbines in the vicinity of the planned project area for the evening environmental noise indicator $L_{evening}$

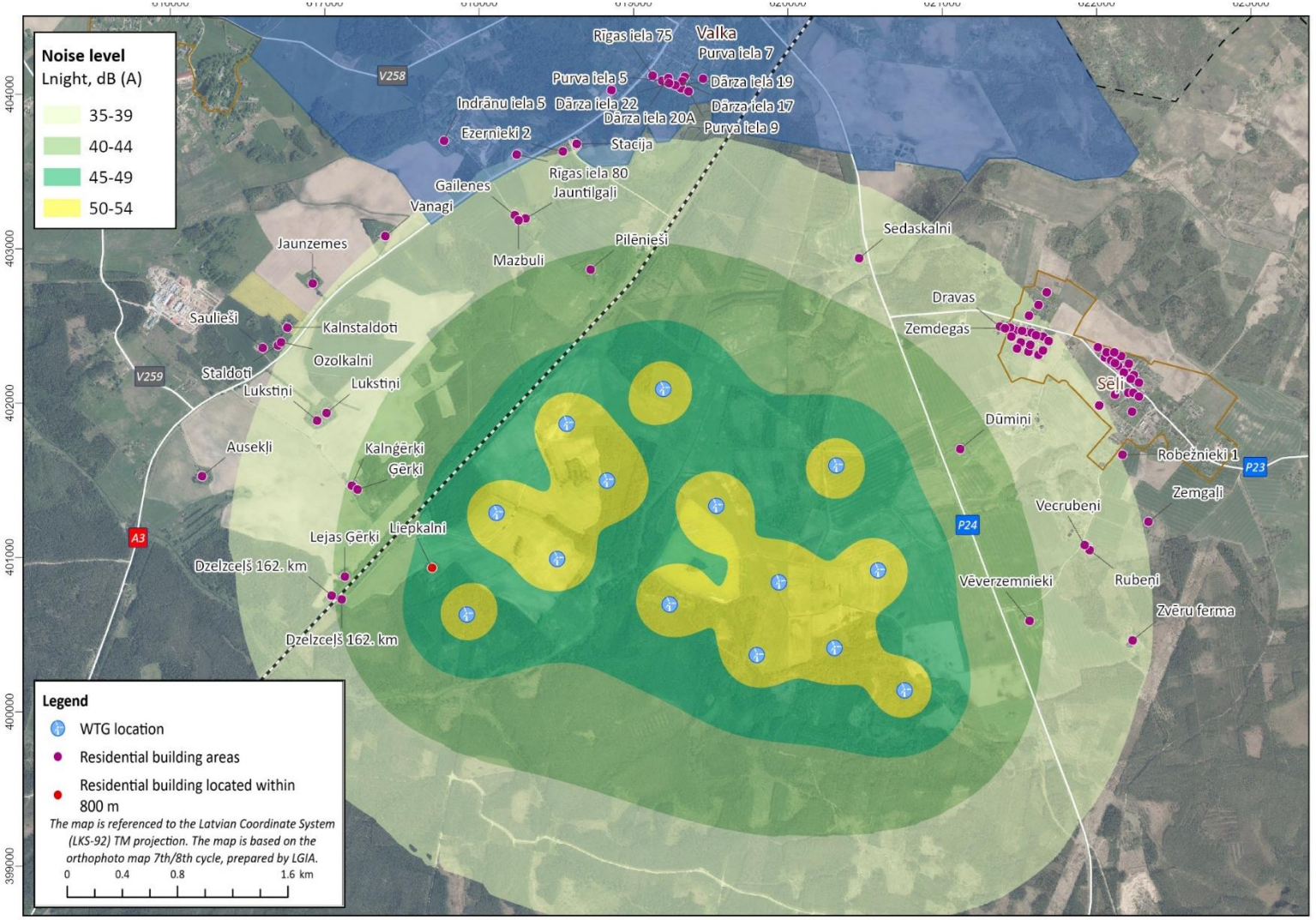


Figure 3.1.8. Noise level generated by Vestas V172 – 7.2 MW wind turbines in the vicinity of the planned project area for the night environmental noise indicator L_{night}

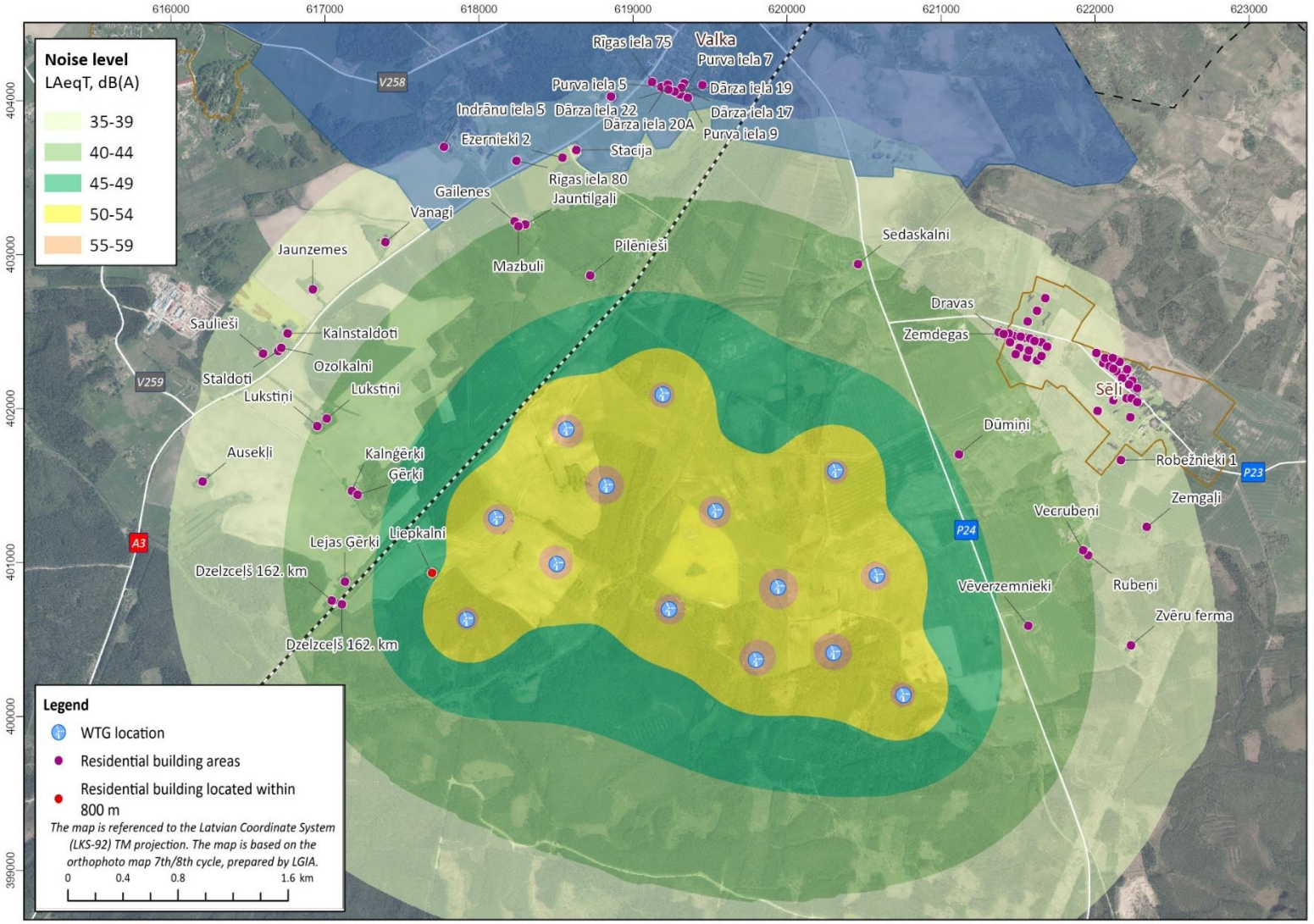
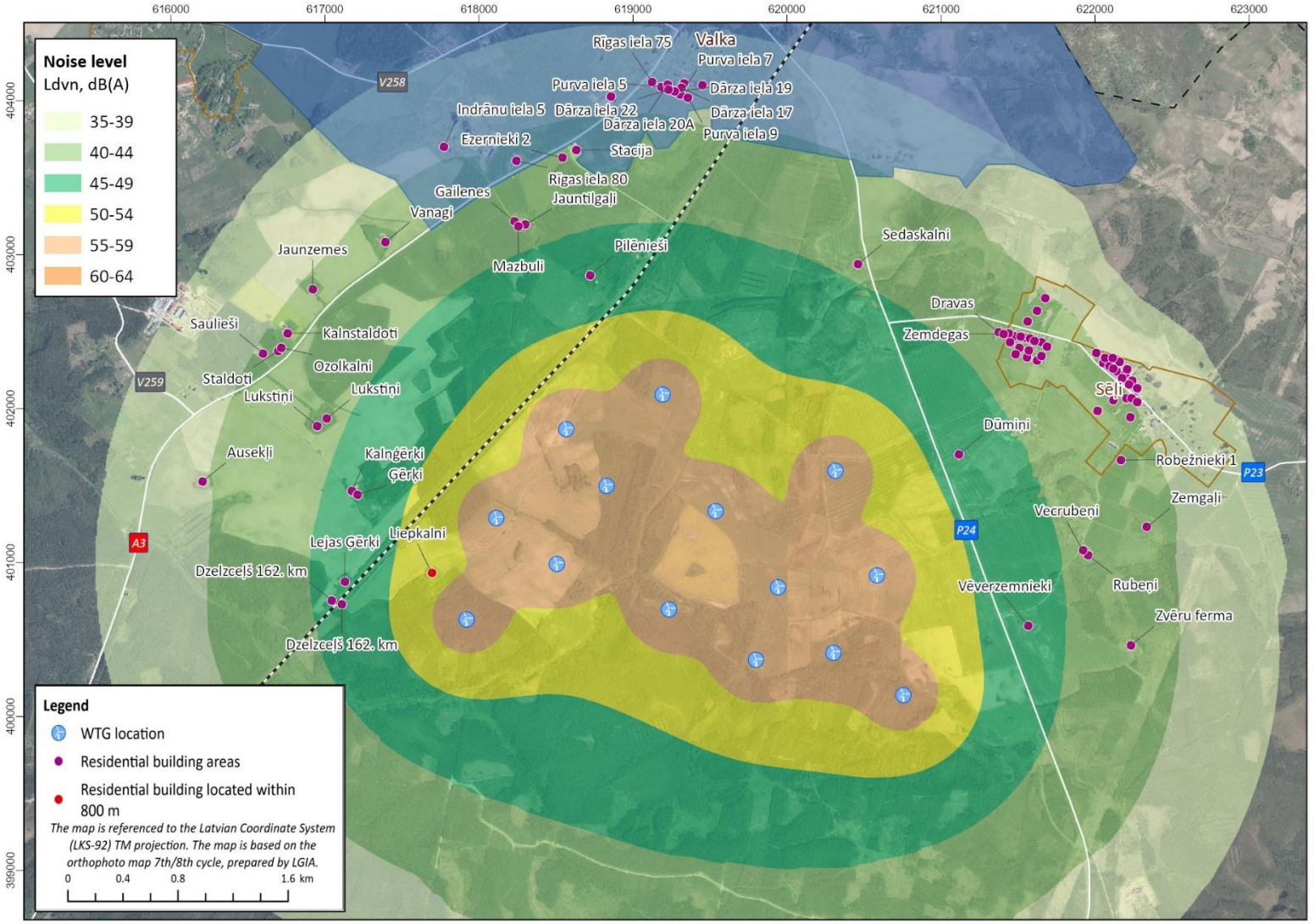


Figure 3.1.9. Noise level generated by Vestas V172 – 7.2 MW wind turbines in the vicinity of the planned project area with all wind turbines operating at nominal capacity



3.1.10. Figure. Noise level generated by Vestas V172 – 7.2 MW wind turbines in the vicinity of the planned project area for the day–night equivalent noise indicator L_{den}

3.1.3.4. Cumulative effects

In accordance with the amendments to Regulation No. 16, which entered into force on 3 November 2023, environmental noise generated by traffic and industrial facilities (which includes wind turbines and substations) has different limit values. Considering that different environmental noise limits apply to residential areas in the vicinity of the "Valka" wind farm, and that current legislation does not provide a procedure for assessing compliance with noise limits in areas where both industrial and traffic sources exist, the evaluation presented here is considered informative.

According to the information on economic activities in the surrounding area provided in the preceding section, the assessment has reviewed permits and certificates regarding noise sources, their conditions, and their location. No significant noise sources were identified that, together with the noise generated by the wind turbines, could pose a risk of exceeding environmental noise limits.

Based on the calculation results, operation of the wind farm could increase the noise level in individual residential areas by 1 – 8 dB(A). However, in areas where currently high environmental noise levels are identified, an increase is not expected. This is because these areas are located close to traffic noise sources – the state main road A3 (Inčukalns – Valmiera – Estonia border, Valka) and the railway. Even after the wind farm is built, the dominant noise source in these areas is expected to remain traffic-generated noise.

According to available information, within a 15 km radius around the "Valka" wind farm, another wind farm is planned – SIA "Latvijas vēja parki" "Valmiera – Valka", which is currently undergoing an EIA. According to publicly available information, the A alternative evaluated in the EIA foresees the construction of 25 wind turbines. The distance between the nearest potential turbine sites in the "Valka" and "Valmiera – Valka" wind farms is slightly over 10 km.

According to the guidelines developed by SES for initial EIA of wind farm construction, a detailed cumulative impact assessment is performed if wind farms are located within 4 km of each other. Considering the location of these two wind farms, it is not expected that significant cumulative impacts will arise in terms of either environmental or low-frequency noise. The overall noise distribution maps for existing background noise (traffic-generated noise) and the wind turbines are shown in Figures 3.1.11 – 3.1.13.

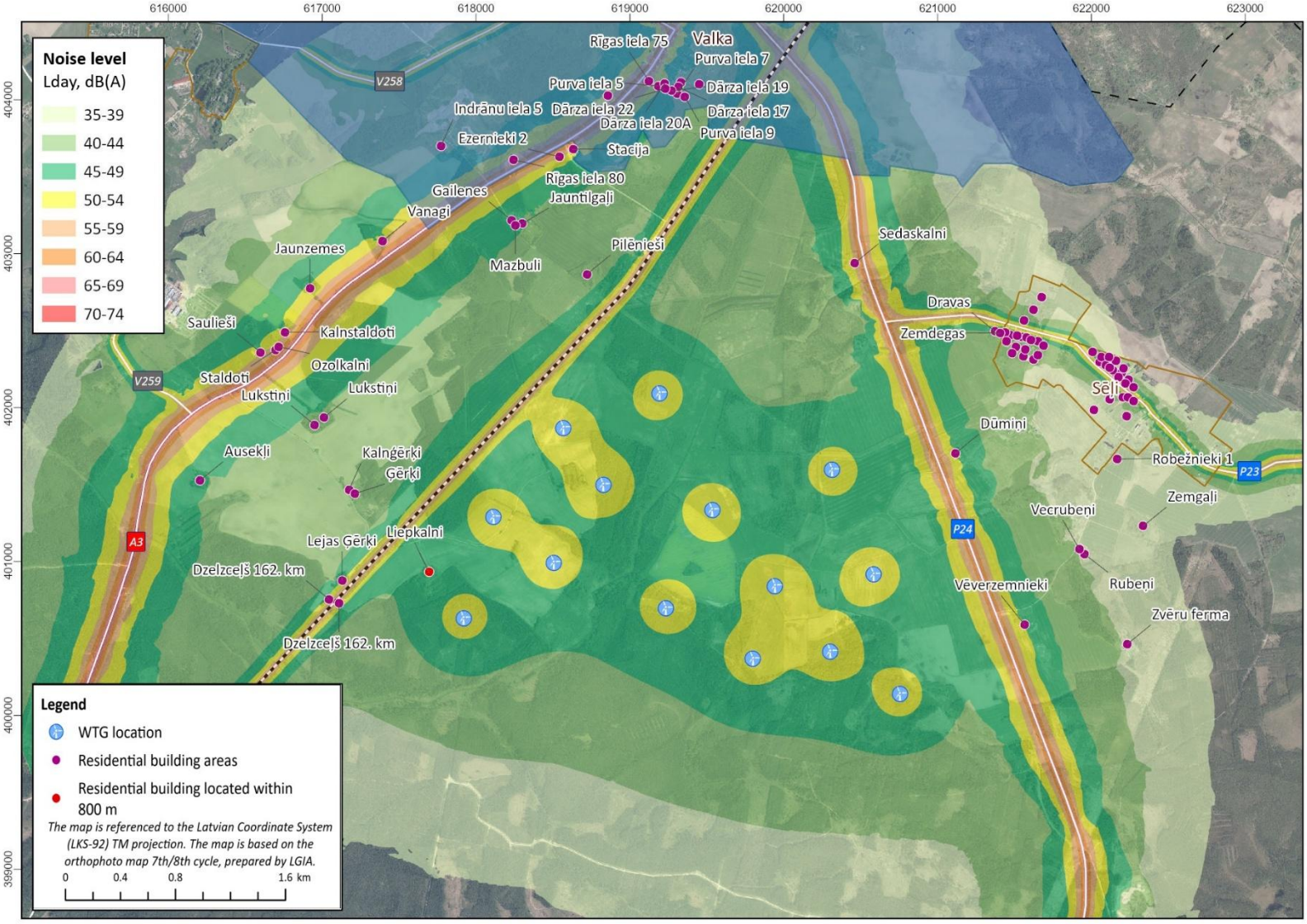


Figure 3.1.11. Total noise level for the L_{day} noise indicator

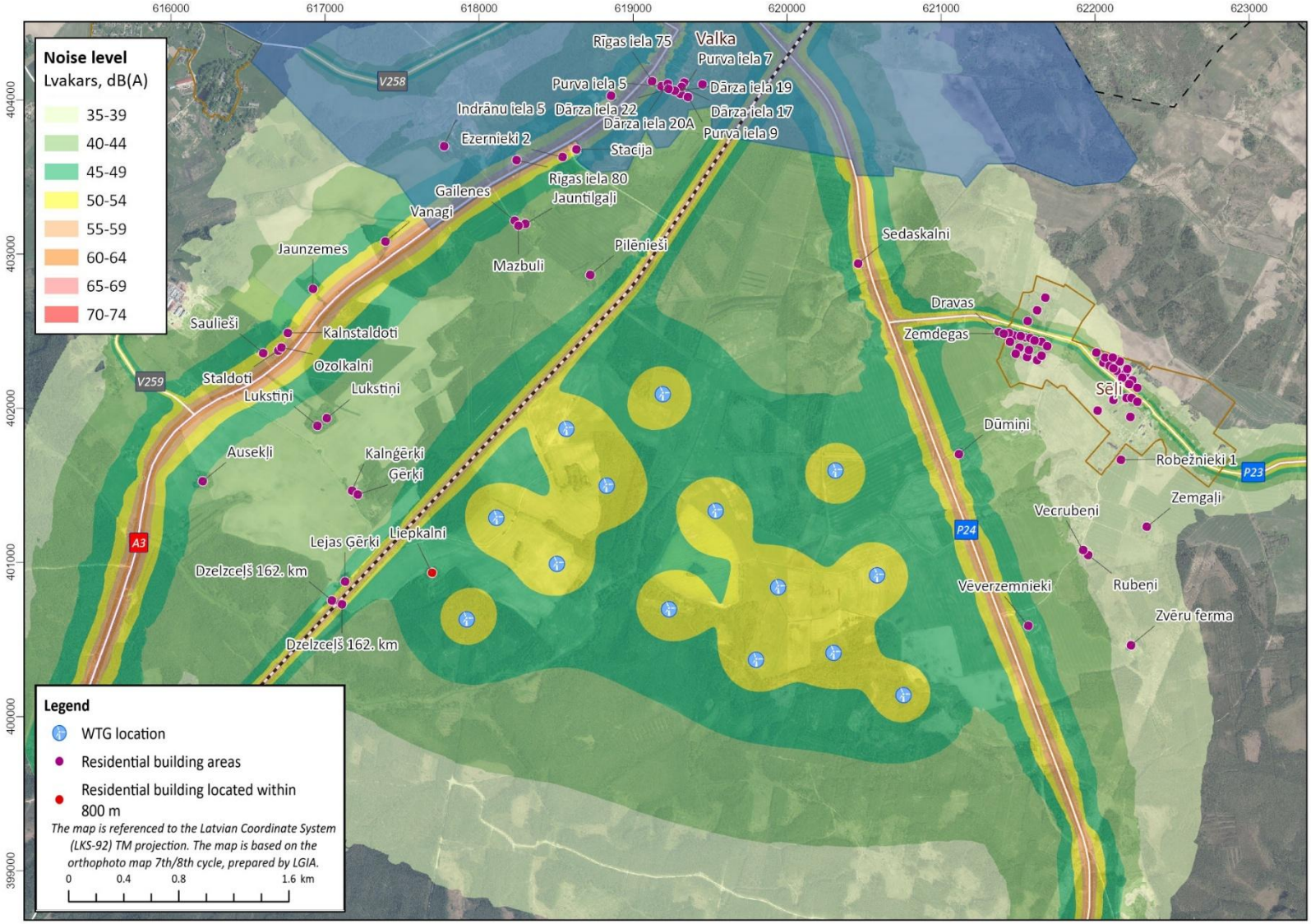


Figure 3.1.12. Total noise level for the $L_{evening}$ noise indicator

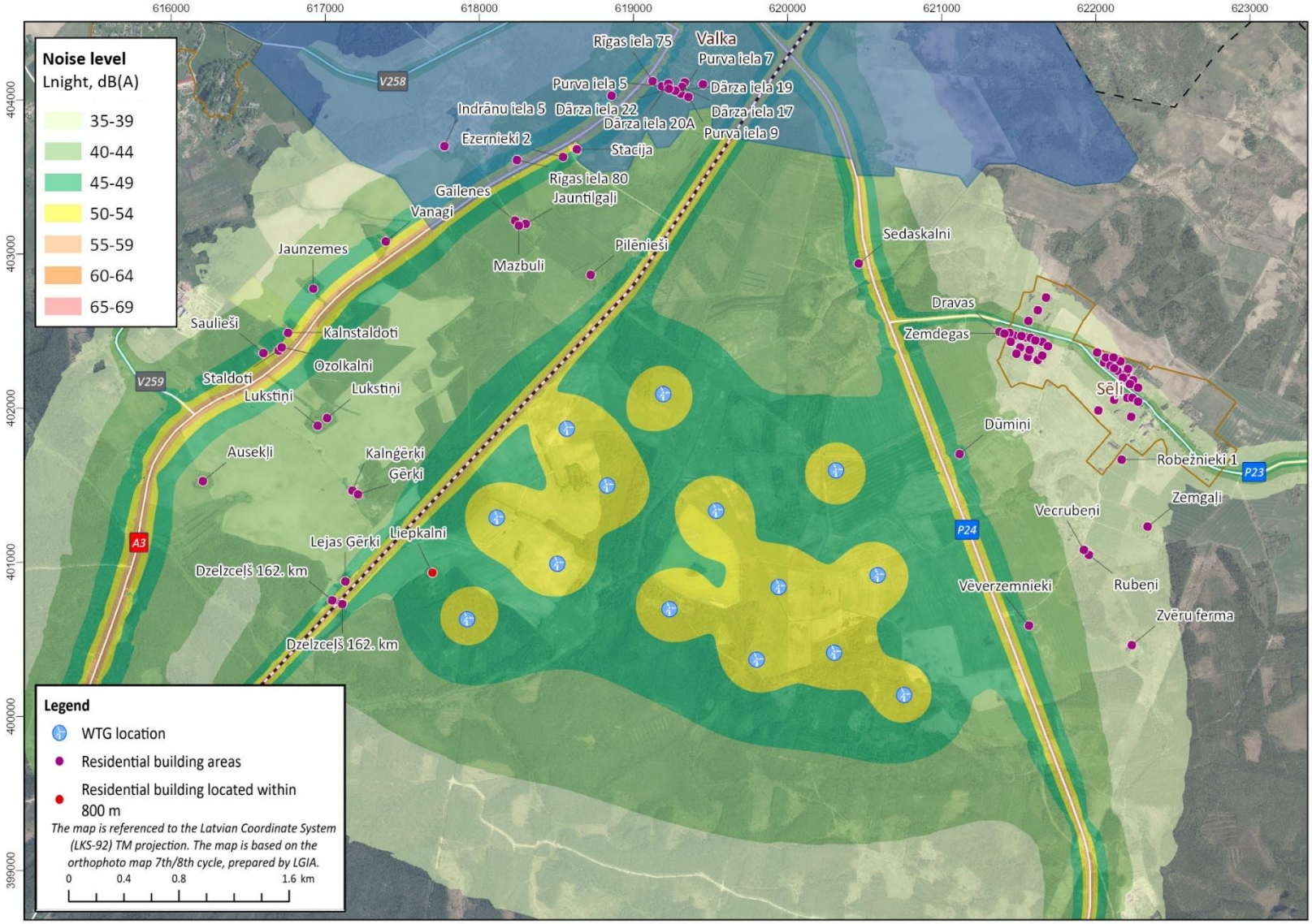


Figure 3.1.13. Total noise level for the L_{night} noise indicator

3.1.4. Low frequency

3.1.4.1. Noise assessment

The low-frequency noise level was overall calculated for 68 residential buildings located within 2 km from the potential wind turbine installation sites in the "Valka" wind farm. Considering that, in the context of total low-frequency noise levels, the noise generated by the wind turbine at a particular frequency may be decisive, the low-frequency noise impact was analyzed for all wind turbine models evaluated in this EIA Report.

According to the calculation results, for a single EIA-evaluated wind turbine model, Vestas V172 – 7.2 MW with standard blades (ST), during operation the 20 dB(A) limit value could be exceeded in seven residential buildings at wind speeds of 6 and/or 8 m/s:

- Dūmiņi (Cad. No. 94880100148001) – reaching 21.8 dB(A);
- Pilēnieši (Cad. No. 94880090057001) – reaching 21.1 dB(A);
- Vēverzemnieki (Cad. No. 94880100052001) – reaching 21.0 dB(A);
- Ģērķi (Cad. No. 94880090023001) – reaching 20.9 dB(A);
- Lejas Ģērķi (Cad. No. 94880090006001) – reaching 20.9 dB(A);
- Kalnģērķi (Cad. No. 94880090011001) – reaching 20.7 dB(A);
- Railway 162 km (Cad. No. 94880090035001) – reaching 20.3 dB(A).

For other wind turbine models evaluated in this EIA, it is not expected that the 20 dB(A) limit value would be exceeded in nearby residential buildings. Information on the highest and lowest predicted low-frequency noise levels for each technological alternative (excluding the "Liepkalni" residential building, which is located closer than 800 m to the potential wind turbine sites) is compiled in Table 3.1.21, while detailed calculation results for residential buildings located within 2 km from the planned wind turbine sites are included in Annex 2. The low-frequency noise distribution map is shown in Figure 3.1.14.

3.1.21. Table. Calculated low-frequency noise levels for wind turbine models evaluated in the EIA

WTG model	Highest noise level	Lowest noise level
	dB(A)	
Vestas V172 - 7.2 MW ST	21,8	15,3
Nordex N175 - 7.0 MW ST	19,3	13,5
Vestas V162 - 7.2 MW ST	19,1	12,4
Nordex N175 - 7.0 MW STE	18,8	13,0
Nordex N163 - 7.0 MW ST	18,4	12,3
Nordex N163 - 7.0 MW STE	17,8	11,8
Vestas V162 - 7.2 MW STE	17,7	11,6
Vestas V172 - 7.2 MW STE	17,2	9,6
Siemens Gamesa SG170 - 7.0 MW ST	15,8	7,6

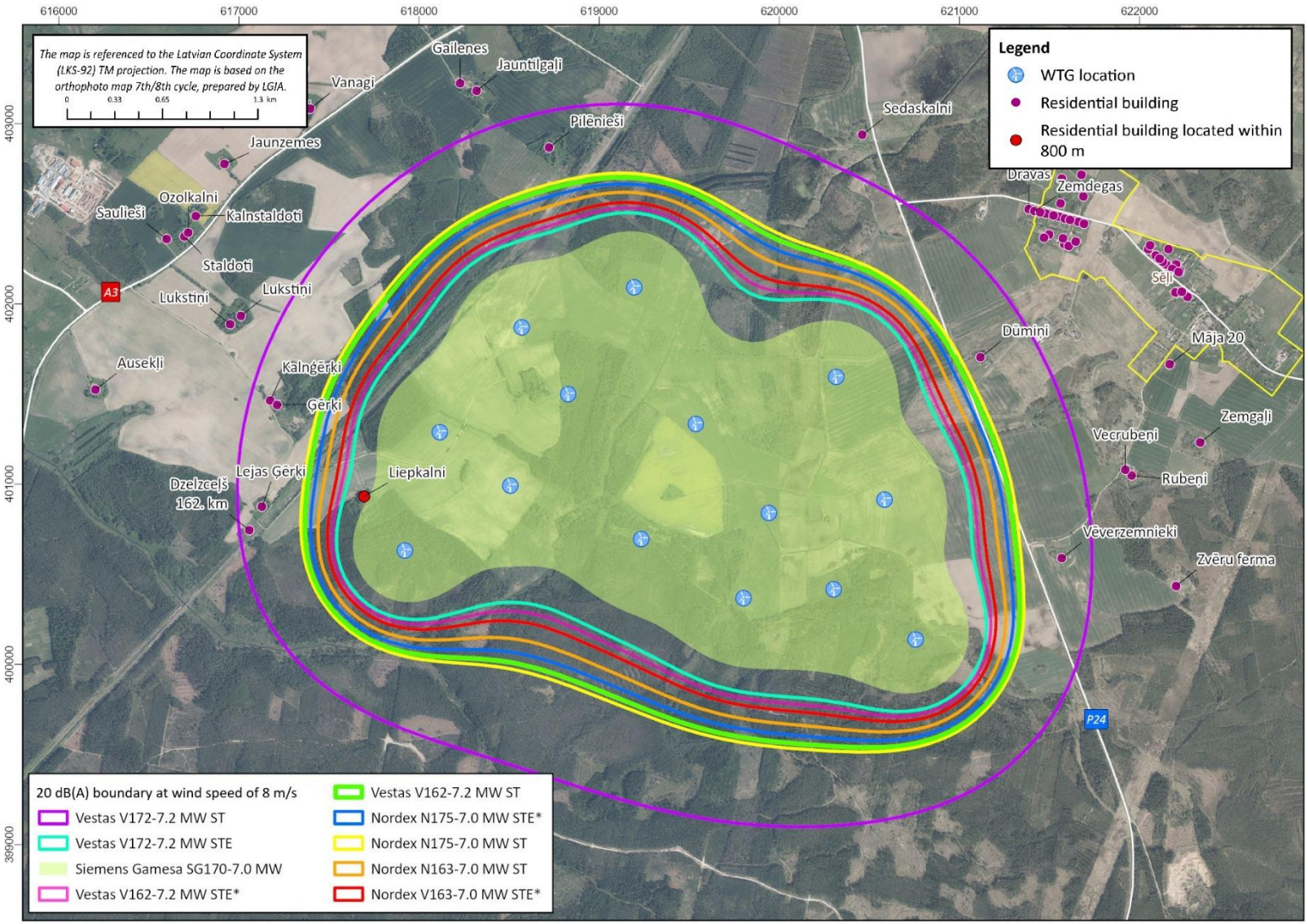


Figure 3.1.14. Low-frequency noise distribution map

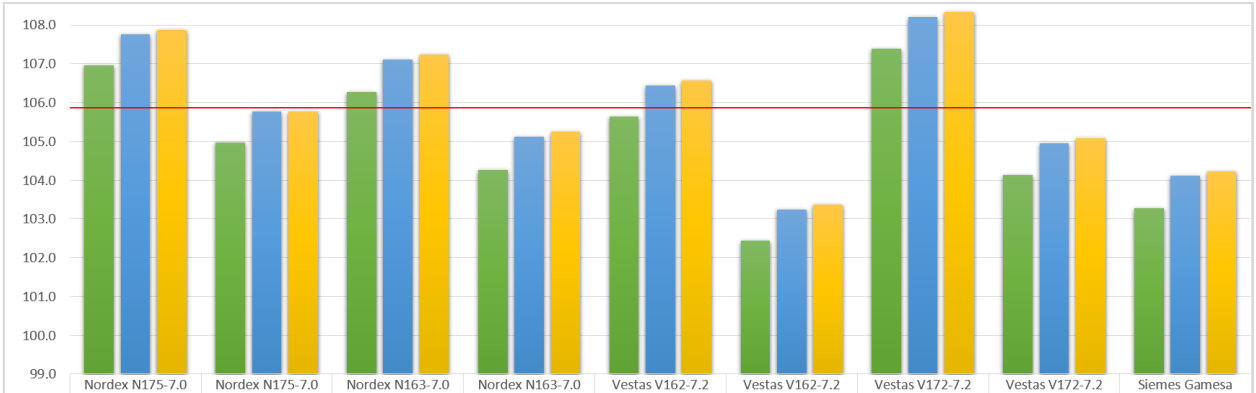
3.1.5. Mitigation measures

The results of the environmental and low-frequency noise calculations indicate that the proposed activity can be implemented while complying with the noise management requirements of Latvia, as well as WHO recommendations on environmental noise. It is also possible to ensure that low-frequency noise in residential buildings does not exceed 20 dB(A). However, the use of certain evaluated wind turbine models would not ensure compliance with the above-mentioned environmental quality standards.

Based on the calculation results, it is expected that compliance with the WHO recommended limit could be ensured if the wind farm is equipped with the following wind turbine models:

- Nordex N175 – 7.0 MW with aerodynamically enhanced blades;
- Nordex N163 – 7.0 MW with aerodynamically enhanced blades;
- Vestas V172 – 7.2 MW with aerodynamically enhanced blades;
- Siemens Gamesa SG170 – 7.0 MW;
- Vestas V162 – 7.2 MW with aerodynamically enhanced blades.

Information on the wind turbine models whose operation would ensure compliance with the WHO recommended limit for wind turbine-generated noise is presented in Figure 3.1.15.



	Nordex N175-7.0 MW ST	Nordex N175-7.0 MW STE	Nordex N163-7.0 MW ST	Nordex N163-7.0 MW STE	Vestas V162-7.2 MW ST	Vestas V162-7.2 MW STE	Vestas V172-7.2 MW ST	Vestas V172-7.2 MW STE	Siemes Gamesa SG170-7.0 MW
Diena	107.0	105.0	106.3	104.3	105.6	102.4	107.4	104.1	103.3
Vakars	107.8	105.8	107.1	105.1	106.4	103.2	108.2	104.9	104.1
Nakts	107.9	105.8	107.2	105.2	106.6	103.4	108.3	105.1	104.2

Figure 3.1.15. Information on wind turbine models whose operation at the EIA-assessed wind turbine location would not exceed the WHO recommended noise limit

Compliance with the low-frequency noise limit – 20 dB(A) at wind speeds of 6 and 8 m/s – would be ensured by all assessed wind turbine models, except for the Vestas V172 – 7.2 MW with standard blades.

Based on the results of the calculations, the Report authors consider it appropriate to set the following conditions for the implementation of the proposed activity:

- **The proposed activity must be implemented by selecting the number, location, and model of wind turbines such that the total noise level generated by the wind turbines in the residential and public building areas around the proposed activity site does not**

exceed the environmental noise limits for industrial noise sources specified in Regulation No. 16.

- **The proposed activity must be implemented by selecting the number, location, and model of wind turbines such that the total low-frequency (10 – 160 Hz) noise level generated by the wind turbines inside residential buildings in the vicinity of the proposed activity site does not exceed 20 dB at wind speeds of 6 m/s and 8 m/s at a height of 10 m above ground level, unless another low-frequency noise standard is specified in external regulatory acts at the time of the design stage.**
- **During the preparation of the substation design, calculations of the noise generated by the substation and BESS must be performed, and, if necessary, measures must be provided to ensure compliance with the environmental noise limits specified in Regulation No. 16. The results of these calculations must be included in the design documentation.**
- **Before commissioning the wind farm, environmental noise measurements must be conducted in the residential areas closest to the wind farm, including the substation and BESS. The measurement locations and methodology must be coordinated with the Health Inspectorate before measurements commence. To ensure traceability and control of compliance, the measurement results must be submitted to the Health Inspectorate and the State Environmental Service. If non-compliance with the limits specified in Regulation No. 16 is detected, additional technical measures to reduce environmental noise must be developed and implemented before the wind farm is put into operation. The plan for technical measures and conditions must be submitted to the Health Inspectorate and the State environmental Service.**
- **If a wind turbine model different from those assessed in the EIA or a revised layout of turbines is selected, a repeated assessment of environmental noise and low-frequency noise must be conducted according to the actually installed turbine model, number, layout, and manufacturer-guaranteed technical parameters. The selected solution must ensure compliance with the above-mentioned noise limits and low-frequency noise limits. The updated noise assessment must be attached to the design documentation.**

When evaluating the potential impact of the proposed activity on public health, considering the available technological alternatives and the calculation results, the Report authors recommend the following for the implementation of the proposed activity:

- **The wind farm should be constructed using the quietest possible turbine model, giving preference to the technological alternative that ensures the environmental noise level generated by the wind turbines does not exceed the WHO recommended daily average noise value (L_{den}) in all assessed residential areas, i.e., 45 dB(A).**

3.1.6. Assessment of alternatives

The results of environmental and low-frequency noise calculations indicate that the proposed activity can be implemented in compliance with the regulatory requirements of the Republic of Latvia in the field of noise management, and observing the low-frequency noise limits established in Denmark. From the perspective of public health protection, a better technological alternative is considered to be the selection of a turbine model whose overall noise emission level is lower

and which, among other things, also ensures compliance with the WHO recommended limit for wind turbine-generated noise.

As stated in Section 2 of the Report, 14 potential construction sites for wind turbines were assessed in the planned wind farm, but due to limitations of the available grid capacity, the number of turbines actually built could be lower. Section 6 of the EIA Report provides an assessment of alternative wind turbine construction sites using a multi-criteria analysis, including an evaluation of noise impact.

3.2. FLICKER EFFECT

The shadow flicker effect is caused by rotating wind turbine blades periodically obstructing sunlight and generating moving shadows on the ground and surrounding surfaces. The phenomenon occurs only under sunny conditions, while it is not observed under cloudy conditions. Flicker from wind turbines may cause disturbance to persons indoors, where sunlight enters through windows in a concentrated form. When turbine blades intermittently block sunlight, short-term reductions in indoor illumination occur. Flicker frequency, depending on wind conditions, ranges from 0.2 – 0.6 Hz. Outdoor impacts are considered negligible due to diffuse lighting.

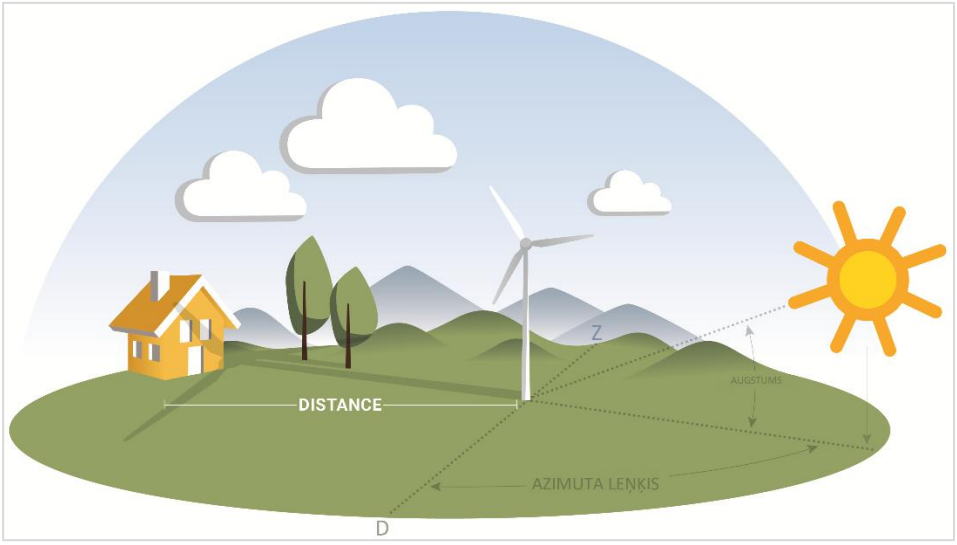


Figure 3.2.1. Schematic representation of flicker effect

3.2.1. Legislative framework

In Latvia no binding regulatory requirements define shadow flicker assessment methods or limit values. In most EU countries, limit values are defined in guidance documents rather than legislation. Where applied, limit values are typically based on German guidelines[51].

Two calculation approaches are used: worst-case scenario and realistic scenario. The worst-case scenario assumes continuous sunshine and a constant perpendicular alignment between sun,

[51] Guideline for Identification and Evaluation of the Optical Emissions of Wind Turbines

rotor blades, and receptor. The realistic scenario is based on historical meteorological data, including sunshine duration, wind speed, and wind direction.

Common international thresholds include: up to 30 hours/year (worst-case), up to 8 hours/year (realistic scenario), and 30 minutes/day for both scenarios.

3.2.2. Impact assessment approach

WindPRO software (EMD International) was used for shadow flicker modelling. The model applies ERA5 reanalysis data from ECMWF covering the period 2015 – 2024 for wind speed and direction. Sunshine duration data for the realistic scenario were taken from the Zosēni meteorological station, representing the nearest station with a continuous 10-year dataset. Average monthly sunshine duration values used in the model are provided below.

Table 3.2.1. Average sunshine time in a given month

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hours	0,8	1,82	4,75	6,09	9,67	10,05	8,16	7,72	5,94	2,93	0,63	0,41

Receptors include residential and public buildings registered in portal of State Land Service, as well as buildings under construction in the Building Information System. All receptors within a 3 km radius of the planned wind turbine locations were included. Buildings were modelled as point receptors with 360-degree exposure (greenhouse approach). A total of 359 buildings were assessed.

Five turbine models were evaluated: Vestas V162, Vestas V172, Nordex N163, Nordex N175, and Siemens Gamesa SG170, assuming up to 14 turbines in total.

3.2.3. Operational phase impacts

Detailed results are presented in original EIA Report (Annex 6) and Annex E.3 contains WindPRO input and output files used for calculation verification. The number of residential and public buildings affected by shadow flicker, as well as the number of exceedances of limit values for each assessed technological alternative, is summarised in Table 3.2.2. According to the results of the calculations using the worst-case scenario method, the highest number of affected buildings and exceedances of limit values is expected if the Siemens Gamesa SG170 model is implemented at the wind farm – the total number of affected buildings is 94, while exceedances of the limit values occur in 40 buildings. The lowest number of affected buildings and exceedances of limit values is calculated for the Nordex N163 model – the shadow flicker impact is assessed for 40 buildings, with exceedances of limit values identified in 16 buildings.

Table 3.2.2. Comparison of the results of flicker effect on technological alternatives

	Technological alternative	Worst-case scenario method	Realistic scenario meth-od
		Maximum possible annual shadow flicker impact duration	Statistically probable annual shadow flicker impact duration
	Vestas V162	66	
	Vestas V172	48	

Number of affected buildings	Nordex N163	40	
	Nordex N175	47	
	Siemens-Gamesa SG170	94	
Number of buildings with exceedances of limit values	Vestas V162	20	13
	Vestas V172	24	13
	Nordex N163	16	13
	Nordex N175	25	13
	Siemens-Gamesa SG170	41	15

Information on buildings where the shadow flicker exposure time, in the case of implementation of the Siemens Gamesa SG170 turbine, would exceed the limit values is presented in Table 3.2.3. The results of shadow flicker exposure time calculations for all five technological alternatives across all assessed buildings are provided in original EIA Report (Annex 6), while detailed information on flicker time periods and the specific turbines affecting each building is presented in Annex E.3. An overview map showing the area affected by shadow flicker is presented in Figure 3.2.2.

Table 3.2.3. Residential and public building areas where the impact of flicker effect is expected to be exceeded in case of selection of Siemens Gamesa SG170 model

Homestead name	Worst-case scenario method maximum calculated flicker time, h/year	Worst-case scenario method maximum calculated flicker time, h/day	Realistic scenario method maximum calculated flicker time, h/year
Bajāri	41:44	00:41	07:02
Dravas	46:13	00:40	07:01
Dūmiņi	144:42	01:04	36:42
Dzelzceļš 162. km	122:50	01:00	60:38
Dzeņi	36:03	00:38	06:22
Gailenes	48:51	00:49	04:04
Gaisiņi	35:55	00:29	04:55
Ģērķi	104:02	01:04	35:39
Gravas	45:33	00:39	06:58
Jauntilgaļi	53:34	00:51	04:28
Jaunzemes	32:28	00:33	05:13
Kalnģērķi	96:40	01:01	32:39
Kalnstaldoti	37:30	00:26	06:23
Kastaņas	35:11	00:37	05:56
Kristāli	38:04	00:38	06:14
Latiņi	43:50	00:38	06:46
Lejas Ģērķi	133:07	01:05	64:08
Liepkalni	266:45	02:03	108:31
Lukstiņi (94880090014001)	60:11	00:34	15:17

Homestead name	Worst-case scenario method maximum calculated flicker time, h/year	Worst-case scenario method maximum calculated flicker time, h/day	Realistic scenario method maximum calculated flicker time, h/year
Lukstiņi (94880090014002)	67:46	00:35	15:49
Māja 20 (94880100123001)	28:07	00:32	07:41
Noras	49:58	00:45	08:07
Oši	40:41	00:35	06:05
Ozolkalni	38:52	00:23	06:57
Pilēnieši	149:15	02:08	13:30
Pīnas	30:41	00:33	04:19
Riekstiņi	30:34	00:37	04:42
Ritas	42:14	00:38	06:40
Rubeņi	47:13	00:31	17:42
Sedaskalni (94880100255001)	59:37	00:50	07:29
Sietiņi	45:20	00:39	06:54
Staldoti	35:28	00:23	05:51
Vanagi	32:35	00:29	03:43
Vecrubeņi	49:50	00:32	18:20
Vēverzemnieki	112:25	00:43	50:53
Vidiņi	38:33	00:38	06:49
Vīteņi	47:27	00:42	07:44
Zeltiņi	39:50	00:37	06:25
Zemdegas	45:57	00:39	06:59
Zemgaļi	23:02	00:24	08:23
Zemītes	40:52	00:40	07:04
Zvēru ferma	40:49	00:27	19:16

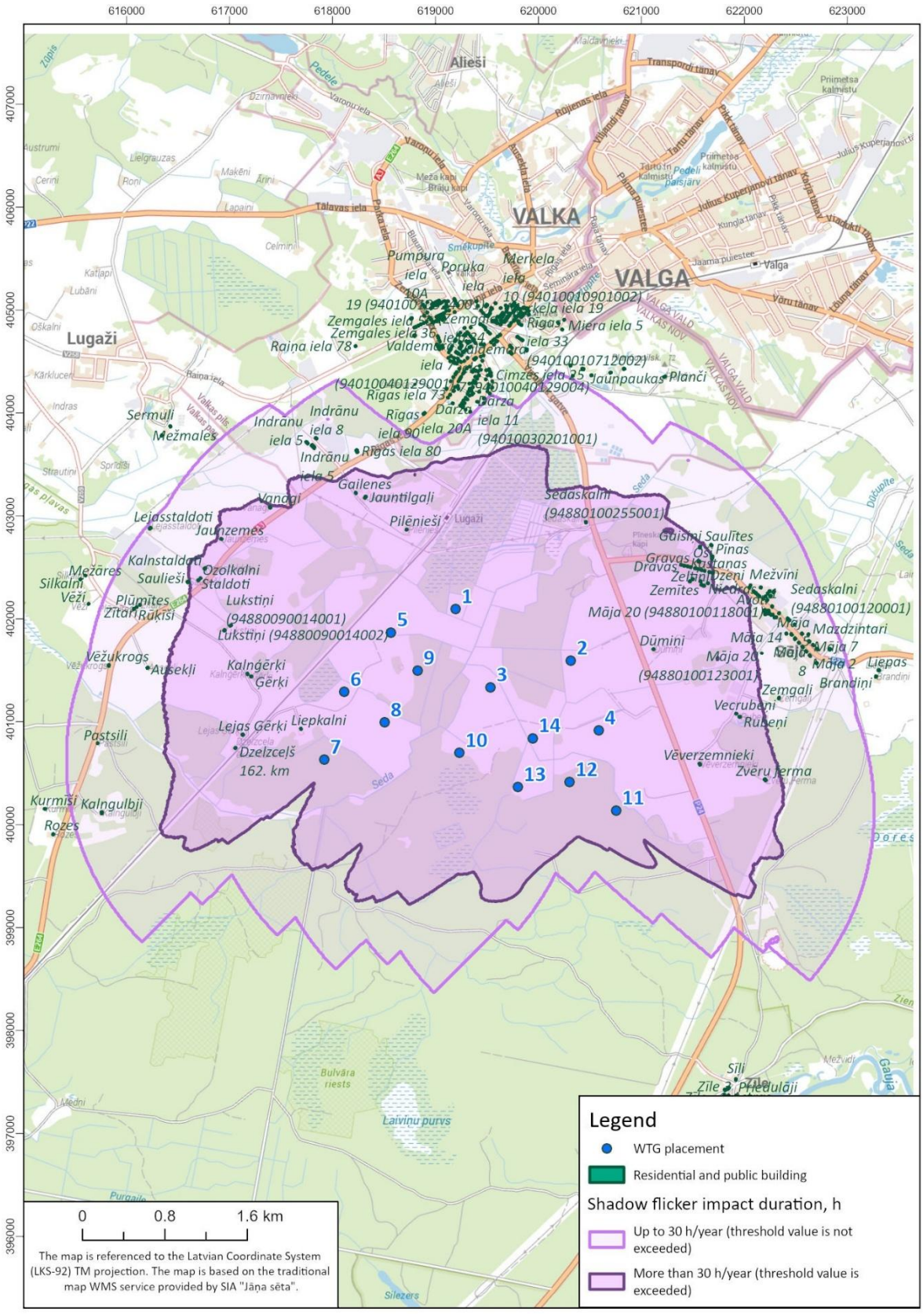


Figure 3.2.2. Flicker effect impact zones according to the worst-case scenario method in case of selection of Siemens Gamesa SG170 model

3.2.4. Mitigation measures

It was identified through the calculations that mitigation measures must be implemented in order to reduce the shadow flicker exposure time at least to the level of the recommended limit values. Moreover, mitigation measures are required irrespective of the technological alternative applied. The only technically feasible solution to ensure that the established shadow flicker exposure limit values are not exceeded in residential and public buildings is the shutdown of wind turbines during periods when shadow flicker occurs.

Based on the results of the EIA calculations, it is possible to precisely determine the time periods during which specific wind turbines must be curtailed in order to prevent or reduce shadow flicker exposure in all residential and public buildings in the vicinity of the wind farm.

A shutdown regime based on theoretical sunshine duration is the technically simplest solution and does not require any additional equipment. Under this approach, wind turbines are stopped during periods when shadow flicker could theoretically occur, regardless of whether the sun is actually shining at that moment. This operational regime is based on shadow flicker calculation results derived using the worst-case scenario method.

A shutdown regime based on actual sunshine duration is a more technically advanced solution, which foresees the shutdown of wind turbines only during periods when shadow flicker may occur and when the sun is actually shining. In this case, equipment must be installed at the wind farm to detect actual sunshine duration.

During public consultation meetings, residents together with the developer and the authors of the Report discussed the possibilities and necessity of limiting shadow flicker. Initially, a proposal was made to restrict shadow flicker in public buildings; however, during subsequent discussions, a proposal was raised by residents to implement a solution whereby shadow flicker would not occur at all in any residential and public buildings in the surrounding area. An exception from full mitigation would only be acceptable if a written consent is received from the building owner confirming that they do not object to the shadow flicker impact.

In the opinion of the authors of the Report, there is currently no requirement arising from regulatory acts or guidelines for full elimination of shadow flicker. At the same time, it should be noted that the proposal submitted by residents is aimed at impact reduction and should be considered in the decision-making process for the proposed activity; therefore, it is included in the report in the form of a recommendation.

In summary, in the opinion of the Report authors, there is justification for imposing the following condition for the implementation of the proposed activity: **during the operational phase of the wind farm, measures shall be implemented to limit shadow flicker exposure time and ensure that the cumulative impact of wind turbines does not exceed the limit values specified in the Report – not more than 30 hours per year and 30 minutes per day if mitigation measures are based on the worst-case scenario calculations, or not more than 8 hours per year and 30 minutes per day if mitigation measures are based on the realistic scenario calculations, or another appropriate level of protection if such is defined by external regulatory requirements.**

Taking into account the proposals submitted by residents regarding mitigation of shadow flicker and the position of the developer, the authors of the Report consider it appropriate to include the following recommendation: **during wind farm operation, it is recommended to reduce shadow flicker in residential buildings below the defined threshold values or eliminate it entirely by providing turbine shutdown during periods when shadow flicker may occur in buildings. This recommendation does not apply to buildings for which written consent has been received from the owner confirming acceptance of shadow flicker impact.**

Considering that the wind turbine model, hub height, and final layout have not yet been defined and may be adjusted during the detailed design stage, the authors of the Report consider it appropriate to impose the following condition: **during preparation of the construction design, shadow flicker calculations shall be carried out based on updated project parameters – turbine layout, number of turbines, and technical specifications of the selected model. For each wind turbine where mitigation is required, operational restrictions (shutdown regimes) for reduction of shadow flicker exposure shall be defined and implemented during construction and operation.**

3.2.5. Assessment of alternatives

Five wind turbine technological alternatives assessed in the Report result in differing levels of shadow flicker exposure time. The calculation results are summarised in Table 3.2.4. As shown in the table, the lowest total shadow flicker exposure is expected if the Nordex N163 turbines are installed in the wind farm, while the highest exposure is associated with the Siemens Gamesa SG170 turbines. The difference between the turbine model with the highest and the lowest impact is significant; specifically, the shadow flicker exposure from the Siemens Gamesa SG170 is approximately twice that of the Nordex N163.

The required curtailment time for compliance with the applicable limit values also differs between the alternatives. In this context, the Nordex N163 is considered the most favourable alternative in terms of shadow flicker impact, whereas the Siemens Gamesa SG170 is considered the least favourable alternative.

Table 3.2.4. The time of impact of the flicker effect and the time of stopping wind turbines, calculated from the worst-case scenario method

WTG model	Maximum calculated flicker time before mitigation measures	Maximum calculated flicker time after mitigation measures	WTG shutdown time to implement mitigation measures
Vestas V162	2125:30	1287:12	838:18
Vestas V172	2103:57	1098:18	1005:39
Nordex N163	1563:23	813:52	749:31
Nordex N175	2106:25	1088:37	1017:48
Siemens-Gamesa SG170	3183:56	1874:46	1309:10

3.3. BIODIVERSITY

3.3.1. Legislative framework

This chapter describes the regulatory framework applicable to the protection of flora, fauna and habitats, as well as the establishment and management of specially protected nature territories (hereinafter – SPNT). To ensure the conservation of biodiversity, issues related to this field are incorporated not only into the regulatory framework but also into sectoral planning documents – strategies, action plans and guidelines.

European Union and international legislation

The European Union has adopted the EU Biodiversity Strategy for 2030 and established regulatory acts aimed at ensuring biodiversity conservation. A key component of the EU nature and biodiversity protection policy is the network of protected areas of European importance – Natura 2000, which also includes SPNTs located in Latvia.

Another international agreement binding on Latvia in relation to biodiversity is the Convention on Biological Diversity, to which Latvia acceded through the Law "On the Convention on Biological Diversity adopted in Rio de Janeiro on 5 June 1992" of 31 August 1995. The objectives of this Convention are the conservation of biological diversity and the sustainable use of living natural resources.

The Council of Europe's Convention on the Conservation of European Wildlife and Natural Habitats (also known as the Bern Convention), approved in Latvia by the act on the Bern Convention (17 December 1996). The objective of this Convention is to protect wild flora and fauna and their natural habitats, particularly those species and habitats whose conservation requires cooperation between several countries, as well as to promote such cooperation. Particular attention is paid to threatened and endangered species, including threatened and endangered migratory species.

The Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention) is binding in Latvia and was adopted through the Law "On the 1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals" of 11 March 1999. The Convention identifies endangered migratory species, migratory species with an unfavourable conservation status, and the principles to be considered when implementing conservation measures for these species.

European Parliament and Council Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds (hereinafter – the Birds Directive). The Directive was adopted to maintain populations of migratory species at levels that correspond to specific ecological, scientific and cultural requirements, while taking into account economic and recreational needs, or to regulate the population size of these species to such levels. Many wild bird species naturally occurring in Europe are declining in number, in some cases rapidly, creating a serious threat to environmental protection, particularly due to the risk to ecological balance.

European Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (hereinafter – the Habitats Directive). The objective of the Directive is to contribute to the conservation of biodiversity by protecting natural habitats and fauna and flora species. It establishes that, within the framework of the Natura 2000 programme, a coherent European ecological network covering SPNTs shall be established. This network shall ensure the

maintenance, or where necessary, the restoration to a favourable conservation status, of natural habitat types and habitats of relevant species within their natural range.

Latvian environmental and nature conservation legislation

Nature conservation in Latvia is regulated by the Law on the Conservation of Species and Biotopes (in force since 19 April 2000). The Law regulates matters related to the protection of protected plant, fungi, lichen and animal species, their biotopes, as well as habitats. The objectives of the Law are to ensure biodiversity conservation by preserving fauna, flora and biotopes characteristic of Latvia; regulate the protection, management and monitoring of species and biotopes; promote the conservation of populations and habitats in accordance with economic and social conditions, as well as cultural and historical traditions; regulate the procedure for designating specially protected species and biotopes; and ensure the necessary measures for maintaining populations. Article 3.1 of the Law establishes requirements for habitats and species of European Union importance and defines their characteristics. Protection of natural biotopes and species of European Union importance in Latvia is ensured in accordance with nature conservation legislation. The Law establishes requirements for species and biotope protection.

Regulation No. 213 of the Cabinet of Ministers, on criteria to be used in assessing the significance of the effects of damage to specially protected species or specially protected habitats (in force from 31 March 2007), sets out the criteria to be used in assessing the significance of the effects of damage to special protected species or special protected habitats in comparison with the baseline condition. The rules require that significant adverse changes from the baseline are determined using numerical data for species and measurable data for habitats.

Regulation No. 1055 of the Cabinet of Ministers, a list of species of animals and plants of significance at EU level that are in need of protection and the list of individual species of animals and plants harvesting of which in the wild may be subject to restricted use conditions (in force from 19 September 2009) establishes the list of species of significance at EU level that are in need of protection (regulation no. 1055, Annex 1) and the list of individual animal and plant species of EU significance harvesting of which in the wild may be subject to restricted conditions of use (regulation no. 1055, Annex 2). This list has been taken into account in the description of the natural assets in the area surrounding the proposed activity.

Regulation No. 153 of the Cabinet of Ministers, a list of the EU priority species and habitats occurring in Latvia (in force from 25 February 2006) contains the list of EU priority species and habitats in Latvia. This list has been taken into account in the description of the natural assets in the area surrounding the proposed activity.

Regulation No. 350 of the Cabinet of Ministers, a list of specially protected habitats (in force from 28 June 2017), defines the list of specially protected habitat types.

Regulation No. 396 of the Cabinet of Ministers, a list of specially protected species and restricted use specially protected species (in force from 18 November 2000), lists the species of plants, animals and fungi that are especially protected and restricted for use in Latvia. The list has been taken into account in the description of the natural assets in the area surrounding the proposed activity.

Regulation No. 940 of the Cabinet of Ministers, on the establishment and management of micro-reserves, their protection, and the establishment of micro-reserves and their buffer zones (in force from 1 January 2013), establishes the procedures for the establishment and management of micro-reserves, their protection, and the establishment of micro-reserves and their buffer zones. Annexes to the regulations:

- specially protected mammal, amphibian, reptile, invertebrate, vascular plant, moss, algae, lichen and fungi species for the protection of which micro-reserves may be established;
- specially protected bird species for the protection of which micro-reserves may be established, including the relevant micro-reserve areas;
- specially protected fish species for the protection of which micro-reserves may be established in spawning areas.

Act on special areas of conservation (in force since 7 April 1993). The act establishes the basic principles of the special areas of conservation system, the procedure for establishing and ensuring the existence of special areas of conservation, the procedure for managing special areas of conservation, monitoring their status and keeping records, and connects national, international, regional and private interests in the establishment, conservation, maintenance and protection of special areas of conservation. Amendments adopted on 15 September 2005 approved the Annex to the act with the Latvian Natura 2000 list of special areas of conservation of European significance where Natura 2000 sites are divided into three types:

A – sites designated for the protection of specially protected bird species;

B – sites designated for the protection of specially protected species other than birds and specially protected habitats;

C – sites designated for the protection of specially protected species and specially protected habitats.

The amendments adopted on 17 March 2022 updated the annex to the Law by specifying the purpose of establishing each Latvian Natura 2000 site of European importance.

Regulation No. 264 of the Cabinet of Ministers, on general regulations on the protection and use of special areas of conservation (in force from 31 March 2010), establishes the general procedure for the protection and use of special areas of conservation, including the permitted and prohibited types of activities in the areas, as well as a special information sign template to be used in nature to mark the protected areas and the procedure for its use and establishment.

Regulation No. 511 of the Cabinet of Ministers of 7 July 2008, on the assessment of damage to natural monuments and calculation of the cost of remediation measures (in force from 12 July 2008), establishes the damage assessment and remediation measures for natural monuments designated by the cabinet of ministers as well as by municipalities.

3.3.2. SPNTs and micro-reserves

This chapter provides information on SPNTs and micro-reserves located in the vicinity of the planned "Valka" wind farm, as well as assesses the potential impact of the proposed activity on Natura 2000 sites. According to the information available in the Nature Conservation Agency's Nature "OZOLS" nature data management system, the "Valka" wind farm study area is partially

located within the neutral zone of the SPNT "North Vidzeme Biosphere Reserve". No micro-reserves have been established within the study area; however, within a distance of up to 10 km from the planned wind park, there are five SPNTs and one Natura 2000 site located in Estonia (see Table 3.3.2.1).

Table 3.3.2.1. SPNTs located in the vicinity of the study area, including Natura 2000 sites

Name	Status	Distance, km
North Vidzeme Biosphere Reserve (site code LV0000100)	Neutral zone of the biosphere reserve	Partially overlaps with the EIA proposed activity area
Burgas pļavas (site code LV0532600)	Nature reserve, Type C Natura 2000 site	2,0
Ziemeļgauja (site code LV0600700)	Protected Landscape Area, Type C Natura 2000 site	1,4
Purgailes River Forests (site code LV0542000)	Nature reserve	3,5
Seda Bog (site code LV0526800)	Nature reserve, Type C Natura 2000 site	7,2
Koiva-Mustjõe (EE0080471)	Type A Natura 2000 site	9,5

The North Vidzeme Biosphere Reserve is located in Limbaži, Valmiera and Valka municipalities, with a total area of 475,514.0 ha. The Biosphere Reserve is an internationally significant protected nature area, established with the objective of achieving a balance of national and international importance between the protection of natural diversity, promotion of economic development and preservation of cultural values. The neutral zone has been designated to promote balanced and sustainable development of settlements located within the territory.

The "Burgas pļavas" Nature Reserve is located in Valka Municipality, Valka Parish, and covers an area of 183.3 ha. The reserve is a Type C Natura 2000 site established for the protection of specially protected species and habitats. Four European Union protected habitats are found within the nature reserve: 6450 Northern boreal alluvial meadows, 6510 Lowland hay meadows, 6410 Molinia meadows on calcareous, peaty or clayey-silt-laden soils, and 6430 Hydrophilous tall herb fringe communities. Two specially protected plant species in Latvia and 16 specially protected bird species have also been recorded, of which 15 are species listed in Annex I of the Birds Directive.

The "Ziemeļgauja" Protected Landscape Area is located in Valka, Smiltene and Valmiera municipalities and covers an area of 21,749.0 ha. The protected landscape area is a Type C Natura 2000 site established for the protection of specially protected species and habitats. This is a unique area along a natural, unregulated section of the Gauja River with old river channels, botanically valuable meadows, and old mixed and deciduous forests, continuing into Estonia. Along the entire section, unique, little-altered habitats can be found, with some areas still traditionally and extensively managed. Habitats listed in the EU Habitats Directive occurring within the territory include: 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation, 3260 Water courses of plain montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation, 6120* Xeric sand calcareous grasslands, 6270* Fennoscandian lowland species-rich dry to mesic grasslands, 6450 Northern

boreal alluvial meadows, 6530* Fennoscandian wooded meadows, 8210 Calcareous rocky slopes with chasmophytic vegetation, 9010* Old or natural boreal forests, 9020* Old broad-leaved deciduous forests, and others. The protected landscape area is also designated as an Important Bird Area. A large number of protected plant and animal species occur within the territory.

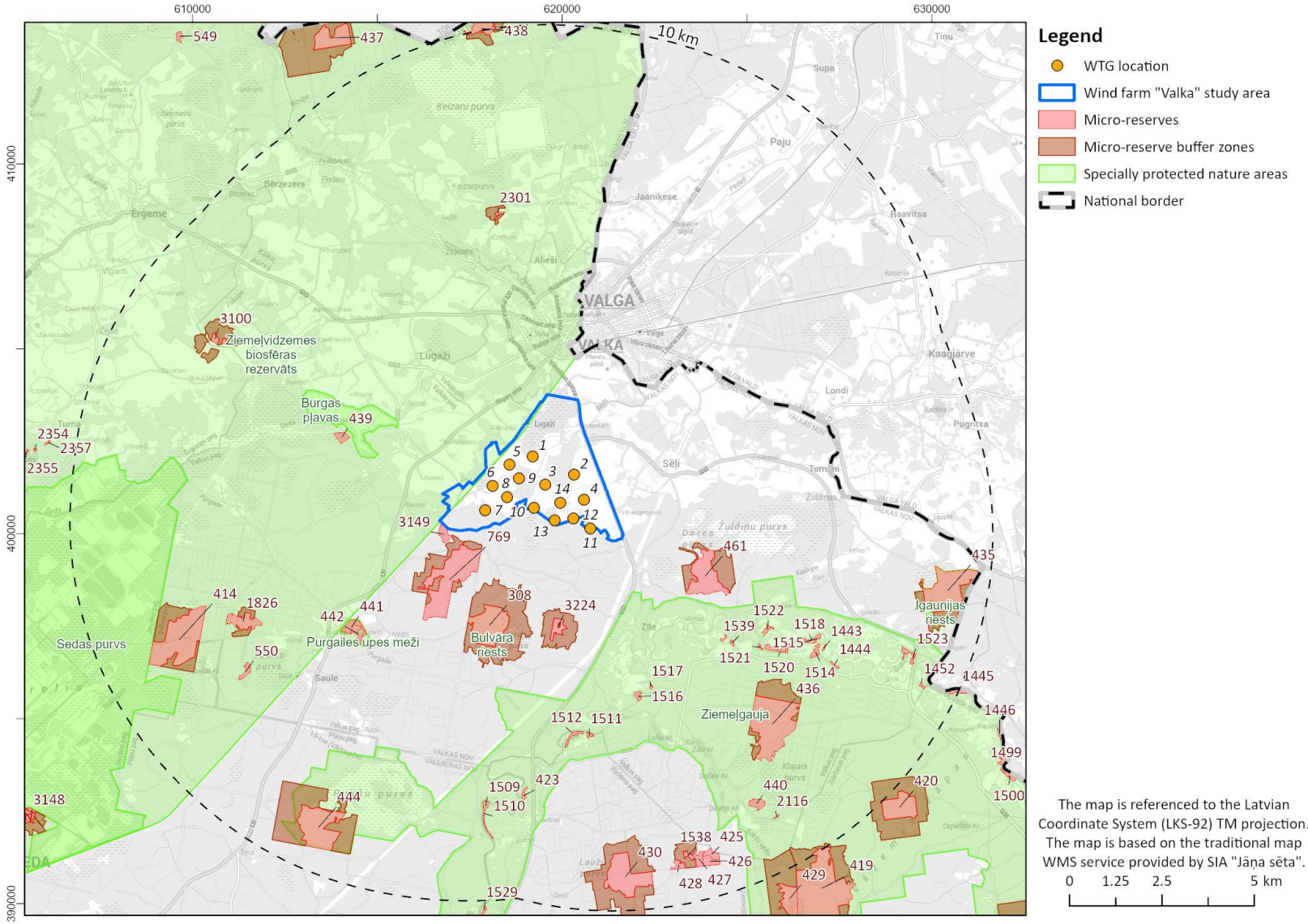
The "Purgailes upes meži" Nature Reserve is located in Valka Municipality, Valka Parish, and covers an area of 40 ha. The following EU Habitats Directive habitats have been identified within the territory: 9010* Old or natural boreal forests, 9050 Fennoscandian herb-rich forests with Picea abies, 9080* Fennoscandian deciduous swamp woods, 91D0* Bog woodland, and 91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior. The territory contains habitats suitable for specially protected bird species, which is also confirmed by the establishment of two micro-reserves within the nature reserve for the protection of specially protected bird species.

The "Sedas purvs" Nature Reserve is located in Valmiera Municipality, Jērcēni and Ēvele parishes, and Valka Municipality, Ērģeme Parish, covering an area of 7,257.7 ha. The reserve is a Type C Natura 2000 site established for the protection of specially protected species and habitats. The most significant EU Habitats Directive habitats within the territory include: 6450 Northern boreal alluvial meadows, 9010* Old or natural boreal forests and 91D0* Bog woodland. The periphery of the Seda bog contains boggy pine forests, and in some locations outstanding boreal forests with old pine trees growing on inland dunes. Approximately 140 bird species have been recorded within the nature reserve, more than 100 of which breed within the reserve, including 24 EU protected bird species. In addition, 17 specially protected plant species and 13 specially protected invertebrate species have been identified. The most valuable areas for birds are the ponds in the northwestern part of the nature reserve, with rich submerged vegetation and favourable feeding conditions, as well as grasslands in the northern part of the reserve. The main threat factors include deepening and straightening of the Seda River, which reduces natural flooding of alluvial meadows and promotes their degradation.

The Koiva – Mustjõe Special Area of Conservation is located in Estonia and borders Latvian territory. In terms of nature values, this protected area represents a continuation of the "Ziemeļgauja" protected landscape area in Estonia, also covering the surroundings of the Mustjõgi River. The area covers 3,735.6 ha. It is a Type A Natura 2000 site established for the protection of specially protected bird species. The main natural values of the territory are four bird species: kingfisher (Alcedo atthis), northern pintail (Anas acuta), corncrake (Crex crex) and great snipe (Gallinago media), three of which are species listed in the Birds Directive. Other specially protected bird, mammal and invertebrate species have also been recorded within the territory.

Within a distance of up to 10 km from the study area, there are 46 micro-reserves, predominantly established for the protection of bird species and forest habitats. The most common bird protection micro-reserves have been established for the protection of the white-backed woodpecker (Dendrocopos leucotos) and capercaillie (Tetrao urogallus), while the most widespread habitat types include riparian forests and broad-leaved forests. The nearest micro-reserve is located 50 m from the study area. The majority of micro-reserves have been established within extensive forest areas located south of the planned wind farm study area. Two micro-reserves are Natura 2000 sites:

- **"Bulvāra riests"** is a Type B Natura 2000 site (LV0830800). The micro-reserve covers an area of 81 ha and is located approximately 2.2 km from the study area. The micro-reserve was established for the protection of habitats 9010* Old or natural boreal forests and 91D0* Bog woodland. The forest stands within the micro-reserve are sparse and considered particularly suitable habitats for capercaillie (Tetrao urogallus).
- **"Igaunijas riests"** is a Type B Natura 2000 site (LV0843500). The micro-reserve covers an area of 161 ha and is located approximately 8.3 km from the boundary of the study area. The territory is important for the protection of capercaillie lek sites, as well as habitats 9010* Old or natural boreal forests and 91D0* Bog woodland.



The map is referenced to the Latvian Coordinate System (LKS-92) TM projection.
The map is based on the traditional map WMS service provided by SIA "Jāņa sēta".
0 1.25 2.5 5 km

Figure 3.3.2.1. SPNTs and micro-reserves in the vicinity of the proposed activity

The potential impact of the proposed activity on Natura 2000 sites is described below in accordance with Regulation No. 300 of the Cabinet of Ministers "Procedures for Assessing the Impact on Special Areas of Conservation of European Importance (Natura 2000)". Table 3.3.2 provides an assessment of the impact on specially protected species and habitats within Natura 2000 sites.

Table 3.3.2. Impact assessment criteria for protected species and habitats in Natura 2000 sites

No.	Criteria	Quantitative indicator value or identified trend (e.g. decreasing, unchanged or increasing)
1.	Area of specially protected habitat or species habitat	No direct changes in the area of habitats and species habitats within Natura 2000 sites or within the Natura 2000 network are expected, as the proposed activity does not directly affect Natura 2000 sites.
2.	Population density of specially protected species	No negative impact on the population density of bat and plant species is expected. The nature reserve "Burgas pļavas" is an important area for bird species conservation. The largest known Great Snipe (Gallinago media) lekking site in Valka Municipality is located there, as well as areas with a very high density of Corn Crake (Crex crex). The territory is located relatively far from the wind farm area; however, it cannot be completely excluded that Great Snipe may use the planned wind farm area as a resting or feeding site. Although construction of the wind farm does not pose a direct threat to the Great Snipe population breeding in the nature reserve, the presence of this species in the area shall continue to be monitored during pre-construction, construction and operational monitoring.
3.	Fragmentation of specially protected habitats or species habitats	The proposed activity will not directly affect polygons of specially protected habitats within Natura 2000 sites; therefore, no habitat fragmentation impacts are expected. The degree of habitat area fragmentation, continuity or permanence, compared with the baseline conditions, will remain unchanged, as neither direct nor indirect impacts are expected as a result of the proposed activity.
4.	Disturbance of specially protected species	No new disturbances to specially protected species associated with the proposed activity are expected, as the physical impacts that could occur during wind farm operation within Natura 2000 sites are insignificant or even unlikely to occur.
5.	Isolation (separation) of specially protected species habitat or habitat from other similar habitats or species habitats	No changes in the isolation of protected habitats occurring within Natura 2000 sites from other similar habitats are predicted.
6.	Changes in the quality of specially protected habitats or species habitats (their	No changes in the quality of specially protected habitats are predicted as a result of implementation of the proposed activity, as no impacts on the quality of habitats within nearby Natura 2000 sites are expected.

No.	Criteria	Quantitative indicator value or identified trend (e.g. decreasing, unchanged or increasing)
	characteristic structures and functions)	
7.	Changes in relationships and interactions determining the structure and functions of the site	No changes in the relationships and interactions determining the structure and functions of the sites are expected, as the implementation of the proposed activity will not alter the hydrological conditions, geological conditions or other characteristics defining the sites.

Considering that the construction of the planned wind farm will not directly affect any Natura 2000 site, it can be concluded that implementation of the activity will not affect the objectives for the establishment and protection of Natura 2000 sites, the factors that have influenced these sites prior to the implementation of the proposed activity, the importance of the sites for the coherence of the Natura 2000 network at national and biogeographical region level.

Summarising the impact assessment on Natura 2000 sites, it can be concluded that currently no specific impact mitigation measures are required in accordance with Regulation No. 300 of the Cabinet of Ministers "Procedures for Assessing the Impact on Special Areas of Conservation of European Importance (Natura 2000)". At the same time, monitoring measures should be implemented in relation to nearby Natura 2000 breeding bird species.

3.3.3. Plants and habitats

This chapter describes the impact of the proposed activity on locations of specially protected plant species, EU protected forest habitats, veteran trees, potential veteran trees and biologically valuable trees. Measures to prevent and reduce impacts during the construction of the planned wind turbines have been identified.

The preparation of this chapter and the impact assessment used the results of field surveys and expert opinions prepared by certified species and habitat experts: Toms Daniels Čakars (certificate No. 182, valid until 20 May 2027 (habitat group – forests and woodlands); valid until 11 November 2026 (habitat group – flowing freshwater and standing freshwater)) and Margita Deičmane (expert certificate No. 024, valid until 14 June 2028 (habitat group – grasslands)). The expert opinion provides an assessment of the impact of the proposed activity – construction of the "Valka" wind farm and associated infrastructure. The expert opinion is included in original EIA Report (Appendix 7).

3.3.3.1. Impact assessment approach

The impact assessment was carried out by analysing the predicted direct and indirect impacts. Direct impact is defined as the complete or partial destruction of protected habitats, protected species or veteran trees caused by the proposed activity, threatening the future existence of these habitats, species or veteran trees. Indirect impact is associated with undesirable changes in environmental conditions caused by the proposed activity, including fragmentation, increased edge effects and other factors that negatively affect the quality of protected habitats or the viability of protected species and veteran trees.

During the surveys, the potential direct impact areas associated with the construction of the planned wind turbines and infrastructure were surveyed and assessed – construction platforms, roads and road intersections, electricity cable routes, potential substation locations – as well as the surrounding areas where, depending on the technical solution, movement of construction machinery could occur. The following direct impact zones were assumed: a 10 m zone around construction platforms and potential substation locations; up to 25 m wide corridors for newly constructed roads and potentially reconstructed existing roads, including placement of cable transmission lines; up to 10 m wide corridors for cable transmission lines outside roads; and up to 10 m wide zones along existing roads.

When assessing indirect impacts, potential habitats located within a 50 m zone around the infrastructure, as well as EU protected habitats registered in the "OZOLS" nature data management system, were surveyed in the field. In addition, an assessment was carried out to determine whether EU protected habitats associated with wet conditions could occur or have been identified within a 180 m zone around the infrastructure. A 30 m wide corridor along the planned cable routes was surveyed.

Potential changes in the hydrological regime of identified habitats were assessed as an indirect impact. Such changes may occur in the vicinity of newly constructed infrastructure objects that may require drainage of the surrounding area. The impact distance was determined in accordance with guidelines for assessing the impact of forest roads and drainage systems[52], which are based on the information provided in Table 1 of Annex 11 to Regulation of the Cabinet of Ministers regarding the Latvian Construction Standard LBN 224-15 "Melioration Systems and Hydrotechnical Structures" (spacing distances between drainage ditches). It was assumed that the maximum depth of side ditches around infrastructure objects could be up to 1.5 m.

Within the framework of the study, field surveys were carried out during the 2024 vegetation season, when the initial wind turbine layout and associated infrastructure were surveyed, and during the 2025 vegetation season, when the revised wind turbine layout was surveyed.

GPS equipment integrated into tablets or smartphones and the ESRI FieldMaps application were used for field surveys and recording information. During the surveys, photographic documentation of objects and conditions was performed.

The expert opinion was prepared in accordance with Regulation No. 925 of the Cabinet of Ministers of 30 September 2010 "The Content of an Expert Opinion in the Field of Conservation of Species and Biotopes and the Minimal Requirements Contained Therein".

3.3.3.2. Description of the existing situation

According to the information available in "OZOLS" nature data management system, within the proposed activity area and its surroundings, seven specially protected species (SPS) listed in Annexes 1 and 2 (List of Specially Protected Species) of Regulation No. 396 of the Cabinet of Ministers of 14 November 2000 "Regulations on the List of Specially Protected Species and Restricted Use Specially Protected Species" have been identified – six vascular plant species and one fungi species. During the surveys, several new species locations were identified, including

[52] Available: https://www.daba.gov.lv/lv/media/22452/download?attachment

lichen, moss, vascular plant, invertebrate and fungi species (see Table 3.3.1 and Figure 3.3.1). The following abbreviations are used in Table 3.3.1:

DMB IS – indicator species of natural forest habitats;

SS – specialised habitat species;

MIK – species for which micro-reserves may be established for protection purposes;

SPS – specially protected species;

IUCN – assessment according to the criteria of the International Union for Conservation of Nature:

LC (Least Concern) – species of least concern;

NT (Near Threatened) – near threatened species.

Table 3.3.1. Specially protected species identified within and in the vicinity of the proposed activity area

Species group	Name	Species group, protection category, IUCN assessment[53]	Number of recorded occurrences within the survey area
Lichens	Arthonia spadicea	SPC I, DMB IS, *LC*	1
Mosses	Heller's notchwort (Crossocalyx hellerianus (Anastrophyllum hellerianum))	SPC I, MIK, DMB SS, *LC*	5
	Goblin gold (Schistostega pennata)	SPC I, *NT*	5
Fungi	Soft Bracket (Leptoporus mollis)	DMB SS, -	1
	Orange Netcrust (Pseudomerulius aureus)	DMB SS, -	1
Vascular plants	Early marsh orchid (Dactylorhiza incarnata)	SPC I, *LC*	1
	Interrupted clubmoss (Lycopodium annotinum)	SPC II, *LC*	7
Invertebrates	Jet ant (Lasius fuliginosus)	SPC I, *LC*	1

EU protected habitats of importance

Information on specially protected habitats occurring within Latvia and the European Union in the proposed activity area and its surroundings was obtained using information from "OZOLS" nature data management system, as well as through field surveys (see Table 3.3.2 and Figure 3.3.1). Protected forest habitats within and around the proposed activity area are mainly located in the southern part of the territory, in forest areas adjacent to state-owned forest complexes. Habitat quality has been assessed as ranging from medium to good. No protected flowing freshwater habitats were identified within the study area. In agricultural areas, arable land

[53] International Union for Conservation of Nature criteria. Available: https://sarkanagramata.lu.lv/par-projektu/materiali

dominates in drier locations, while wet grasslands occurring in the Seda floodplain are mostly unmanaged for a long period of time and do not correspond to the status of protected EU habitat types. Detailed information on the identified EU protected habitats, their characteristics and locations is provided in the habitat expert opinion included in original EIA Report (Appendix 7).

Table 3.3.2. EU protected habitats within and in the vicinity of the study area

Habitat group	Habitat code and name	Occurrence
Grasslands	6510 Lowland hay meadows	Identified at one location in the western part of the area assessed during surveys.
Forests	9010* Old or natural boreal forests	Several habitat polygons, mainly located in the southern part of the EIA area. Wind turbine No. 12 in its current planned location is located approximately 30 m from a good-quality habitat polygon No. 22AP116_404. The planned substation Alternative B and BESS Alternative B/1 border a good-quality habitat polygon No. 25TC182_10 identified during the survey.
	91D0* Bog woodland	One habitat polygon located 130 m from the access road between wind turbines No. 12 and No. 13.
	91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior	One habitat polygon located in the southern part of the area. Wind turbine No. 11 is planned approximately 100 m from a medium-quality habitat polygon No. 25TC182_12 identified during the survey.
	91T0 Central European lichen pine forests	One habitat polygon located in the southwestern part of the EIA study area.

Other natural values

Other surveyed values important for the conservation of biodiversity and landscape include veteran trees, potential veteran trees and large-dimension trees. These trees may serve as potential habitats for specially protected species, thereby supporting the persistence of species micro-populations outside protected habitats and contributing to biodiversity conservation. Some of these trees have been preserved within intensively managed agricultural land areas, near old farmsteads, while others are located in areas where forest stands have developed. According to the information available in "OZOLS" nature data management system, one previously registered veteran tree is located within the assessment area – an English oak (Quercus robur) (ID_14909), with a circumference of 4.75 m. During the surveys, six new veteran trees, one potential veteran tree and ten large-dimension trees were identified. The locations of veteran trees and potential veteran trees identified within or in the vicinity of the study area are provided in Table 3.3.3 and Figure 3.3.2.

Table 3.3.3. EU protected habitats within and in the vicinity of the proposed activity area

ID	Species	Circumference, m	Notes	X	Y
DV2	European ash (Fraxinus excelsior)	3,57	Veteran tree	401032	618241
DV3	Scots pine (Pinus sylvestris)	3,02	Veteran tree	402017	618617
DV4	Scots pine (Pinus sylvestris)	2,78	Veteran tree	400455	620704
DV5	Scots pine (Pinus sylvestris)	2,70	Veteran tree	401694	618379

ID	Species	Circumference, m	Notes	X	Y
DV9	English oak (Quercus robur)	4,57	Veteran tree	401127	618273
DV14	Small-leaved lime (Tilia cordata)	4,70	Veteran tree	400958	617695
DV17	Small-leaved lime (Tilia cordata)	3,41	Potential veteran tree	401509	618601

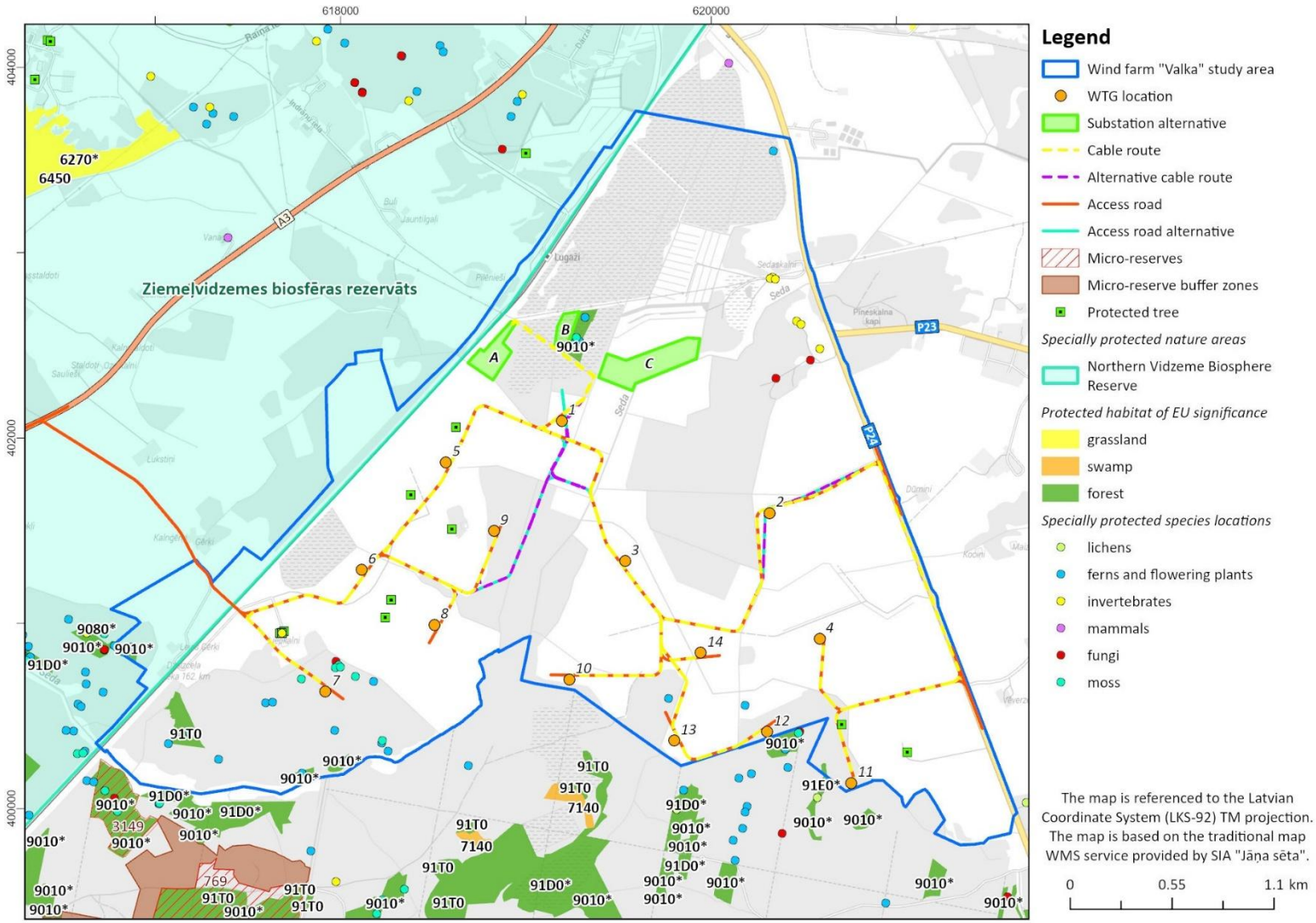


Figure 3.3.1. Location of EU protected habitats, specially protected or rare species and protected trees occurring within and in the vicinity of the study area

3.3.3.3. Impact on specially protected plants, habitats and veteran trees

Within the framework of the EIA, the impact of the construction of the planned wind turbines and associated infrastructure on protected natural values was assessed. The following potential impacts were identified as possible threats to protected species locations, protected forest and grassland habitats, and protected trees:

- direct impact resulting from the destruction of natural values during wind turbine construction;
- indirect impact expressed as fragmentation of habitat areas, potential drainage caused by changes in hydrological conditions, and an increase in edge effects within habitats.

According to the expert assessment, construction of the planned wind turbines No. 2, 3, 4, 5, 8, 9, 10 and 14 and their access roads is not expected to cause negative impacts on specially protected species, habitats or other natural values, and no impact mitigation measures are required.

Construction of the planned wind turbines No. 1, 6, 12 and 13 and their access roads may result in a potential minor negative local impact on natural values – indirect impact on three large-dimension trees, as well as indirect impact on the microclimate of habitat 9010* Old or natural boreal forests over an area of 0.2 ha (see Figure 3.3.4). It is predicted that a valuable forest stand of approximately 0.2 ha will be felled and that hydrological conditions within this area may be indirectly affected (see Figure 3.3.3). The impact can be reduced by implementing mitigation measures (see Table 3.3.4).

Construction of the planned wind turbines No. 7 and 11 and their access roads may result in a potentially significant local negative impact on natural values – including possible destruction of individual locations of the specially protected moss species Hamatocaulis vernicosus (see Figure 3.3.3), predicted changes in hydrological conditions over an area of 0.6 ha within habitat 91E0* Alluvial forests (alluvial riparian and floodplain forests), and direct impact on one veteran tree (see Figure 3.3.4). The impact can be avoided by applying appropriate mitigation measures (see Table 3.3.4).

The construction of substation Alternative A and BESS Alternative A/1 is not expected to cause negative impacts on habitats of specially protected species, EU protected habitats or protected trees. Construction of substation Alternative B and BESS Alternative B/1 is expected to result in a negative impact on the microclimate of EU protected forest habitat 9010* Old or natural boreal forests over an area of 1.3 ha and on the hydrological regime over an area of 2.2 ha (see Figure 3.3.5). The impact is assessed as a significant negative impact at the local scale, or as an insignificant impact if mitigation measures are taken into account.

Forest land, particularly long-established forest complexes, is essential for maintaining biodiversity. Forests fulfil the function of ecological corridors and serve as potential habitats for specially protected species – including forest stands and individual structural elements within them (standing deadwood, fallen trees). Subchapter 2.3.3 summarises information on forest areas subject to deforestation, as well as their distribution by age groups.

For Alternative A, deforestation of 4.10 ha is predicted, while for Alternative B, deforestation of 4.92 ha is predicted. In both alternatives, the distribution by age groups is similar – 82–88% consists of young stands, middle-aged stands and maturing stands. Deforestation is not expected to cause significant impacts on specially protected plant species and habitats.

In summary, the impact on EU protected habitats and species habitats at regional and national scales is considered an insignificant adverse impact; however, locally within the forest complex, it is considered a potentially significant adverse impact that can be reduced by implementing mitigation measures. A detailed description of the impacts associated with the construction of WTGs and related infrastructure is provided in the habitat expert opinion included in original EIA Report (Appendix 7).

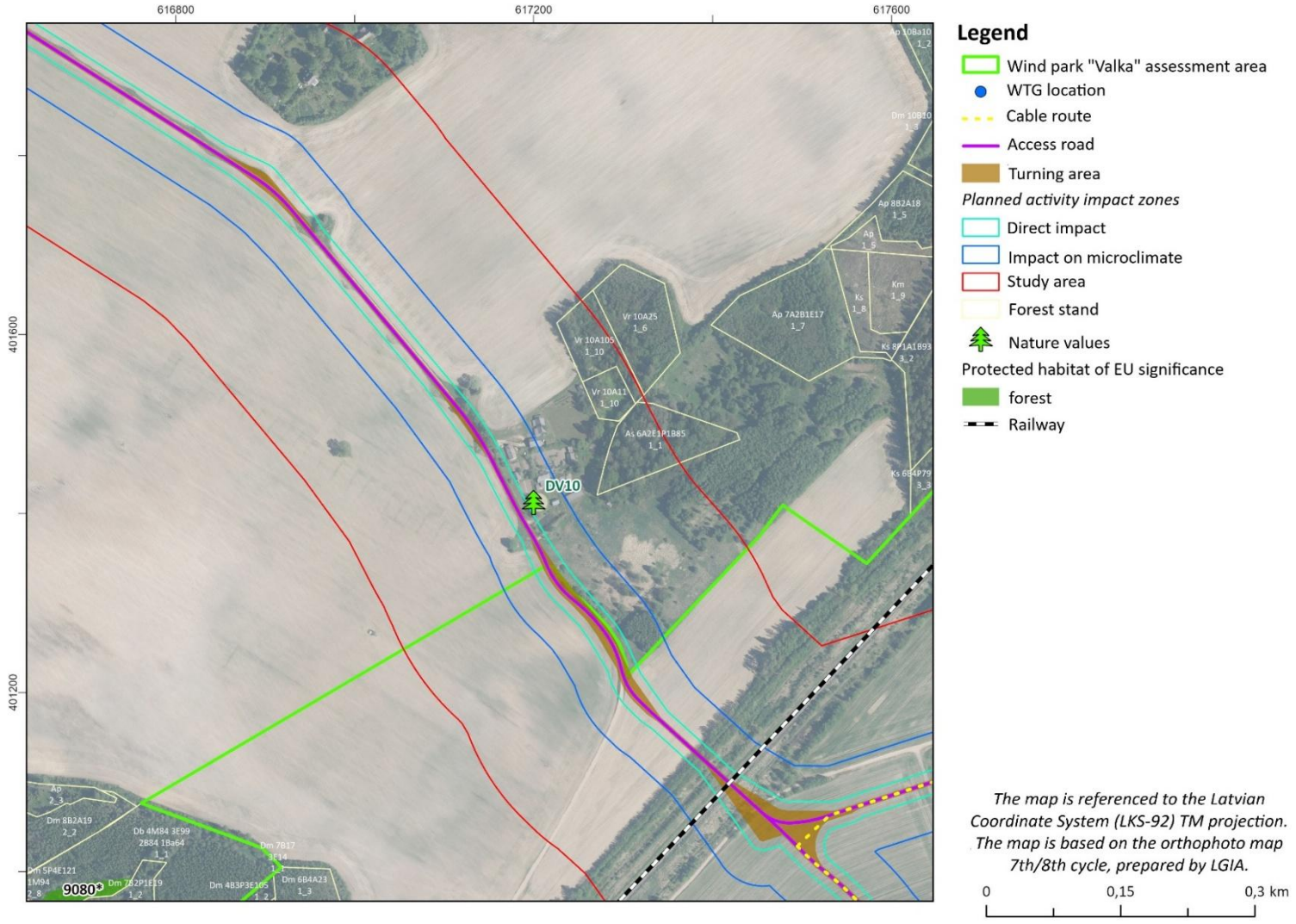


Figure 3.3.2. Planned access road and location of protected tree

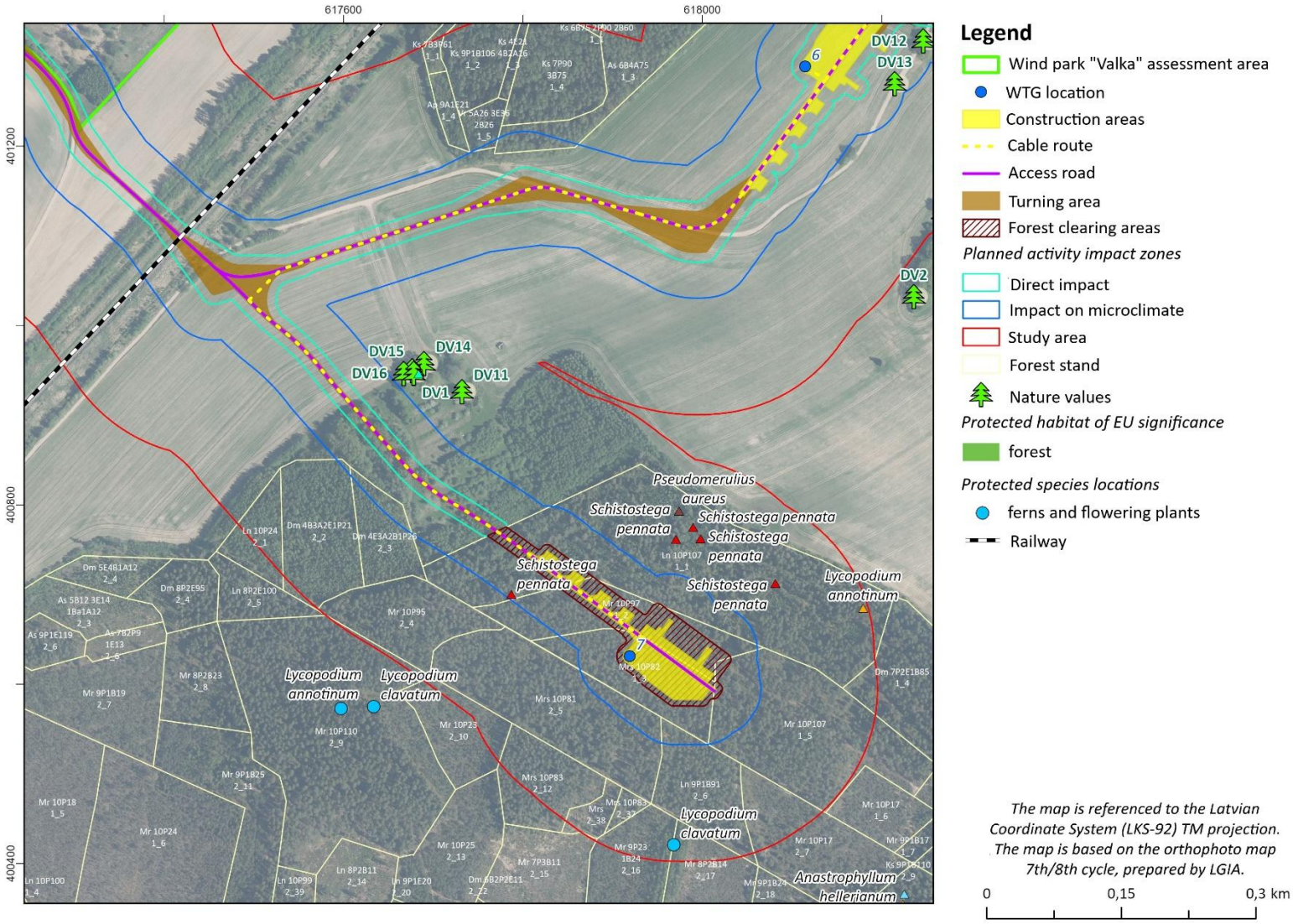


Figure 3.3.3. Location of wind turbine No. 7 and associated infrastructure, protected trees and plant species

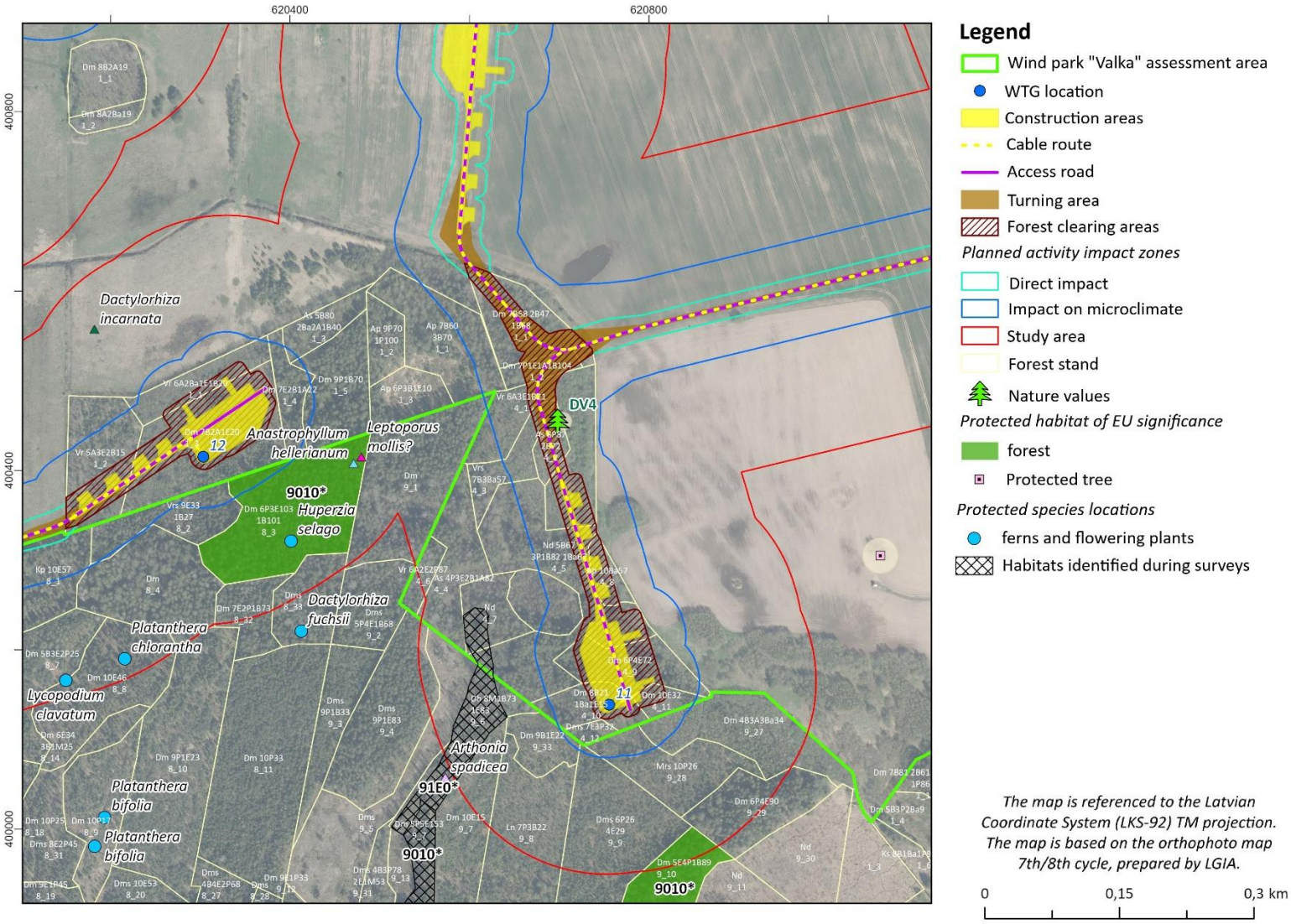


Figure 3.3.4. Location of wind turbines No. 11 and 12 and associated infrastructure, protected trees, species and forest habitats

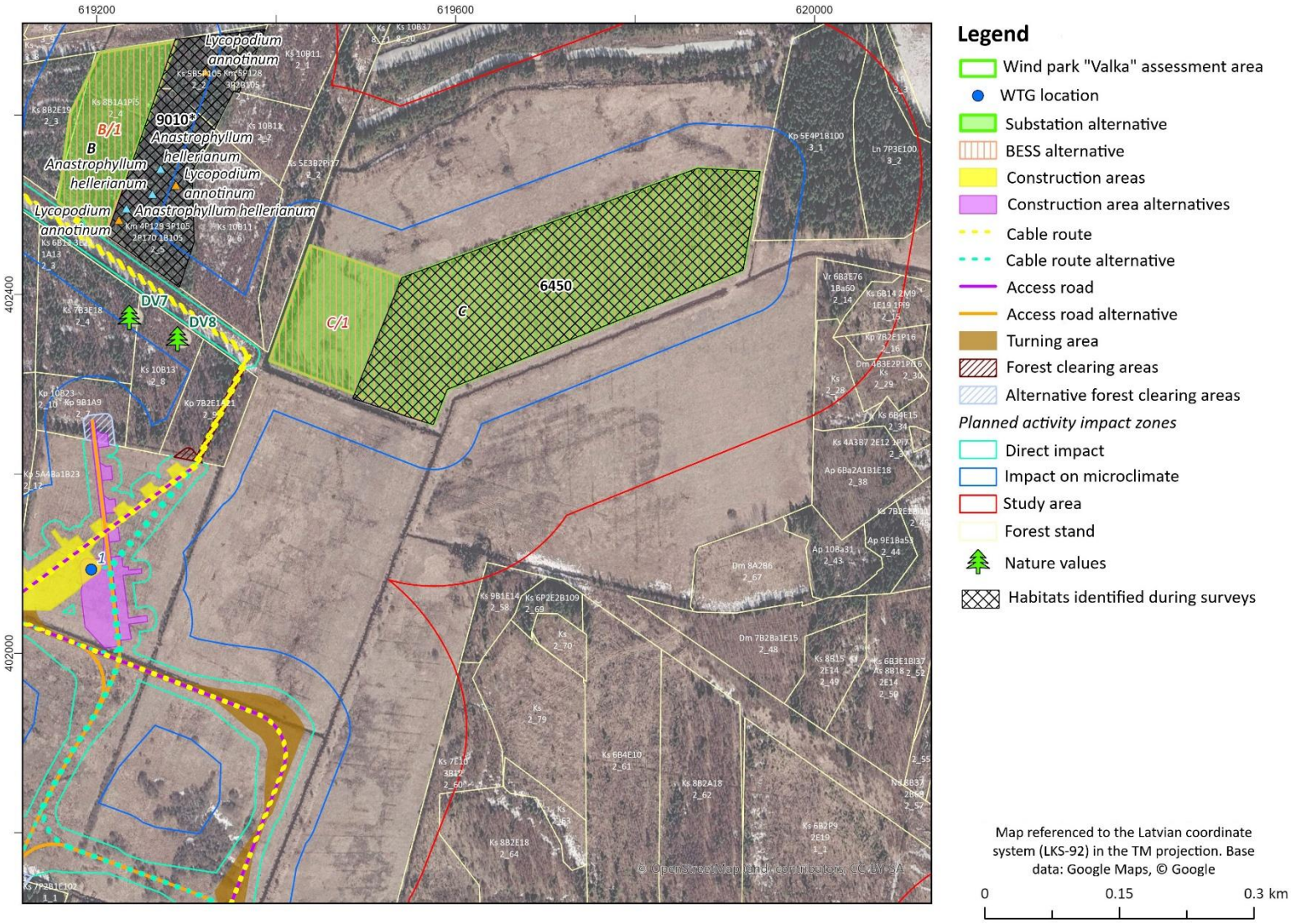


Figure 3.3.5. Location of wind turbines sites, substation Alternative B, BESS Alternative B/1 and associated infrastructure, protected trees, species and forest habitats

3.3.3.4. Mitigation measures

Construction of the wind farm may cause negative impacts on specially protected habitats and other natural values if impact mitigation measures are not implemented. Measures to prevent and reduce potential impacts on natural values have, where possible, already been implemented during the preparation of expert opinions by assessing the initial layout of wind turbine infrastructure within the study area and providing planners with information on identified natural values and possible alternative locations for wind turbines and associated infrastructure. The main mitigation measures recommended by experts are related to maintaining the hydrological regime and applying construction restrictions.

Table 2.3.3.4. Precautionary measures for reducing impacts during the construction of wind turbines and infrastructure of the "Valka" wind farm

Location	Applicable measure
Wind turbine No. 1 access road	During construction of the access road between wind turbines No. 1 and No. 3, at the Seda River crossing, a culvert with an appropriate diameter or width corresponding to the width of the riverbed shall be used. The culvert shall be installed with an allowable immersion depth of 20% of its diameter or width if a flattened culvert is used (a 5 m wide culvert is recommended). The optimal solution would be construction of a bridge that does not affect the riverbed. When constructing a new access road or cable route crossing the Seda River, free water flow within the existing watercourse width shall be maintained, barriers or steps shall not be created, and bank vegetation shall be restored after completion of works. Implementation of this measure would reduce potential negative impacts on significantly modified watercourses occurring within the assessment area and prevent the introduction of suspended soil particles, as well as various plant protection products and fertilisers used in agricultural areas, into rivers.
Wind turbine No. 6 (see Figures 3.3.2 and 3.3.3)	During construction, protection of the identified large-dimension trees (DV 10, 12, 13) shall be ensured by prohibiting movement of heavy machinery, storage of materials and placement of excavated soil within a 10 m radius around their trunks. Installation of protective fencing around the tree protection zones is recommended.
Wind turbine No. 7 (see Figure 3.3.3)	Construction of the wind turbine within the forest massif, crossing the land unit with cadastral designation 94880090187, compartment 1, stand 1, shall be carried out using the technically narrowest possible deforestation corridor option. Implementation of this measure will reduce the potential negative impact on the habitat of the identified protected and rare moss species – Schistostega pennata.
Wind turbine No. 11 (see Figure 3.3.4)	The access road location shall be refined by relocating it at least 20 m away from the identified veteran tree (DV 4). Works associated with road construction – formation of road embankments, construction of side ditches, movement of machinery, storage of materials, placement of excavated soil, etc. – shall not be carried out within the protection zone of the veteran tree (10 m radius from the tree crown projection). Protection of the tree shall be ensured during construction. The location of the veteran

Location	Applicable measure
	tree and crown projection shall be refined during the design stage through topographic surveying. At the lowest elevation points of the planned wind turbine assembly areas, embankments shall be constructed where necessary, avoiding construction of ditches deeper than 0.5 m on the western side of the assembly area. This will prevent negative impacts on the hydrological regime of the protected alluvial forest habitat.
Substation Alternative B and BESS Alternative B/1 (see Figure 3.3.5)	The substation and BESS shall be redesigned by planning the areas requiring tree felling no closer than 50 m from the habitat polygon 9010* Old or natural boreal forests. The area shall be constructed on an embankment without excavation of new ditches or deepening of existing ditches. By implementing mitigation measures, negative impacts on changes to the hydrological regime and microclimate of the habitat can be avoided.

Considering that the wind turbine and infrastructure layout assessed in the EIA Report may change, the following mandatory condition is established: **during the preparation of the construction design, the expected impact on EU protected habitats shall be reassessed, taking into account the designed infrastructure layout. If it is determined that the implementation of the designed solutions will result in the destruction of EU protected habitats or create a risk of deterioration of their quality, the project proponent shall prepare a compensation measures plan, which shall be submitted to the Nature Conservation Agency for approval. The plan and approval from the Nature Conservation Agency shall be attached to the construction design documentation.**

The areas of affected habitats shall be reassessed after completion of infrastructure construction works and, if necessary, the compensation measures plan shall be updated. Compensation measures shall be implemented in accordance with the conditions established by the Nature Conservation Agency.

If, during the preparation of the construction design, it becomes necessary to relocate infrastructure objects associated with the wind farm, modify the configuration of wind turbine construction platforms, increase the area requiring deforestation for construction platforms, or place new objects within the territory that were not assessed in this Report, such as material storage areas, water abstraction points, etc., the selected solutions shall be discussed with species and habitat experts during the construction design stage. An expert opinion prepared by a certified expert shall be obtained and submitted to the Nature Conservation Agency for approval. The expert opinion and approval from the Nature Conservation Agency shall be attached to the construction design documentation.

Any changes made shall also be subject to the previously established requirement regarding compensation for damage caused to habitats.

3.3.3.5. Assessment of alternatives

When assessing the proposed activity, technological alternatives were analysed – namely, construction of different wind turbine models. Considering that all technological alternatives

assessed are considered equivalent with regard to factors that may affect the protection of protected habitats, protected species and veteran trees, there is currently no basis to consider any of the assessed wind turbine models as preferable. Technological alternatives, considering their equivalence from the perspective of nature conservation, may therefore be selected based on other considerations, such as technological efficiency or economic performance indicators.

The most significant differences in terms of impacts on EU protected habitats, locations of specially protected plant species and protected trees are expected to result from differences in the layout alternatives of wind turbines and associated infrastructure. Regarding the arrangement of construction platforms in Alternatives A and B, differences occur in the locations of wind turbines No. 1 and 2; however, no advantages have been identified for either alternative in terms of protected plant species, habitats or trees.

Considering that 14 wind turbine construction locations have been assessed for the planned wind farm, but the number of constructed wind turbines may be lower due to available grid capacity limitations, Chapter 6 of the EIA Report includes an assessment of wind turbine location alternatives, including the assessment described in this chapter.

For the layout of cable routes and access roads, a minor advantage has been identified for Alternative A in the section between wind turbines No. 1 and 9, where the routes are planned through managed agricultural land and do not cross forest land. In the case of Alternatives A and B, a smaller deforestation area is predicted for Alternative A (0.82 ha less).

For the planned substation and BESS alternatives, from the perspective of specially protected plant species, habitats and protected trees, preference should be given to Substation Alternative A and BESS Alternative A/1, as their construction is not expected to result in negative impacts on habitats of specially protected species, EU protected habitats or protected trees.

Implementation of Substation Alternative B and BESS Alternative B/1 is expected to result in a locally significant negative impact, or an insignificant impact if mitigation measures are taken into account.

3.3.4. Bats

This chapter analyses the potential impact of the planned "Valka" wind farm on bat populations in the vicinity of the proposed activity. The impact assessment is based on the assessment prepared by Alise Elksne, bat expert of SIA "Dabas eksperti" (certificate No. 236). The expert opinion describes the potential impact of the construction and operation of the planned wind farm on the identified bat species both within the wind farm area and its surroundings, and provides recommendations for reducing potential impacts and for further monitoring.

The expert report was prepared based on Regulation No. 925 of the Cabinet of Ministers of 30 September 2010 "The Content of an Expert Opinion in the Field of Conservation of Species and Biotopes and the Minimal Requirements Contained Therein", issued in accordance with Article 4, Paragraph 17 of the Law on the Conservation of Species and Habitats, as well as taking into account the EUROBATS guidelines "Guidelines for Consideration of Bats in Wind Farm Projects" and the "Guidelines for Assessing the Impact of Wind Turbines on Bats" developed by the Latvian Bat Research Society in 2022. The expert opinion is included in original EIA Report (Appendix 8).

3.3.4.1. Impact assessment approach

According to the methodology applied in Latvia (Latvian Bat Research Society "Guidelines for Assessing the Impact of Wind Turbines on Bats"), the "Valka" wind farm study area was surveyed for two nights during each survey period – in May, June, July, the first half of August (until 15 August), the second half of August (after 15 August), the first half of September (until 15 September), and the second half of September (after 15 September).

The survey periods were selected according to the biological cycle of bats, including breeding, migration and mating periods. In August and September, surveys were carried out more frequently to determine whether increased bat activity associated with migration could occur within the wind farm area. Visits to the wind farm site were carried out during nights with low or moderate wind speeds and without precipitation or with short-term precipitation periods, when a reduction in bat activity due to weather conditions was not expected.

Bat activity was recorded using the acoustic method (ultrasonic detectors), which was primarily focused on detecting so-called open-space species. The orientation calls of open-space species are adapted for hunting away from trees or other obstacles in open areas; they are relatively loud and contain pronounced constant-frequency or near-constant-frequency components. Measurements of the constant-frequency component using sound analysis software facilitate identification of these species.

Bat recordings were performed using ultrasonic detectors. Five D-500x ultrasonic detectors manufactured by the Swedish company Pettersson Elektronik AB were used for one-night surveys. Four detectors were used for automatic bat recordings at fixed stationary points without human presence, while one detector was used for route surveys, operating in automatic mode at each survey point along the route.

Selection of routes and stationary survey locations

Bat surveys were carried out for two nights during each survey period, with a different part of the planned wind farm area surveyed each night. Bat activity monitoring was performed by placing ultrasonic detectors at stationary survey points (four points per night) and by conducting route surveys (one route per night) (see Figure 3.3.4.1). The selection of stationary points where detectors were installed was carried out before the field surveys started in May, based on daytime site inspections. Thus, bat activity within the wind farm area was recorded at a total of eight survey points.

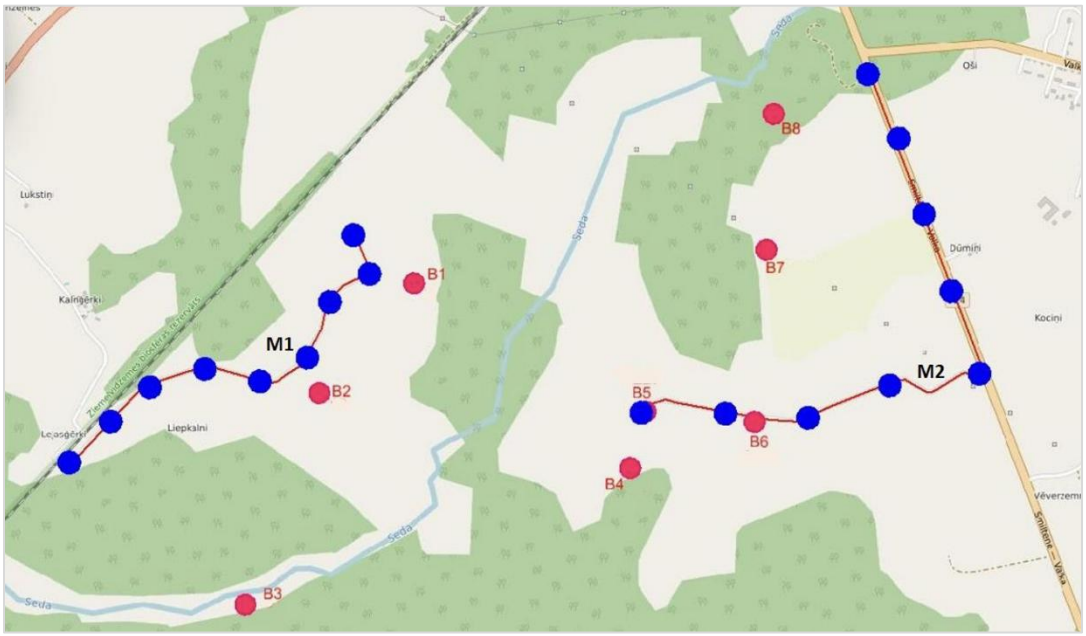


Figure 3.3.4.1. Location of stationary survey points. Points are marked with blue circles and assigned numbers B1 – B8. Survey routes, marked with white lines, are designated N1 and N2

Route surveys started one hour after sunset. During the surveys, bat ultrasonic calls were recorded at nine survey points, with a total recording duration of 90 minutes. The second and third hours after sunset were selected for route recordings because the highest bat activity during the night is usually observed during these hours. Automatic recorders (B1 – B8) at the stationary survey points recorded continuously throughout the night.

The stationary survey points were selected taking into account the proportional distribution of planned wind turbines within habitats. In forest habitats, open-space bat species usually forage in various open areas – above forest roads, clearings, forest gaps and forest edges. Therefore, the selected survey points were located near such habitat structures. The selected survey points and their habitat types are summarised in Table 3.3.4.1.

Table 3.3.4.1. Stationary survey points and their location within habitats

Point	Habitat	Latitude	Longitude
B1	Field	57.74009	25.99179
B2	Field	57.73654	25.986
B3	Forest	57.72781	25.9798
B4	Edge of forest	57.73207	26.00794
B5	Field	57.7352	26.01049
B6	Field	57.73382	26.01807
B7	Edge of forest	57.74128	26.01937
B8	Forest	57.74652	26.02052

At the monitoring stations, ultrasonic detectors were installed in the evening and collected again on the following day. The detectors were placed on the ground or suspended from tree branches

at a height reachable from the ground. Their microphones were oriented towards open areas, directed upwards at an angle of 30 – 45°. Detectors placed on the ground were camouflaged using grass, moss or branches.

Data analysis

Automatic detectors record all sounds within a specified frequency range; therefore, recordings were analysed using the sound analysis software BatSound 4.1.4. Since automatic detectors record all sounds within the specified frequency range, prior to further file analysis, only those files containing bat recordings were selected from the acoustic recordings obtained during the survey season. The observation time was marked for each recording for subsequent analysis of bat activity during the night. Data were compiled and analysed in Excel spreadsheets.

To enable comparative analysis of bat recording data, the number of bat passes per hour (activity or activity index) was determined for each species at each survey point, and all further analyses were performed using the transformed data. The quartile method was used to assess bat activity. Data from 44 sites in Latvia (including the wind farm area surveyed within this study), where bat monitoring was carried out between 2019 and 2024 using the same methodology and ultrasonic detectors of the same model, were used for this purpose.

3.3.4.2. Description of existing situation

Overall, during the acoustic monitoring carried out in 2024, 467 bat call recordings were obtained, in which 483 bat passes were recorded. Five bat species were observed within the planned wind farm area (see Table 3.3.4.2): Northern bat (Eptesicus nilssonii) – 88% of recorded calls, Common noctule (Nyctalus noctula) – 5%, Nathusius' pipistrelle (Pipistrellus nathusii) – 1%, Parti-coloured bat (Vespertilio murinus) – 1%, Brown long-eared bat (Plecotus auritus) – <1%. In addition, bats of the genus Myotis were recorded (4%). The bat species observed within the wind farm area include both hibernating and migratory species.

Table 3.3.4.2. Bat species identified in the planned "Valka" wind farm area during May – September 2024 and their status in Latvia

Bat species (Latin name)	Migratory or hibernating species
Eptesicus nilssonii	Hibernating
Nyctalus noctula	Migratory
Vespertilio murinus	Partly migratory, partly hibernating
Myotis spp.	All species hibernating
Pipistrellus nathusii	Migratory
Plecotus auritus	Hibernating

The "loudness" of bat calls differs between species; therefore, in order to assess the relative frequency of occurrence of different bat species based on bat call recordings (relative occurrence), species-specific detection coefficients must be applied. Based on relative occurrence, the most frequently occurring species within the planned "Valka" wind farm area are northern bats. The relative occurrence of northern bats is 79%.

The second most frequently occurring group consists of noctule bats, with a relative occurrence estimated at 11%. The occurrence of brown long-eared bats is estimated at 6%, while common noctules account for 2%. The relative occurrence of Nathusius' pipistrelles and parti-coloured bats within the wind farm area is estimated at 1% (see Figure 3.3.4.2).

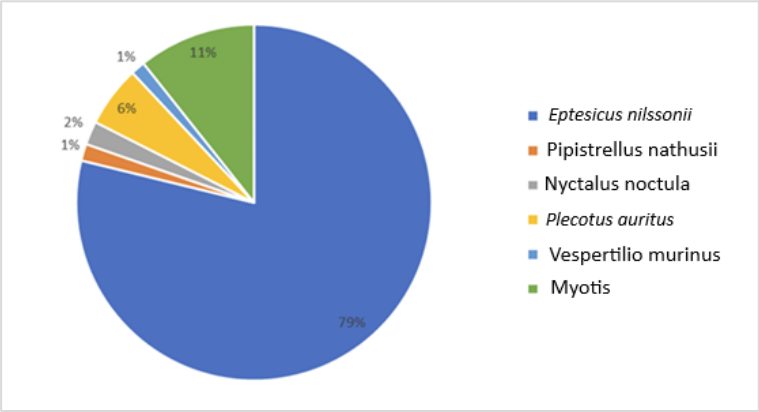


Figure 3.3.4.2. Bat species observed within the "Valka" wind farm area and their relative occurrence during the 2024 season

Bats are active throughout the night, with the highest activity usually observed during the second and third hours after sunset. Increased bat activity may also occur during the later part of the night – several hours before sunrise. A similar pattern was observed within the planned "Valka" wind farm area, where the highest bat activity occurred during the second hour after sunset, reaching an average of 5.67 passes per hour. The third hour after sunset showed the third-highest activity level, with an average of 3.81 passes per hour. The second-highest bat activity was observed during the seventh hour after sunset, when average bat activity reached 4.62 passes per hour.

When interpreting the increase in bat activity during the second half of the night, it should be taken into account that night length varies throughout the survey season. For example, in July the night duration is only approximately 6 hours, whereas in September it may reach 11.5 hours. Therefore, the increase in bat activity during the seventh hour after sunset does not necessarily indicate that this pattern persists throughout the entire season. Rather, it suggests that increased bat activity may occur not only at the beginning of the night but also towards the end of the night. The pattern of highest bat activity occurring during the second and third hours after sunset remains consistent regardless of night length (Figure 3.3.4.3).

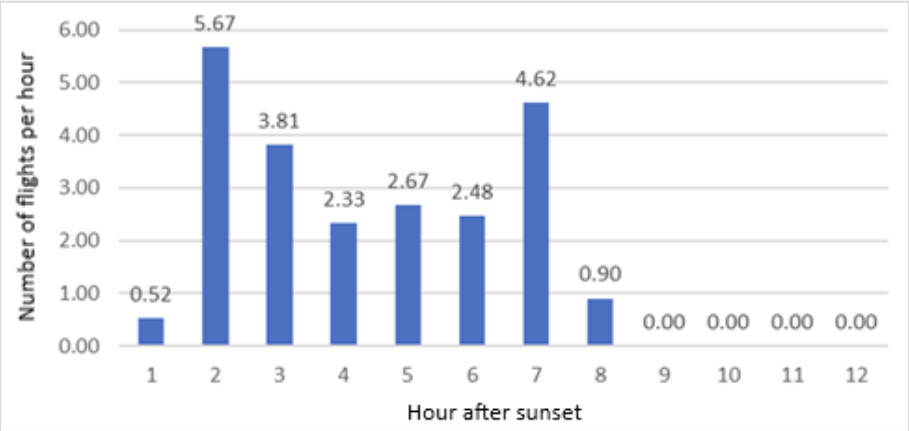


Figure 3.3.4.3. Average bat activity during night hours

For each designated survey point, the habitat type was recorded. The overall bat activity across the entire wind farm area was 1.05 passes per hour, which is assessed as low activity. Bat activity was relatively similar across habitats, with the highest activity recorded in forest habitats, reaching an average activity of 1.22 passes per hour. In open fields, activity was 1.02 passes per hour, while in forest edge habitats it was 0.9 passes per hour (see Figure 3.3.4.4).

Comparing bat activity in the habitats of the study area with bat activity recorded in the same habitat types in other areas, bat activity in forests is assessed as medium-high (threshold range: 0.98 – 2.11), and activity in open fields is also assessed as medium-high (threshold range: 0.95 – 2.53). Activity in forest edge habitats is assessed as medium-low (threshold range: 0.62 – 1.25). Practically the same species were observed in all habitat types, with the exception of brown long-eared bats, which were recorded in forest and forest edge habitats but were not observed in open fields. The proportion of observed bat species was also similar across all habitats – the highest proportion of records was attributed to the northern bat (Eptesicus nilssonii) (80% in forest edges, 89% in open fields and forests).

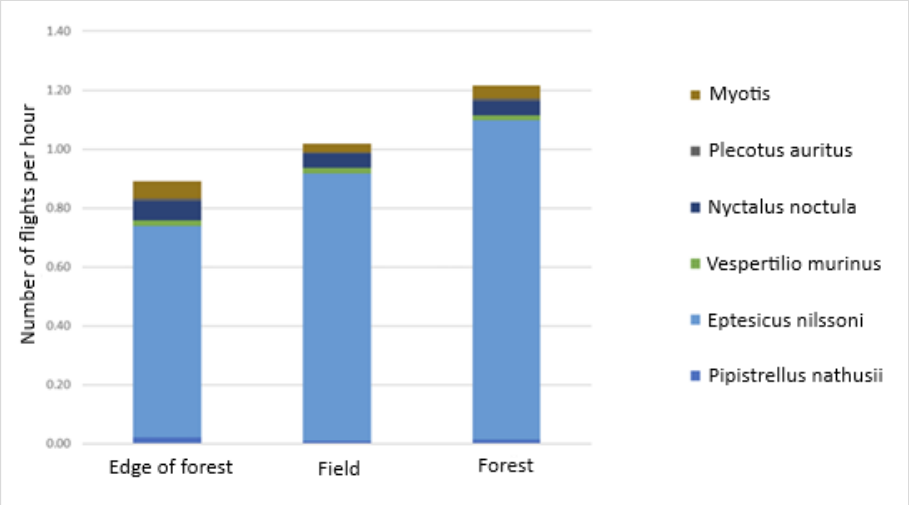


Figure 3.3.4.4. Average bat activity in habitats

The highest average bat activity was observed at stationary survey point B6, which was located in an open field. At this point, average bat activity was 2.2 passes per hour. The second most active point was B3, located in a forest habitat, where activity reached 1.8 passes per hour. The last point where activity exceeded 1.2 passes per hour was B7, which was located at a forest edge (see Figure 3.3.4.5).

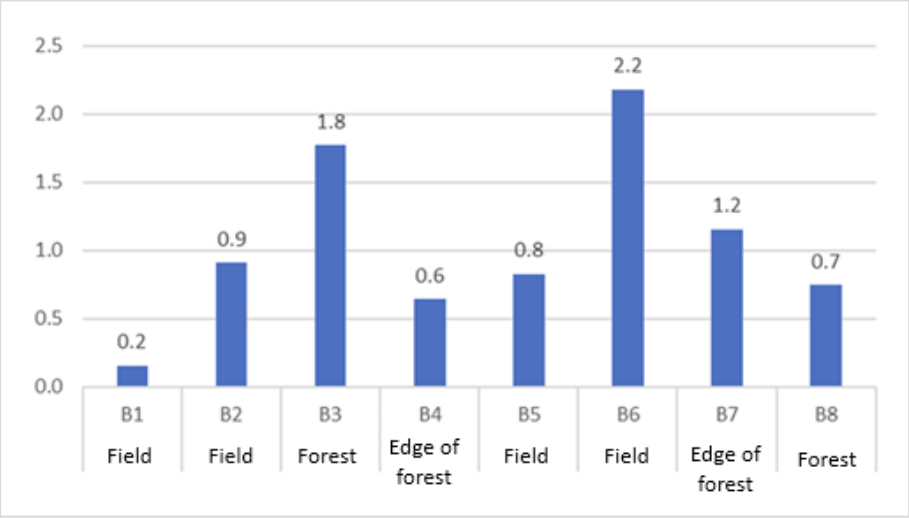


Figure 3.3.4.5. Bat passes at stationary survey points during the 2024 season within the "Valka" wind farm area

The highest bat activity recorded at a stationary survey point located in an open field is considered atypical. This can be explained by the presence of the Seda River, as several smaller tributaries of this river cross the study area. Survey point B3 was located in a forest near the Seda River. Open water bodies generally increase bat activity; therefore, one of the highest activity levels at this point was expected. Survey point B6 was located in an open field at the edge of a tree group. A larger tributary of the Seda River was located near this tree group. Bat activity often increases in the vicinity of such groups of trees.

Increased bat activity is usually associated with open water bodies and tree structures. However, the presence of these factors does not automatically result in increased bat activity. For example, survey point B1 was also located in an open field at the edge of a tree group, but bat activity at this point was the lowest – an average of 0.2 passes per hour. Point B5, located near B6, was also situated in an open field adjacent to the same Seda River tributary as B6. However, bat activity at this survey point was only 0.8 passes per hour.

It is generally expected that the highest bat activity occurs in forests or forest edge habitats. Higher bat activity in forest habitats can be explained by the availability of feeding areas, as well as the use of forest areas for movements between daytime roosts and feeding grounds. Overall, bat activity in the area was assessed as low, and it is likely that the territory is inhabited by a relatively small number of bats. However, the proximity of water bodies and tree structures may create locally favourable feeding conditions, resulting in increased bat activity in certain parts of the wind farm area.

Bat activity along survey routes

Bat activity during the first night (M1) and second night (M2), as well as average bat activity at stationary survey points during the second and third hours after sunset, is shown in Figure 3.3.4.6. Bat activity along the survey routes was considerably lower than the average bat activity recorded at stationary survey points. During the first night route survey, average bat activity was 1.33 passes per hour, while during the second night route survey it was 5.9 passes per hour. The average bat activity across all stationary survey points was 13.86 passes per hour.

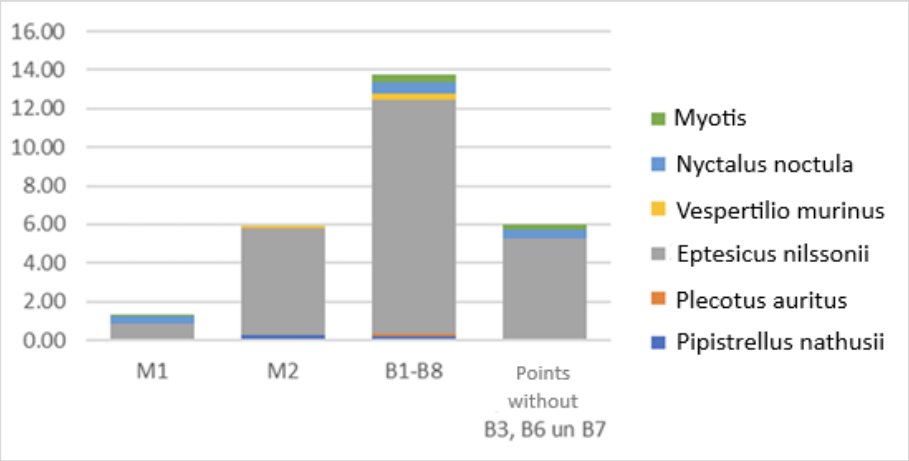


Figure 3.3.4.6. Bat activity along survey routes and at survey points during the 2nd – 3rd hours after sunset

These results indicate that increased bat activity occurred at individual stationary survey points. Bats are not expected to be distributed evenly throughout the territory; instead, they are more frequently encountered in locations where optimal feeding conditions occur – areas where higher concentrations of insects are present. Overall bat activity within the territory is assessed as low, but areas with increased bat activity may occur locally within the wind farm area.

Seasonal bat activity

The way bats use an area changes according to their biological cycle requirements. For example, during the breeding period bats are more closely associated with a specific location and mainly local populations are observed, whereas during migration periods migratory bats may temporarily use the area. Seasonal bat activity within the wind farm area is shown in Figure 3.3.4.7. The highest bat activity within the area was observed in June and August. These seasonal activity patterns are mainly influenced by the behaviour of the most frequently recorded species in the area – the northern bat.

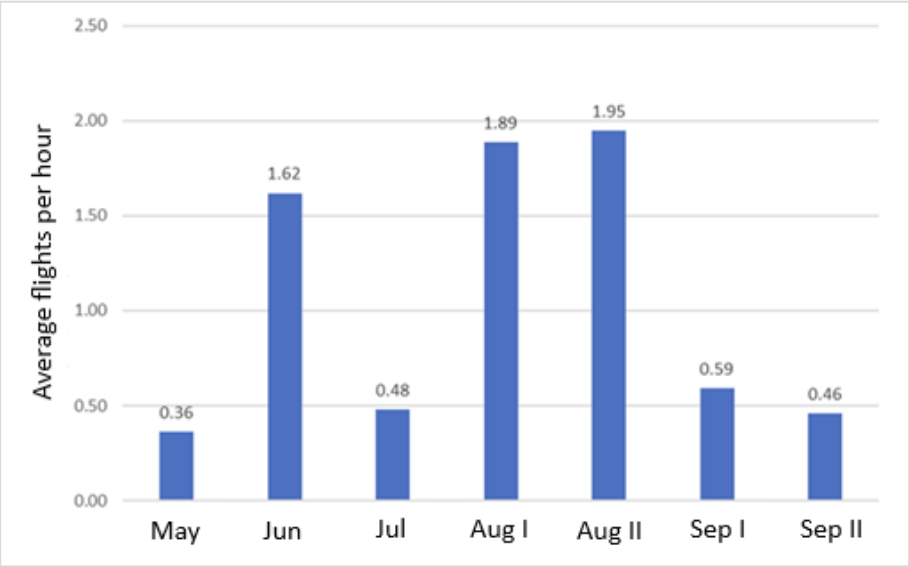


Figure 3.3.4.7. Seasonal bat activity within the planned "Valka" wind farm area in 2024

3.3.4.3. Impact on bats

Any wind farm constructed in Latvia causes and will continue to cause negative impacts on bat populations. According to studies conducted in other countries regarding the impact of wind turbines on bats, the most significant negative impacts are considered to be bat mortality due to collisions with wind turbines, as well as habitat loss associated with wind farm construction. Bats are not always able to avoid collisions with rotor blades; they may suffer injuries or die due to internal organ damage and haemorrhaging caused by barotrauma, which occurs when bats enter areas of reduced air pressure and air turbulence behind rotating blades.

Northern bat

The average activity of this species at survey points throughout the entire season was 0.93 passes per hour, which is considered medium-low activity in the Latvian context. The highest activity of the northern bat in the study area was observed in June and during both August surveys. The northern bat is a species commonly occurring in the northern part of Europe.

The northern bat is considered a high-risk species in terms of mortality risk associated with wind turbines. In addition to collision risk, construction of a wind farm in forest areas may cause disturbance, as a result of which bats may be forced to avoid the area[54].

Other species

The activity of other bat species within the potential wind farm area is assessed as low. Common noctules, noctule bats and parti-coloured bats reached their highest activity levels in the study area during August. The increase in activity of all these species, as well as the northern bat, during August indicates that bats use locally favourable feeding conditions. August is associated with the

[54] 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. Vol. 231.

beginning of autumn migration (common noctule and parti-coloured bat), as well as regional movements of wintering bats and accumulation of energy reserves before wintering.

A potentially higher risk of collision/mortality occurs at wind turbines planned close to forests and other tree structures, while lower mortality risk is expected at wind turbines located in open fields. This assessment assumes that wind turbines shall be located at least 100 m away from rivers, ponds and lakes. The highest risk of bat mortality at wind turbines occurs during the 2nd to 7th hours after sunset. The highest bat mortality risk within the planned wind farm is expected from June to August, i.e., during the bat breeding and dispersal/migration period. However, if favourable feeding conditions develop, an increase in bat activity during other survey periods cannot be excluded.

Considering that changes were made to the initial wind turbine layout assessed for the "Valka" wind farm, the distribution of the wind turbines among habitats has also changed compared with the layout assessed in the EIA Report. Initially, 15 wind turbines were planned (9 in open fields, 2 at forest edges, and 4 in forests), while after the changes the layout includes 14 wind turbines (5 in forests, 7 in open fields, and 2 at forest edges). As a result, the proportion of wind turbines associated with an increased bat mortality risk has increased. Considering that higher bat activity is expected in forest habitats, these changes are acceptable only under the condition that the mitigation measures described in the following subsection are implemented.

3.3.4.4. Mitigation measures

The establishment of the "Valka" wind farm is permissible only subject to the following wind turbine operational restrictions and conditions:

1**. During operation of the wind farm, shutdown or prevention of operation of wind turbines shall be ensured from 20 May to 10 September during nighttime hours, from sunset to sunrise, when all of the following conditions are met simultaneously:**

a) wind speed is 5 m/s or lower;
b) air temperature is above 6°C;
c) precipitation does not exceed 1 mm per hour.

2. Bat monitoring shall be carried out during the first, second and third years after the commencement of wind turbine operation. The monitoring methodology shall be implemented in accordance with the Latvian Bat Research Society guidelines "Guidelines for Assessing the Impact of Wind Turbines on Bats", involving a bat species expert certified by the Nature Conservation Agency (NCA). The expert shall adapt the methodology described in the guidelines to the conditions of the wind farm area. The monitoring methodology shall include:

a) acoustic monitoring using ultrasonic detectors at ground level;
b) acoustic monitoring using ultrasonic detectors installed in wind turbine nacelles;
c) monitoring of bat fatalities beneath selected wind turbines.

It is recommended that acoustic monitoring in wind turbine nacelles is carried out by installing automatic ultrasonic detectors in the nacelles, which record bat activity from 1 April to 31 October. The selection of wind turbines to be equipped with detectors shall take into account

recommendations provided by an NCA certified bat species expert and the actual (constructed) wind turbine distribution across different habitat types.

Bat fatality monitoring shall be carried out by trained searchers, while simultaneously controlling search efficiency and carcass persistence time. Dead bats shall be searched either: within the vegetation-free area around the wind turbine base for all turbines (with results extrapolated to the total projected area of all wind turbines); or within the entire rotor-swept area of selected turbines, where vegetation conditions allow such surveys.

Based on monitoring results after the first year, wind turbine operational restrictions may be modified – either relaxed or strengthened – according to the results of bat carcass searches and acoustic monitoring. Following the results of the second and third years of monitoring, wind turbine operational restrictions shall be reviewed again if necessary.

3.3.4.5. Alternatīvu vērtējums

When assessing the proposed technological alternatives in relation to bat species, no significant factors providing advantages for the selection of a specific technology have been identified. Considering that 14 potential wind turbine construction locations have been assessed for the wind farm, but the number of wind turbines constructed may be lower due to grid capacity limitations, the impact on bats has been included as a criterion in the overall assessment of each wind turbine layout alternative in Chapter 6 of the EIA Report.

3.3.5. Ornithofauna

his chapter assesses the impact of the construction and operation of the planned "Valka" wind farm on ornithofauna. The chapter was prepared using the expert opinion prepared by Nature Conservation Agency certified experts – Jānis Ukass (expert certificate No. 249), Elza Marija Zacmane (expert certificate No. 259) and Pēteris Daknis (expert certificate No. 221). The expert opinion includes information on the current situation, potential impacts of the planned wind farm, impact mitigation measures and recommendations for further monitoring. The expert opinion is included in original EIA Report (Appendix 9).

3.3.5.1. Impact assessment approach

To assess the impact of the planned wind farm on breeding birds in the vicinity of the proposed development, the ornithological survey area included both the wind farm area and a 2 km buffer zone around the planned wind turbines, forming a total area of 30.6 km². Additional surveys were also carried out outside this area to refine the conclusions of the assessment.

Within the framework of the study, all planned wind turbine construction locations and surrounding areas were surveyed in the field, and forest stands in the immediate vicinity of these locations were inspected. Surveys included recording specially protected bird species, searching for large nests and conducting migratory bird counts. Large nests were surveyed not only from the ground but also by documenting nest conditions using an unmanned aerial vehicle (drone).

Information from the Nature Data Management System "Ozols" and the portal dabasdati.lv was used in the assessment. The latter contains historical observations of birds reported by other observers within and around the proposed activity area. Although the main surveys were

conducted within a distance of up to 2 km from the planned wind turbines, historical data were also analysed for the wider surrounding area in order to obtain a broader understanding of bird species occurring in the area and potential breeding species.

The following activities were carried out during the study:

- The territory was surveyed using field observation methods to identify specially protected species occurring in the area.
- Surveys of corncrake, owls and nightjars were carried out using playback stimulation methods.
- During the autumn migration period (September – November), surveys were conducted from stationary observation points to assess migration intensity, species composition and behaviour, and locations used by migratory birds were identified.
- During the spring migration period (March – May), surveys were conducted from stationary observation points to assess migration intensity, species composition and behaviour, and locations used by migratory birds were identified.
- Passive acoustic monitoring (PAM) was carried out using autonomous recording devices to identify bird species presence and intensity of occurrence.
- During the breeding season, mapping of breeding protected bird species was carried out within the territory using field observation methods and deploying recording devices simultaneously at several locations.
- During the leafless period, suitable forest stands previously selected according to age and tree species composition were surveyed by walking through the areas and examining them from the air using a drone in order to identify large bird nests.
- During the breeding season, all known nests of birds of prey and large nests were monitored to determine breeding success.

Field surveys within the territory (Figure 3.3.5.1) were carried out from 9 March 2024 to 12 February 2025, with each survey season focused on the surveys and investigations relevant to the respective period. In addition to targeted surveys and investigations, incidental bird observations were also recorded within the survey area, providing additional information on migratory birds and their concentration areas. The total length of preserved survey routes was 1175 km.

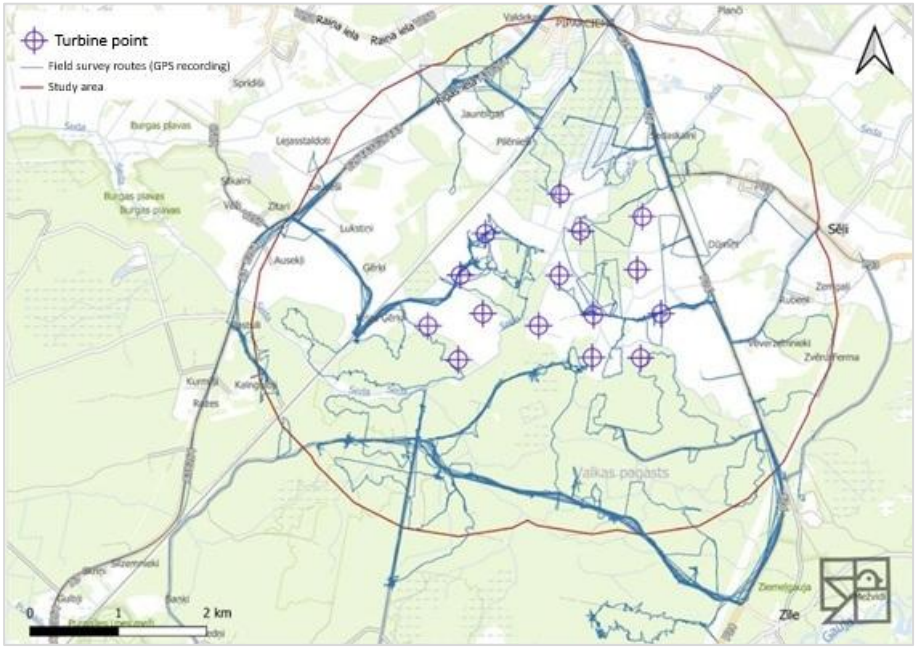


Figure 3.3.5.1. Field survey routes within the study area, including movement by vehicle and on foot

To assess the impact of the wind farm on habitats important for birds, spatial data on species-suitable habitats throughout Latvia developed within the research project "High-resolution biodiversity quantification for nature conservation and management: HiQBioDiv" were used. The analysis used habitat model results for 110 bird species, assessing both the availability of suitable habitats and their value within a distance of up to 1 km around the planned wind turbines.

For all habitat models, data cells above the maximum training data sensitivity and specificity threshold were selected. This indicator characterises the ability of the model to distinguish between suitable and unsuitable habitats when projecting habitat suitability for a species. Species-suitable habitats were divided into quartiles according to the equal interval principle, assuming that the lowest suitability values represent suboptimal habitats, while the highest values represent highly suitable habitats. Within the analysis, both the total area of habitats affected by the wind farm and their proportion relative to habitats of corresponding quality in Latvia were calculated. The resulting datasets allow assessment of the wind farm impact on bird-suitable habitats, comparison of different wind farms, and accumulation of information on the overall impact of wind farms in Latvia. If necessary, these data may be used to limit impacts or define compensation measures aimed at improving the conservation status of particular species. Particular attention was given to bird species for which the density of suitable habitats within the two highest quartiles exceeds the average density of suitable habitats in Latvia.

3.3.5.2. Description of existing situation and potential impact on ornithofauna

The "Valka" wind farm is planned to be constructed in a diverse mosaic-type landscape south of the town of Valka. A large forest complex is located south of the planned wind farm area. A small part of this forest complex in the southern section is included in capercaillie micro-reserves;

however, also outside the micro-reserves, the forest area contains high-quality old or natural boreal forest habitats, as well as pine forests rich in lichens.

Within the wind farm area and to the north of it, particularly closer to Valka and the railway line, the existing forests are mostly fragmented deciduous forests, many of which have relatively wet conditions and dense undergrowth. The planned wind farm area is currently actively used for both agricultural and forestry activities. Agricultural land is mainly used as arable land for cultivation of various crops. Agricultural areas are predominantly drained.

Natural grasslands also occur within the territory, including wet floodplain meadows along the Seda River, which flows in a northeast – southwest direction and crosses the study area. In the central part of the territory, unused agricultural areas consist of wet, tussocky grasslands that are rarely or historically managed. The potential wind farm area is characterised by gently undulating terrain, is generally well drained, and does not contain large bog areas.

The surroundings of the wind farm, except for the forest complex south of the park, are relatively densely populated. The area has a well-developed road network and an actively used railway line.

Micro-reserves have been established in the vicinity of the study area for the protection of Eurasian goshawk (Accipiter gentilis), Western capercaillie (Tetrao urogallus), and woodpecker species – two micro-reserves for white-backed woodpecker (Dendrocopos leucotos) and one for Eurasian three-toed woodpecker (Picoides tridactylus). The northwestern boundary of the "Ziemeļgauja" PLA is located approximately 2 km southeast of the territory, while the "Seda bog" Nature Reserve is located approximately 7 km southwest of the territory.

The following sections describe the specially protected bird species identified within the territory. For each species, information is provided on its conservation status and potential impacts from wind farm construction, as well as recommendations for measures required to reduce negative impacts on the respective species.

Western Capercaillie (Tetrao urogallus)

Capercaillie is a resident bird species that remains within its territory throughout the year. Globally, the species is not considered threatened (Least Concern – LC) and its population is increasing. The Latvian breeding population is assessed as endangered (EN)[55,56], although according to somewhat older breeding bird atlas data[57], the short-term population trend remains uncertain. Capercaillie is a specially protected species included in Annex I of the Birds Directive.

Within the study area, capercaillie occur only in the southern part, where suitable pine forest habitats are located[58]. The ornithological survey area includes part of one capercaillie micro-reserve, while two other micro-reserves are located nearby. Since adult birds (both females and

[55] Ķerus, V., Avotiņš, A., Auniņš, A. 2025. Latvijas Sarkanā grāmata. 6. sējums. Putni. Dabas aizsardzības pārvalde, Latvijas Ornitoloģijas biedrība, Latvijas Universitātes MDZF Bioloģijas institūts, Sigulda
[56] Turpmāk tekstā Latvijas Sarkanā grāmata izmantota sugas stāvokļa raksturošanai Latvijā
[57] Ķerus V., Dekants A., Auniņš A., Mārdega I. 2021. Latvijas ligzdojošo putnu atlanti 1980-2017. Rīga: Latvijas Ornitoloģijas biedrība.
[58] Strazds M. 1999. Medņa aizsardzības pasākumu plāns. Latvijas Ornitoloģijas biedrība, Rīga.

males) were observed during different seasons, and droppings and feeding sites were identified, it can be considered that active capercaillie leks continue to occur within the micro-reserves.

Outside the breeding and lekking period, capercaillie are generally considered to occur at distances of up to 3.5 – 4 km from the lek centre. Observations of capercaillie on or near roads correspond to this distance; however, these locations are sufficiently far from the planned wind turbine construction sites. It should also be taken into account that the wind farm is not planned within the forest complex inhabited by capercaillie, but rather in a mosaic landscape to the north, consisting mainly of agricultural land and floodplain meadows. The project area therefore does not include habitats used by capercaillie throughout the year.

According to the bird habitat suitability modelling results developed within the HiQBioDiv project, the most suitable capercaillie habitats are located south of the planned WTG construction sites (see Figure 3.3.5.2). Within 1 km of the wind turbines, there are 367 ha of low to medium suitability habitats (T – Q2) and 130 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats located near the wind farm account for 0.06% of such habitat area in Latvia.

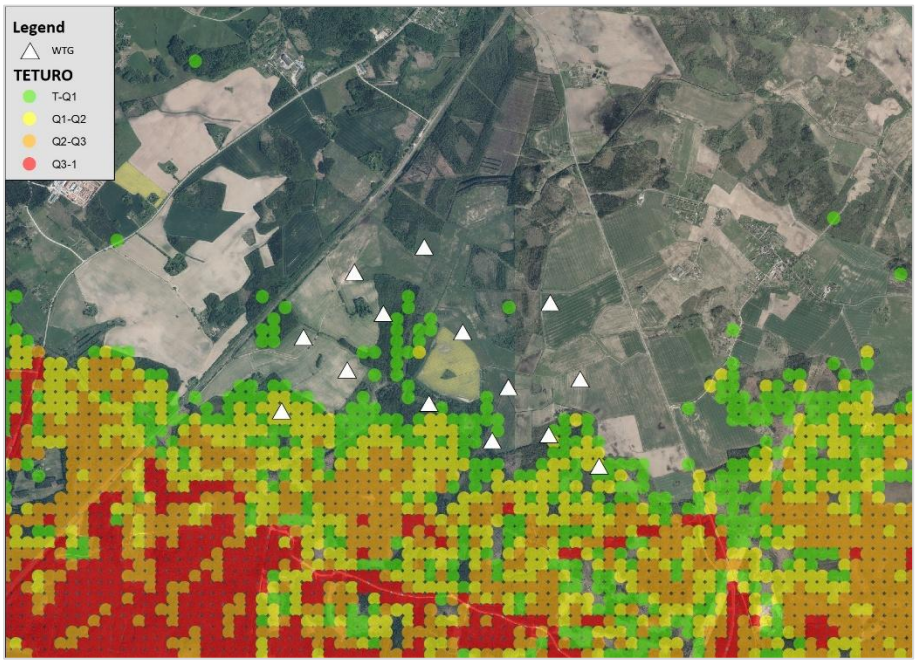


Figure 3.3.5.2. Distribution of capercaillie suitable habitats within the study area

Construction of wind farms within capercaillie habitats or in their immediate vicinity may significantly affect capercaillie populations by causing habitat quality deterioration, fragmentation and even habitat loss, as well as noise and shadow flicker disturbance. Studies indicate that capercaillie do not completely abandon areas affected by wind turbines; however,

habitat suitability decreases. This negative impact has been observed at distances of up to 865 m from wind turbines[59,60].

Within the planned wind farm layout, the southernmost wind turbines (No. 7 and No. 11) are located approximately 750 – 800 m from capercaillie observation locations, while wind turbine No. 7 is approximately 1 km from a micro-reserve established for capercaillie protection. It can therefore be concluded that the impact of the planned wind farm on capercaillie population status may be significant in the vicinity of the wind turbine located furthest to the southwest. The impact of wind turbine on habitats important for capercaillie could be reduced by relocating these wind turbines northwards and placing them on agricultural land.

Although not stated in the expert opinion, studies conducted in other countries[61] indicate cases where capercaillie mortality has occurred due to collisions with wind turbines. Considering the wind turbine dimensions assessed in this EIA Report, mortality of capercaillie due to collisions with rotor blades is considered almost impossible. At least in scientific literature, no information is available regarding typical capercaillie flights at heights of 80 m or higher. However, collisions with wind turbine towers under conditions of insufficient visibility remain possible. One solution used to reduce collision risks between grouse species and wind turbine towers is tower colouring[62]. Scientific literature indicates that the effectiveness of this measure is not very high; however, a reduction in grouse mortality at wind turbines with contrasting tower colours has been demonstrated. There are no unified guidelines regarding the optimal tower colouration for impact reduction; however, a darker lower section of the tower has been recognised as a measure that may reduce collision risks for grouse species.

Considering that tower colouring options are limited after wind farm operation begins, the Report authors consider that the developer should consider applying special colouring to the lower sections of WTG towers, at least for turbines located on forest land in the southern part of the wind farm, in the context of capercaillie protection. However, the relatively low effectiveness of this measure, the probability of collisions, and the potential landscape impact of the solution mean that this measure should be classified only as a recommendation for impact mitigation.

Black grouse (Lyrurus tetrix)

Black grouse is a resident bird species that remains within its territory throughout the year. Globally, the species population is not considered threatened (LC) and is increasing. In Latvia, the species population is assessed as vulnerable (VU). The short-term population trend in Latvia is

[59] Coppes, J. M. (2020). Consistent effects of wind turbines on habitat selection of capercaillie across Europe. Biological Conservation, 244, 108529. doi:10.1016/j.biocon.2020.108529

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

[61] T. Langgemach, T. Dürr, Informationen über Einflüsse der Windenergienutzung auf Vögel. Stand 05.02.2026, Aktualisierungen außer Fundzahlen hervorgehoben, Landesamt für Umwelt Brandenburg

[62] B.G. Stokke, T. Ntgard, U. Falkdalen, H. C. Pedersen & R. May (2020): Effect of tower base painting on willow ptarmigan collision rates with wind turbines. Ecology & Evolution 10: 5670–5679.

uncertain, while the long-term population trend is increasing. Black grouse is a specially protected species included in Annex I of the Birds Directive.

The habitat complex within the wind farm area is suitable for black grouse breeding, providing suitable lekking, nesting and feeding habitats throughout the year. Black grouse were not observed during field surveys, and expert conclusions are based on previous observations. The potential suitability of the area for black grouse is also supported by habitat suitability modelling results from the HiQBioDiv project. Suitable black grouse habitats occur throughout the wind farm area; however, most habitats are assessed as having low to medium suitability. Within 1 km of the WTGs, there are 835 ha of low to medium suitability habitats (T – Q2) and 121 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for 0.05% of such habitat area in Latvia.

Because black grouse flights, similarly to capercaillie, generally occur at low heights, the risk of collision with wind turbine blades is relatively low or even negligible. A higher possibility exists for collisions with power lines, wind turbine towers and other structures associated with the wind farm. This risk can be reduced by selecting object colours that are more visible to birds.

Wind turbine-generated noise affects black grouse lekking activity. According to experts, under favourable sound propagation conditions black grouse lekking can be heard several kilometres away, and if wind turbine noise exceeds the sound level of lekking calls, it may affect lekking activity, potentially leading to abandonment of the lek and territory.

Without disputing the expert opinion regarding the impact of wind farm noise on black grouse lekking, the Report authors consider that information regarding lekking audibility over several kilometres is not scientifically substantiated. Although one publication analysing black grouse call acoustics indicates that calls may be audible at long distances, without specifying a particular distance, information regarding audibility over several kilometres appears to originate primarily from sources that cannot be considered scientific research results.

According to experts, the impact of the planned wind farm on black grouse population status in the area is insignificant, largely based on historically observed numbers of birds within the territory and its surroundings. However, habitat modelling results indicate that the territory is potentially suitable for this species. As a collision risk reduction measure for collisions with wind turbine towers during foggy conditions, experts recommend dark tower colouring in the lower section (at least 0 – 30 m). Similar to the capercaillie protection context, the Report authors consider this measure to be recommendatory only. At the same time, the relatively low effectiveness of the measure and its potential landscape impact should be considered. The continuous dark colouring of the tower up to 30 m height proposed by experts is not supported from a landscape protection perspective. However, a gradual transition from a darker colour at the wind turbine base to a lighter colour at the end of the first or second tower section could be considered.

Hazel grouse (Bonasa bonasia)

Hazel grouse is a specially protected species included in Annex I of the Birds Directive. In Latvia, the species population is considered endangered (EN), with a rapid short-term population decline, while the long-term population trend is unknown. In Europe, the species population is not considered threatened (LC); however, the population trend is unknown.

The forests in the northern and central parts of the planned wind farm area are fragmented, and only part of these forests are suitable for hazel grouse. However, in the forest complex located in the southern part of the territory, hazel grouse habitats are more suitable and are also occupied by the species. According to the bird habitat suitability modelling results developed within the HiQBioDiv project, the most suitable areas for hazel grouse are located south of the planned wind turbine construction sites. Within 1 km of the wind turbines, there are 253 ha of low to medium suitability habitats (T – Q2) and 295 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats located near the wind farm account for 0.06% of such habitat area in Latvia.

Although no data are available regarding the effects of wind farm operation on hazel grouse, the species conservation plan[63] identifies disturbance caused by transport noise as one of the most significant disturbance factors. It is considered likely that noise from other sources, including railway traffic, industrial activities, WTGs and other sources, may also affect habitat availability for hazel grouse.

Observation data and habitat modelling results indicate that the planned wind farm area is relatively important for hazel grouse; however, the proportion of affected habitats compared with habitats of equivalent quality is small. Development of the planned wind farm will nevertheless have a negative impact on hazel grouse occurring in the area. The greatest impacts will result from habitat destruction or habitat quality deterioration during deforestation, access road construction and electricity transmission infrastructure construction, as well as disturbance caused by noise during wind farm construction and operation. Experts indicate that wind turbines No. 7, 10 and 11 should be considered turbines with the highest potential impact on hazel grouse and recommend that these turbines are not constructed for species conservation purposes.

Grey partridge (Perdix perdix)

Grey partridge is a resident bird species. In Europe, the species population is not considered threatened (LC), although it is declining. Data are insufficient for assessing the status of the grey partridge population in Latvia (Data Deficient – DD). The species population is declining in the long term but is stable in the short term.

The agricultural landscape within the wind farm area provides suitable conditions for grey partridge breeding, and field observations confirm that grey partridge occurs as a breeding species within the wind farm area. Based on observation data, the grey partridge population in the assessed area is estimated at 2 – 6 breeding pairs. According to the HiQBioDiv habitat suitability modelling results, the most suitable grey partridge habitats are located in managed agricultural lands along the eastern and western margins of the wind farm area. Within 1 km of

[63] Hazel grouse (Bonasa bonasia) Conservation Plan. Available: https://www.daba.gov.lv/lv/media/5922/download?attachment

the wind turbines, there are 264 ha of low to medium suitability habitats (T – Q2) and 82 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for 0.04% of such habitat area in Latvia.

According to experts, the impact of the wind farm on grey partridge will be insignificant, and specific impact mitigation measures are not required. Since grey partridge flights occur at low heights, collisions with wind turbine blades represent a relatively minor threat. A higher probability exists for collisions with power lines, towers and other structures associated with the wind farm; however, this risk is lower than, for example, for black grouse. No studies are available regarding the effects of wind turbine-generated noise on grey partridge. Since the planned wind farm contains extensive areas suitable for grey partridge, experts consider that even if operation of individual wind turbine affects certain grey partridge territories, birds will have opportunities to relocate to nearby suitable areas.

Whooper swan (Cygnus cygnus) and geese (Anser sp.)

The whooper swan is a short-distance migratory bird species that also breeds relatively frequently in suitable habitats in western Latvia. During migration, travelling birds use agricultural lands and wetlands as resting and feeding areas. In Europe, the species population is not considered threatened (LC) and is increasing. In Latvia, both the breeding and wintering populations are assessed as near threatened (NT), while the breeding population trend is increasing both in the short and long term. The reasons for population growth are associated with overall population trends throughout Europe and improved feeding conditions at wintering grounds. The whooper swan is a specially protected species included in Annex I of the Birds Directive.

Considering available habitats, areas suitable for whooper swan breeding may occur within the wind farm area. However, breeding density in northern Latvia is uneven, and the species currently selects the most suitable habitats. Therefore, it is not unexpected that breeding of whooper swans has not been confirmed within the planned wind farm area. A relatively large number of observations were recorded during the breeding season, but these are more likely related to non-breeding individuals. Confirmed breeding locations near the park are located in the Sedas bog and Ziemeļgauja areas. According to the HiQBioDiv habitat suitability modelling results, suitable habitats for whooper swan are fragmented, with a larger continuous area occurring in wetlands north of the wind farm area. Within 1 km of the wind turbines, only 29 ha of low to medium suitability habitats (T – Q2) occur, while no high to excellent suitability habitats (Q2 – 1) were identified. According to experts, the impact of the planned wind farm on whooper swan breeding locations and breeding success is insignificant.

Several goose species occur in Latvia, of which the greylag goose (Anser anser) breeds in Latvia; however, breeding sites in northern Latvia are scarce, and confirmed breeding has only been recorded in the previously mentioned Seda bog area. No suitable habitats for this species occur within the planned wind farm area. However, substantially larger numbers of migratory geese occur in Latvia, particularly three species:

- tundra bean goose (Anser serrirostris);
- taiga bean goose (Anser fabalis);
- greater white-fronted goose (Anser albifrons).

Although these goose species are not specially protected birds, construction of the wind farm may have a significant impact on their resting areas during migration periods. Goose migration intensity in the planned wind farm area is likely higher than the Latvian average, which is facilitated by the proximity of the Sedas bog. Experts conclude that the study area is suitable for stopping and feeding by migrating bird flocks, which is also confirmed by observations made during field surveys.

Based on the distribution of observations, it can be concluded that migrating bird flocks select suitable agricultural fields throughout the wind farm area where crops or suitable feeding conditions are available during the respective migration season. Observations indicate that the wind farm area is an important resting and feeding area for migrating whooper swans and geese, and construction of the wind farm will have a negative impact on their migration. Since agricultural lands between forest areas in the central part of the wind farm are used by birds both as migration resting areas and feeding areas, these areas almost completely overlap with potential wind turbine locations. According to experts, construction of the wind farm will result in a potentially significant loss of habitat availability.

Without questioning the experts' conclusions regarding the nature of the expected impact, the Report authors consider that the conclusion regarding significant loss of feeding areas is overstated. Monitoring data from operational wind farms in Kurzeme indicate that the distance at which birds avoid wind turbines is small. According to certified expert R. Lebuss, who performs monitoring at the Tārgale wind farm, migrating goose flocks have also been observed feeding less than 100 m from wind turbines. Reviewing agricultural land use data in the vicinity of the planned wind farm shows that relatively large cultivated areas are located both east of the wind farm, around Sēļi, and northwest, around Lugaži and Ērģeme. When comparing declared crop areas around the Sedas bog, which is undoubtedly an important bird resting area during migration periods, with cultivated areas occupied by the wind farm, it can be seen that the "Valka" wind farm area represents only a small proportion of the available feeding habitats.

Crane (Grus grus)

The crane is a medium-distance migratory bird species that, especially during autumn migration, tends to gather in large flocks, using agricultural lands and wetlands as resting and feeding areas. In Europe, the species population is not considered threatened (Least Concern – LC) and is increasing. In Latvia, the breeding population is also not considered threatened (LC) and is increasing both in the short and long term. The reasons for population growth are associated with overall population trends throughout Europe and improved feeding conditions at wintering grounds. The crane is a specially protected species included in Annex I of the Birds Directive.

The habitat complex within the wind farm area provides suitable conditions for crane breeding. Suitable habitats are available both for nesting, as the species uses various wetlands, including wet meadows and clearings, and foraging areas in agricultural lands. Although larger bogs are not present within the territory, they are no longer the dominant breeding habitats for cranes today. Field observations do not conclusively confirm crane breeding within the wind farm area. The breeding population within the planned wind farm study area is estimated at 2 – 5 pairs. According to the bird habitat suitability modelling results developed within the HiQBioDiv project,

suitable crane habitats are distributed throughout the wind farm area; however, the highest-value habitats are located around the Seda area. Within 1 km of the wind turbines, there are 415 ha of low to medium suitability habitats (T – Q2) and 59 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for 0.01% of such habitat area in Latvia.

Cranes were also observed within the wind farm area during migration periods. Overall, it can be concluded that the area is suitable for migrating crane flocks to stop and feed. This is also confirmed by observations after the breeding season, when concentrated flocks consisting of several families were recorded. Studies have shown that the negative impact of wind farms on cranes is low, as cranes demonstrate pronounced avoidance behaviour. Considering this avoidance behaviour and the favourable conservation status of crane populations both in Latvia and the wider region, it can be concluded that the negative impact of wind farm construction and operation on this species will not be significant. Therefore, no additional species-specific mitigation measures are required.

Corncrake (Crex crex)

Corncrake is a long-distance migratory bird species. It is a specially protected species included in Annex I of the Birds Directive. In Latvia, the species population is assessed as vulnerable (VU). The Latvian breeding population has increased in the long term but is declining in the short term. The European population is not considered threatened (LC).

The agricultural landscape within the wind farm area provides suitable conditions for corncrake breeding. During the study, targeted corncrake surveys were carried out in suitable habitats. Field observations confirm that corncrake occurs as a breeding species within the wind farm area. Experts estimate that the corncrake population within the assessed area may consist of 6 – 15 pairs (calling males). According to the HiQBioDiv habitat suitability modelling results, suitable corncrake habitats are distributed throughout the agricultural lands within the wind farm area, with the highest-value habitats identified around the P24 regional road. Interestingly, grasslands in the Seda floodplain, where the highest number of observations was recorded during field surveys, are indicated by the model results as lower-value habitats compared with arable lands near the road. Within 1 km of the wind turbines, there are 408 ha of low to medium suitability habitats (T – Q2) and 251 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for 0.04% of such habitat area in Latvia.

Corncrakes fly at low heights within breeding areas, and collision risk is therefore mainly associated with WTG towers or other infrastructure objects under poor visibility conditions. Scientific literature contains indications that corncrakes avoid areas near wind turbine rotors, which is associated with turbine-generated noise. Such avoidance behaviour has been observed within a radius of up to 500 m around wind turbines[64]. It is expected that construction of wind turbines No. 1, 3, 4, 5, 6 and 14 will negatively affect 3 – 6 corncrake territories, and these birds are likely to abandon these areas.

[64] Working Group of German State Bird Conservancies. Recommendations for distances of wind turbines to important areas for birds as well as breeding sites of selected bird species (as at April 2015) (2014): Ber. Vogelschutz 51: 15–42.

Quail (Coturnix coturnix)

Quail is a long-distance migratory bird species wintering in Africa south of the Sahara. Globally, the species population is not considered threatened (LC), although population size varies considerably. In Latvia, the species population is assessed as vulnerable (VU), and population trends fluctuate in the long term but remain uncertain in the short term. It should be noted that this species is characterised by significant annual population fluctuations. Quail is a specially protected species.

The agricultural landscape within the wind farm area provides suitable conditions for quail breeding. During the study, targeted quail surveys were carried out in suitable habitats. Quail presence was not confirmed during field surveys; however, other bird observers recorded quail observations within the territory in 2024. Based on observation data, the quail population within the study area is estimated at 1 – 2 pairs (calling males). According to the HiQBioDiv habitat suitability modelling results, the most suitable quail habitats are located in the eastern part of the wind farm area, around the P24 road. Within 1 km of the wind turbines, there are 193 ha of low to medium suitability habitats (T – Q2), while no high to excellent suitability habitats (Q2 – 1) occur near the wind farm.

Since quail flights occur at low heights, the risk of collisions with wind turbine blades is relatively low. Scientific literature does not provide information on the effects of wind turbine-generated noise on quail. As the planned wind farm contains extensive areas suitable for quail, even if operation of individual wind turbine affects particular quail territories, birds will have opportunities to relocate to other suitable habitats nearby. Experts consider that the impact of the planned wind farm on quail breeding in the area will be insignificant; therefore, no specific mitigation measures are required for this species.

Spotted crake (Porzana porzana)

Spotted crake is a long-distance migratory bird species. Both in Latvia and Europe, the species population is not considered threatened (Least Concern – LC); however, the population trend in Europe is unknown. In Latvia, the species population is increasing in the long term, while the short-term trend is uncertain. Spotted crake is a specially protected species included in Annex I of the Birds Directive.

Within the study area, spotted crake was recorded both through audio recordings in early June and visually in mid-July in a small reedbed in the northern part of the study area near the houses "Sedaskalni" on the right bank of the Seda River. This most likely indicates breeding of the species in this habitat. According to the bird habitat suitability modelling results developed within the HiQBioDiv project, the most suitable areas for spotted crake are located around the Seda River. Within 1 km of the wind turbines, there are 59 ha of low to medium suitability habitats (T – Q2) and 1 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for less than 0.01% of such habitat area in Latvia.

Based on the frequency of observations and availability of suitable habitats, experts consider that the impact of the planned wind farm on spotted crake breeding in the area will be insignificant. Therefore, no specific mitigation measures are required for this species.

Eurasian curlew (Numenius arquata)

Eurasian curlew is a short-distance migratory bird species. Both in Latvia and globally, the species population is assessed as vulnerable (VU) and is declining. In Latvia, the population trend is stable in the short term and uncertain in the long term. Eurasian curlew is a specially protected species included in Annex I of the Birds Directive.

Although the literature generally describes Eurasian curlew as a species breeding in bogs, and extensive bog habitats are not present within the wind farm area, nowadays curlews may also choose agricultural lands for breeding, including intensively managed arable land. Such agricultural landscapes suitable for curlew breeding are available within the study area, and existing observations indicate that Eurasian curlew may occur as a breeding species within the wind farm area. Overall, the analysis used two curlew observations recorded within the assessed area or its immediate surroundings in 2024. Both observations were recorded close to each other with a 10-day interval; therefore, they may be associated with breeding. However, convincing evidence of breeding was not obtained. It should also be considered that non-breeding juvenile birds may occur in the area, moving across a wider territory during the breeding season. In addition, migration of curlews from breeding areas further north begins very early, already in June, making interpretation of the obtained data more difficult.

According to the HiQBioDiv habitat suitability modelling results, the most suitable curlew habitats are located in agricultural lands around the P24 road and railway line. Within 1 km of the wind turbines, there are 388 ha of low suitability habitats (T – Q1), while no medium to excellent suitability habitats (Q1 – 1) occur near the wind farm.

During migration periods, both in spring and autumn, migrating curlews may use agricultural lands and wetlands. They may migrate either individually or in larger flocks. The planned wind farm area is suitable as a stopover site for such migrating birds, although no curlew concentrations were identified during field surveys. Since breeding of Eurasian curlew within the territory has not been confirmed, and the small number and character of migration observations do not indicate that the assessed area is an important stopover and resting site for curlews during migration, experts consider that the negative impact of wind farm construction and operation on this species will not be significant. Therefore, no mitigation measures are required for this species.

Common redshank (Tringa totanus)

Common redshank is a long-distance migratory bird species. Globally, the species population is not considered threatened (Least Concern – LC), although it is declining. In Latvia, the species population is assessed as endangered (EN). The Latvian population trend is fluctuating in the long term and uncertain in the short term. Common redshank breeds in wet grasslands unevenly throughout Latvia. The nearest known breeding site is located within the PLA "Ziemeļgauja". Five observations of common redshank were recorded within the study area, including one observation in June in habitat suitable for breeding. However, reliable evidence of breeding within the wind farm area was not obtained.

According to the HiQBioDiv habitat suitability modelling results, the most suitable common redshank habitats are located in agricultural lands around the Seda River and near larger drainage

ditches. Within 1 km of the wind turbines, there are 145 ha of low to medium suitability habitats (T – Q2) and 56 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.09% of such habitat area in Latvia. Since breeding of common redshank within the territory has not been confirmed, and the small number and character of migration observations do not indicate that the assessed area is an important stopover and resting site for common redshank during migration, experts consider that the negative impact of wind farm construction and operation on this species will not be significant. Therefore, no mitigation measures are required for this species.

European golden plover (Pluvialis apricaria)

European golden plover is a specially protected species included in Annex I of the Birds Directive. It is a short-distance migratory bird species that, during migration, particularly in autumn, tends to gather in large flocks, using agricultural lands as resting and feeding areas. In Latvia, the species population is assessed as near threatened (NT), and the population trend is stable both in the long and short term. Globally, the species is not considered threatened (Least Concern – LC).

European golden plover breeds in large raised bogs; however, such habitats do not occur within the planned "Valka" wind farm area. Therefore, no breeding birds were identified during the surveys. According to the bird habitat suitability modelling results developed within the HiQBioDiv project, there are practically no suitable habitats for European golden plover in the vicinity of the wind farm. Within 1 km of the wind turbines, there are only 5 ha of low suitability habitats (T – Q1), while no medium to excellent suitability habitats (Q1 – 1) occur near the wind farm.

During field surveys, European golden plovers were recorded during migration periods. In autumn, flocks were observed, with the largest flock consisting of approximately 250 individuals. Observations indicate that the wind farm area is an important stopover and feeding area for migrating European golden plovers, and construction of the wind farm may potentially negatively affect their migration. According to experts, operational monitoring should determine the number of individuals killed and/or injured in collisions, and if this exceeds 1% of the total number of European golden plovers present in the area, appropriate risk reduction measures should be introduced, for example, temporary shutdown of high-risk wind turbines while birds are present. In the opinion of the Report authors, the mitigation measure proposed by experts cannot be practically implemented. Although European golden plovers occur in larger flocks in the area during autumn, it is technically impossible to determine the total number of European golden plovers present within the wind farm area, and therefore it is also impossible to calculate what proportion of the total population is represented by killed or injured individuals. At the same time, it should be noted that, similarly to mortality of any other bird species, monitoring carried out during operation shall assess the significance of such impacts and, in cooperation with the Nature Conservation Agency, additional mitigation or compensation measures shall be implemented if necessary. Such measures may also include temporary suspension of wind turbines operation during specific periods.

Ruff (Calidris pugnax)

Ruff is a long-distance migratory bird species. The breeding population in Latvia is assessed as critically endangered (CR), while insufficient data are available for assessing the status of the

migratory population (Data Deficient – DD). Globally, the species population is not considered threatened (Least Concern – LC); however, it is declining.

The most likely reason for the decline of the species population in Latvia is overgrowth of coastal meadows along the sea and lakes. Ruff is a specially protected species included in Annex I of the Birds Directive. During migration periods, both in spring and autumn, migrating ruffs may use agricultural lands and wetlands, and they readily use temporary water bodies formed along field and meadow edges. They may migrate either individually or in larger flocks.

The planned wind farm area is suitable as a stopover site for such migrating birds. This is supported by three observations of the species recorded between 2017 and 2021, when migrating ruff flocks were observed within suitable agricultural landscapes in the planned wind farm area. Within the HiQBioDiv project, suitable habitat data for ruff were not analysed as part of the bird habitat modelling.

Although the species population in Latvia is critically endangered and data on the migratory population are insufficient, the small number and character of observations do not indicate that the assessed area represents an important stopover and resting site for ruffs during migration. Therefore, according to experts, the negative impact of wind farm construction and operation on this species will not be significant, and no mitigation measures are required.

Wood sandpiper (Tringa glareola)

Wood sandpiper is a long-distance migratory bird species. Globally, the species population is not considered threatened (Least Concern – LC) and fluctuates. In Latvia, the species population is assessed as vulnerable (VU). The population trend in Latvia is stable in the long term but declining in the short term. Wood sandpiper is a specially protected species included in Annex I of the Birds Directive.

Wood sandpiper is a species breeding in bog habitats; however, larger bogs do not occur within the planned wind farm area, and therefore no breeding birds were identified during field surveys. According to the HiQBioDiv habitat suitability modelling results, the most suitable areas for wood sandpiper are located in agricultural lands around the Seda River. Within 1 km of the wind turbines, there are 90 ha of low to medium suitability habitats (T – Q1), while no high to excellent suitability habitats (Q2 – 1) occur near the wind farm.

During migration periods, migrating sandpipers of various species may use agricultural lands and wetlands, and they readily use temporary water bodies along field and meadow edges. They may migrate either individually or in larger flocks. The planned wind farm area is suitable as a stopover site for such migrating birds, which is also confirmed by observations. The presence of the species within the wind farm area was recorded during spring migration (four observations in total).

The small number and character of observations do not indicate that the assessed area is an important stopover and resting site for wood sandpipers during migration. Therefore, according to experts, the negative impact of wind farm construction and operation on this species will not be significant, and no specific mitigation measures are required.

Great snipe (Gallinago media)

Great snipe is a long-distance migratory bird species occurring in specific habitats – regularly flooded grasslands, such as floodplain meadows. Great snipe is a specially protected species included in Annex I of the Birds Directive. In Latvia, the species population is assessed as vulnerable (VU). The long-term population trend is unknown, while the short-term trend is stable. Globally, the species is not considered threatened (Least Concern – LC).

Great snipe was not observed within the wind farm area during the surveys; however, the "Burgas pļavas" Nature Reserve, an Important Bird Area, is located approximately 2 km west of the territory. The largest known great snipe lek in Valka Municipality is located within this nature reserve. Although the reserve is located at a relatively large distance, males gather at the lek only in the late evening, while during the rest of the time they may occur elsewhere searching for better feeding conditions. Therefore, it cannot be completely excluded that great snipe may use the planned wind farm area as a resting or feeding site.

Within the HiQBioDiv project, suitable habitat data for great snipe were not analysed as part of the bird habitat modelling. Although experts consider that no specific mitigation measures are currently required to reduce impacts on great snipe, the presence of the species in the area should continue to be monitored during pre-construction, construction and operational monitoring.

Black stork (Ciconia nigra)

Black stork is a long-distance migratory bird species that winters in equatorial Africa. Globally, the species population is not considered threatened (Least Concern – LC); however, in Latvia it is assessed as critically endangered (CR). The Latvian population is declining, although the global population trend is increasing. Black stork is a specially protected species included in Annex I of the Birds Directive.

There are no known black stork breeding territories within the "Valka" wind farm study area. The nearest historically known nest is located less than 4 km from the wind farm. According to the bird habitat suitability modelling results developed within the HiQBioDiv project, suitable black stork habitats practically do not occur within 1 km of the planned WTGs. Only one low suitability grid cell was identified north of wind turbines No. 1 and No. 2. The nearest high-quality habitats are located around the Ķeizaru and Žuldiņu bogs.

Although suitable black stork habitats are scarce in the immediate vicinity of the wind farm, the species may travel considerable distances when searching for food, including visiting drained rivers and drainage ditch systems. Considering the importance of watercourses as black stork feeding habitats, experts recommend maintaining a buffer zone of at least 50 m on both sides of the Seda River banks, thereby preserving a free flight corridor above the river and its immediate surroundings. The buffer zone shall apply to the rotor blade projection area of wind turbines.

Overall, experts predict that the impact of the planned wind turbines on black stork movement patterns in the area will be insignificant. At the same time, experts recommend using systems capable of detecting black stork flights and stopping operation of certain wind turbines, if necessary, to prevent collisions.

White stork (Ciconia ciconia)

White stork is a long-distance migratory bird species. In Europe, the species population is not considered threatened (Least Concern – LC) and is increasing. The Latvian breeding population is also not considered threatened (LC), with a long-term increasing trend and a stable short-term trend. White stork is a specially protected species included in Annex I of the Birds Directive.

Field observations confirm that white stork occurs as a breeding species within the wind farm area. During the breeding season, white storks travel over relatively large areas around the nest while searching for food, mainly flying within 1 – 2 km of the nest. The habitat complex within the wind farm area provides suitable conditions for white stork breeding and feeding. According to the HiQBioDiv habitat suitability modelling results, suitable white stork habitats around the wind farm are fragmented; however, the mosaic landscape as a whole is considered suitable for this species. Within 1 km of the wind turbines, there are 68 ha of low to medium suitability habitats (T – Q2) and 8 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for less than 0.01% of such habitat area in Latvia.

According to experts, an increased collision risk zone where collisions between white storks and wind turbines are more likely extends within a 1 km radius around stork nests. Analysing the wind turbine layout proposed by the developer, experts concluded that the planned wind turbines are not located within the 1 km buffer zones around white stork nests; therefore, no specific mitigation measures are required for this species. Experts recommend using systems capable of detecting white stork flights and stopping operation of certain wind turbines, if necessary, to prevent collisions.

Ural owl (Strix uralensis)

Ural owl is a resident bird species that remains within its territory throughout the year. Both in Latvia and globally, the species population is not considered threatened (Least Concern – LC) and is increasing. Ural owl is a specially protected species included in Annex I of the Birds Directive.

Before the surveys were carried out, Ural owl observations had already been recorded within the planned wind farm study area. The area is located in a region where the species is a common breeder in suitable forest stands, particularly in larger continuous forest complexes. During field surveys, including owl surveys using playback methods in priority areas identified according to the owl species conservation plan, several territories occupied by Ural owls were identified.

According to the HiQBioDiv habitat suitability modelling results, the most suitable Ural owl habitats are located in the forest complex south of the wind farm. Within 1 km of the wind turbines, there are 226 ha of low to medium suitability habitats (T – Q2) and 311 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.09% of such habitat area in Latvia.

The risk of Ural owl mortality due to collision with wind turbines is low; however, changes in habitat conditions may significantly affect local populations. Forest fragmentation is one of the most important negative factors affecting the species[65]. It is also important to preserve forests with limited management influence within breeding territories, ensuring sufficiently large

[65] Rueda. M. u.c. 2013. Does fragmentation increase extinction thresholds? A European-wide test with seven forest birdsGlobal Ecology and Biogeography: Volume 22, Issue 12, 1282-1292.

habitats with mature and over-mature forest stands containing structures required for nesting[66], including standing dead trees, trees with large cavities and large nests.

According to experts, to ensure favourable conditions for conservation of the species within the planned wind farm area, existing Ural owl habitats must be preserved without fragmentation by wind turbines and associated infrastructure. Experts consider that the most significant impact on Ural owls may be caused by construction of wind turbines located adjacent to the forest complex south of the wind farm. To reduce negative impacts on Ural owl breeding, experts recommend carrying out deforestation works outside the species' breeding season.

Pygmy owl (Glaucidium passerinum)

Pygmy owl is a resident bird species that remains within its territory throughout the year. In Europe, the species population is not considered threatened (Least Concern – LC) and is stable, whereas in Latvia the breeding population is assessed as vulnerable (VU). The species population in Latvia is declining in the long term, while the short-term trend is uncertain. Pygmy owl is a specially protected species included in Annex I of the Birds Directive.

According to the bird habitat suitability modelling results developed within the HiQBioDiv project, the most suitable pygmy owl habitats are located in the forest complex south of the wind farm. Within 1 km of the wind turbines, there are 381 ha of low to medium suitability habitats (T – Q2) and 74 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.02% of such habitat area in Latvia.

During field surveys within the wind farm study area, no occupied pygmy owl territories were identified; however, observations recorded before the surveys indicate the presence of the species in the vicinity of the study area. Using passive acoustic monitoring, pygmy owl vocalisations were recorded only temporarily – on 25 May 2024 near wind turbine No. 9, as well as several times during the autumn migration period in the northern-central part of the planned wind farm area. These observations do not indicate the presence of a breeding territory within the study area.

According to experts, the negative impact of wind farm construction and operation on this species will not be significant, and no mitigation measures are currently required.

Boreal owl (Aegolius funereus)

The global population of boreal owl is not considered threatened (Least Concern – LC) and is regarded as stable; however, in Latvia the species population is assessed as endangered (EN). The Latvian population trend is declining in the long term, while the short-term population trend is uncertain. According to the owl species conservation plan, priority squares for boreal owl protection are located within the planned wind farm area; however, the presence of the species within the territory has not been confirmed, and historical observations also do not indicate its occurrence.

[66] Avotiņš jun. A. 2019. Apodziņa Glaucidium passerinum, bikšainā apoga Aegolius funereus, meža pūces Strix aluco, urālpūces Strix uralensis, ausainās pūces Asio otus un ūpja Bubo bubo aizsardzības plāns. Latvijas Ornitoloģijas biedrība, Rīga.

According to the bird habitat suitability modelling results developed within the HiQBioDiv project, the most suitable boreal owl habitats are located in the forest complex south of the wind farm. Within 1 km of the wind turbines there are 372 ha of low to medium suitability habitats (T – Q2), while no high to excellent suitability habitats (Q2 – 1) have been mapped.

According to experts, the potential negative impact of wind farm construction and operation on this species will not be significant; therefore, no mitigation measures are required.

Lesser spotted eagle (Clanga pomarina)

Lesser spotted eagle is a long-distance migratory bird species that winters in Africa south of the Sahara. In Europe, the species population is not considered threatened (Least Concern – LC) and is increasing. The Latvian breeding population is also not considered threatened (LC), with an increasing short-term trend and a stable long-term trend. Approximately 20% of the global population breeds in Latvia; therefore, Latvia has a particularly important responsibility for global conservation of this species. Lesser spotted eagle is a specially protected species included in Annex I of the Birds Directive.

The habitat complex within the wind farm area provides suitable conditions for lesser spotted eagle breeding. The area contains forest stands suitable for nest construction and nearby grassland habitats suitable as feeding areas. According to the HiQBioDiv habitat suitability modelling results, suitable lesser spotted eagle breeding habitats are fragmented and distributed throughout the study area. Experts, based on field conditions and analysis of observation data, have also identified potentially important feeding areas for this species (see Figure 3.3.5.3). Within 1 km of the wind turbines, there are 129 ha of low to medium suitability habitats (T – Q2) and 31 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.02% of such habitat area in Latvia.

The only known nest identified during the study was found by Edgars Dzenis in August 2023. During the initial site survey, it was determined that clear-cutting had been carried out in the area where the lesser spotted eagle nest was located; however, the nest tree and a group of trees within approximately a 10 m radius around it had been preserved. The clear-cutting has negatively affected the breeding area; however, there remains a possibility that the lesser spotted eagle pair may return to breed in this nest or in the surrounding area in future years. The lesser spotted eagle that most likely lost its nest was observed in late April and mid-May 2024, when active feeding was recorded in the central part of the territory, within agricultural lands and floodplain meadows. Although a new nest was not found, on 13 August 2024, two vocalising birds were recorded near Lugaži railway station, where a juvenile bird and an adult bird were calling to each other, indicating possible breeding nearby. During this period, lesser spotted eagles have not yet started migration and remain near their breeding territories.

Although breeding of the species has not been confirmed within the territory, experts consider that special attention should continue to be given to this species during future monitoring. Experts recommend equipping wind turbines with camera-based systems capable of detecting approaching lesser spotted eagles and stopping rotor movement when birds approach critically close distances.

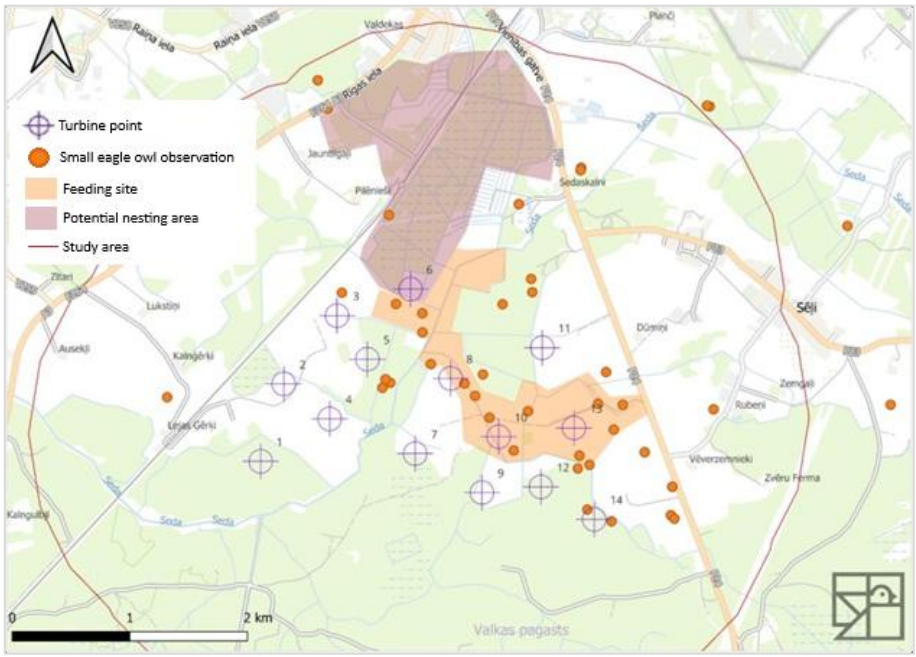


Figure 3.3.5.3. Lesser spotted eagle observations, potential breeding area and feeding range

Western marsh harrier (Circus aeruginosus)

Western marsh harrier is a long-distance migratory bird species that winters in southern Europe or Africa. Globally, the species population is not considered threatened (Least Concern – LC), but the Latvian population is assessed as vulnerable (VU). The long-term trend of the Latvian population is unknown, while the short-term trend is uncertain. Western marsh harrier is a specially protected species included in Annex I of the Birds Directive.

The habitat complex within the wind farm area provides suitable conditions for western marsh harrier breeding. Although larger wetlands and reedbeds are not present, the species is capable of breeding in relatively small reed patches. Despite the relatively high number of observations, only a few may indicate the presence of a breeding pair in the northern part of the study area. Based on observation data, the western marsh harrier population in the assessed area is estimated at 0 – 2 pairs.

According to the HiQBioDiv habitat suitability modelling results, suitable habitats for western marsh harrier within and around the wind farm are limited and fragmented. Within 1 km of the WTGs, there are 16 ha of low to medium suitability habitats (T – Q2) and 1 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for less than 0.01% of such habitat area in Latvia.

Male western marsh harriers may travel long distances while foraging (up to 6 – 12 km from the nest), while during early spring they perform high display flights near breeding sites, rising very high (disappearing from view, i.e. above 1 km). For these reasons, the collision probability for this species is considered very high, regardless of how close or far the nearest nest is located from the wind turbines. According to experts, similarly to other soaring bird species, wind turbines should be equipped with bird protection systems.

Hen harrier (Circus cyaneus)

Hen harrier is a short-distance migratory bird species that also winters in western Latvia. Globally, the species population is assessed as near threatened (NT) and is declining. In Latvia, the species population is assessed as critically endangered (CR) and is declining in the long term, while the short-term population trend is unknown. Hen harrier is a specially protected species included in Annex I of the Birds Directive.

Within the "Valka" wind farm area, hen harrier has only been observed during migration in 2022. Suitable habitat maps for this species have not been developed within the HiQBioDiv project. Although the overall pattern of observations indicates that the species is likely to occur only rarely within the wind farm area, experts consider that it cannot be excluded that the number of migrating hen harriers passing through the planned wind farm area is considerably higher.

According to experts, to reduce the probability of hen harrier mortality due to collisions with wind turbines, similarly to other soaring bird species, wind turbines should be equipped with bird protection systems.

Goshawk (Accipiter gentilis)

Goshawk is a resident bird species that remains within its territory throughout the year or undertakes relatively short-distance movements. In Europe, the species population is not considered threatened (Least Concern – LC), although the goshawk population is declining. In Latvia, the breeding population is assessed as critically endangered (CR). The long-term population trend is unknown, while the short-term trend is declining.

No known goshawk nests are located within the planned wind farm area. However, in 2023, certified bird expert Edgars Dzenis identified an occupied nest approximately 1 km from the study area, and a micro-reserve for goshawk protection was established there in 2024. The distance from the nest to the nearest potential wind turbine is slightly less than 3 km. Goshawks generally hunt within approximately 3 km of their breeding site; however, this does not exclude movements over longer distances if prey availability is higher in agricultural fields or near settlements.

According to the HiQBioDiv habitat suitability modelling results, suitable goshawk habitats occur within the wind farm and study area. Most of these habitats are fragmented, while larger continuous areas are located within the forest complex south of the wind farm. Within 1 km of the wind turbines, there are 254 ha of low to medium suitability habitats (T – Q2) and 43 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.02% of such habitat area in Latvia.

According to experts, the impact of the planned wind farm on goshawk movement patterns in the area will be insignificant and will not pose direct threats to habitats used by the species. Therefore, no specific mitigation measures are required, except for equipping wind turbines with camera-based systems capable of detecting approaching goshawks and stopping rotor rotation when birds approach critically close distances.

White-tailed eagle (Haliaeetus albicilla)

White-tailed eagle is a resident bird species that remains within its territory throughout the year and also undertakes relatively short-distance movements. In Europe, the species population is not considered threatened (Least Concern – LC), while in Latvia the breeding population is assessed as vulnerable (VU). The Latvian population is increasing in the long term, while the short-term trend is uncertain. White-tailed eagle is a specially protected species included in Annex I of the Birds Directive.

No known white-tailed eagle nests are located within the planned wind farm area; however, the nearest known nests are located approximately 7 km away in the Sedas bog area. Although breeding of the species has not been identified in the immediate vicinity of the planned wind farm, the increasing population trend of white-tailed eagles in Latvia means that non-breeding individuals of this species occur regularly throughout the country. White-tailed eagles have been regularly observed within the wind farm area during different seasons, and it can be confidently concluded that the species is frequently present in the area.

The Report authors consider it important to note that white-tailed eagle is a species with a relatively large breeding territory. When searching for food, even breeding individuals may be observed more than 10 km from their nesting site. These characteristics make white-tailed eagle, similarly to black stork, a potentially vulnerable species regardless of the selected wind farm location.

According to the HiQBioDiv habitat suitability modelling results, suitable habitats for white-tailed eagle breeding are scarce in the immediate vicinity of the wind farm. The modelling results indicate that within 1 km of the wind turbines there are only 3 ha of low to medium suitability habitats (T – Q2). However, regarding habitat suitability, it should be noted that white-tailed eagles may successfully breed even in seemingly suboptimal habitats, for example, using large-dimension ecological trees retained in clear-cut areas.

According to experts, considering the increased sensitivity of white-tailed eagles to wind farms (due to relatively high collision risk) and the high probability of species presence throughout the year, it is recommended that wind turbines are equipped with camera-based systems capable of detecting approaching white-tailed eagles and stopping rotor rotation when birds approach critically close distances.

Black kite (Milvus migrans)

Black kite is a long-distance migratory bird species that winters in Africa or the Mediterranean region. Globally, the species population is not considered threatened (Least Concern – LC), while in Latvia the species population is assessed as endangered (EN). However, the Latvian black kite population is increasing both in the long and short term. Black kite is a specially protected species included in Annex I of the Birds Directive.

No known black kite nests are located within the planned wind farm area. Based on existing observations, there is no reason to consider black kite a breeding species within the wind farm area; however, the species presence has been recorded during field surveys. Overall, one observation of this species was recorded in April 2024, which is more consistent with the migration period than with early breeding activity. The HiQBioDiv habitat suitability modelling

results also do not indicate high importance of the territory for black kite. According to the modelling results, within 1 km of the planned wind turbines, only one model grid cell has been identified as low suitability habitat.

The number and nature of observations do not indicate that the assessed area is important for black kite. Therefore, according to experts, the negative impact of wind farm construction and operation on this species will not be significant.

However, similarly to other soaring bird species, it is recommended that wind turbines are equipped with camera-based systems capable of detecting approaching birds and stopping rotor rotation when birds approach critically close distances.

Common buzzard (Buteo buteo)

Common buzzard is a short-distance migratory bird species and also a resident species. Globally, the species is not considered threatened (Least Concern – LC) and its population is stable. In Latvia, the species population is declining both in the long and short term, and the species is assessed as endangered (EN). Common buzzard is currently not a specially protected species; however, due to the negative population trend, discussions are currently ongoing regarding its inclusion in the list of protected species. Experts have also given particular attention to common buzzard because diurnal birds of prey often occupy nests previously used by other bird species. Since the common buzzard population is currently larger than the populations of many other protected diurnal birds of prey, the number of nests available for occupation by other protected species is also higher.

The habitat complex within the wind farm area provides suitable conditions for common buzzard breeding, and this is the most frequently observed diurnal bird of prey species in the territory. During the study period, one occupied nest was identified within the territory, which is known to have previously been used by lesser spotted eagle (see Figure 3.3.5.4). According to the HiQBioDiv habitat suitability modelling results, suitable habitats for common buzzard occur within the wind farm and study area. Within 1 km of the wind turbines, there are 206 ha of low to medium suitability habitats (T – Q2) and 61 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.01% of such habitat area in Latvia.



Figure 3.3.5.4. Former lesser spotted eagle nest used by common buzzard in 2024

The expert opinion does not define specific mitigation measures to be implemented for common buzzard protection. Considering the area of affected habitats, construction of the wind farm is not expected to cause a significant negative impact on the common buzzard population in Latvia. To reduce the risk of species mortality due to collisions with wind turbines, measures equivalent to those recommended for other diurnal birds of prey should be implemented, including the use of camera-based detection systems if the number of bird fatalities is high.

Common kestrel (Falco tinnunculus)

Common kestrel is a short-distance migratory bird species that rarely winters in Latvia, mainly in the western part of the country. Globally, the species is not considered threatened (Least Concern – LC), although its population is declining. The long-term population trend in Latvia is unknown, while the short-term trend is uncertain. In Latvia, the species population is assessed as vulnerable (VU). Common kestrel is a specially protected species.

The habitat complex within the wind farm area provides suitable conditions for common kestrel breeding; however, evidence confirming breeding of the species has not been obtained. The HiQBioDiv habitat suitability modelling results also indicate that suitable habitats for common kestrel occur within the wind farm and study area. Within 1 km of the wind turbines, there are 153 ha of low to medium suitability habitats (T – Q2), while no high to excellent suitability habitats (Q2 – 1) for this species have been identified within or around the wind farm area.

Since breeding of common kestrel within the territory has not been confirmed, experts consider that the negative impact of wind farm construction and operation on this species will not be significant. Therefore, no specific mitigation measures are required.

Three-toed woodpecker (Picoides tridactylus)

Three-toed woodpecker is a resident bird species that remains within its territory throughout the year. Globally, the species population is not considered threatened (Least Concern – LC), although its population trend is unknown. In Latvia, the long-term population trend is stable; however, the short-term population trend is declining, and the species is assessed as endangered (EN). Three-toed woodpecker is a specially protected species included in Annex I of the Birds Directive.

For the assessment, experts used six observations of three-toed woodpeckers or traces of their activity (foraging marks) recorded within the study area in 2022 and 2023. It should be taken into account that three-toed woodpecker is a relatively quiet and difficult-to-detect species; therefore, it is likely that not all territories occupied by the species were identified. Based on observation data, experts estimate that the three-toed woodpecker population within the assessed area may consist of 1 – 5 pairs. Part of the observations of three-toed woodpeckers or their activity traces were recorded in the forest complex south of the wind farm. The HiQBioDiv habitat suitability modelling results also indicate that suitable habitats for three-toed woodpecker occur within and near the wind farm, with most suitable habitats concentrated in the forest complex south of the park. Within 1 km of the wind turbines, there are 492 ha of low to medium suitability habitats (T – Q2) and only 40 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.02% of such habitat area in Latvia.

According to experts, wind turbine construction would negatively affect three-toed woodpecker habitats, and construction-related disturbance could hinder or prevent breeding of the species. The Report authors consider it important to note that direct infrastructure impacts would affect approximately 1 ha of habitats classified as high to excellent suitability habitats for three-toed woodpecker. In addition, construction works carried out at high intensity during the woodpecker breeding period, causing disturbance, could potentially affect habitats within a distance of up to 1 km from construction sites, where high to excellent suitability habitats have been identified over an area of 40 ha. According to experts, similarly to capercaillie, hazel grouse, Ural owl, pygmy owl and other forest species, the southernmost wind turbines should preferably not be located within forest areas but should be moved further north, thereby increasing the distance from forest species habitats. The Report authors consider that this expert conclusion, when comparing the potential impact on three-toed woodpecker populations with other forest bird species, is not scientifically substantiated. For example, studies are available for capercaillie and owl species demonstrating avoidance of wind farms during operation, whereas empirical data on three-toed woodpecker avoidance of wind farms are not available.

White-backed woodpecker (Dendrocopos leucotos)

White-backed woodpecker is a resident bird species that remains within its territory throughout the year. Globally, the species population is not considered threatened (Least Concern – LC) and the population trend is stable. In Latvia, the species population is also not considered threatened (LC). The long-term population trend is increasing, while the short-term population trend is

uncertain. White-backed woodpecker is a specially protected species included in Annex I of the Birds Directive.

According to the woodpecker species conservation plan, no priority areas for white-backed woodpecker protection have been identified within the planned wind farm area. However, two observations of this species were recorded during the study. According to experts, these observations do not include reliable breeding indicators; therefore, it cannot be conclusively determined that wind turbine construction will negatively affect white-backed woodpecker breeding in the area. However, disturbance associated with construction and operating wind turbines may negatively affect areas suitable for white-backed woodpecker breeding.

According to the HiQBioDiv habitat suitability modelling results, suitable habitats for white-backed woodpecker occur within and near the wind farm area. However, these habitats are considerably less extensive than those suitable for three-toed woodpecker and are significantly fragmented. Within 1 km of the wind turbines, there are 28 ha of low to medium suitability habitats (T – Q2) and 4 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for considerably less than 0.01% of such habitat area in Latvia.

Experts consider that the impact of the planned wind farm on the status of white-backed woodpecker in the area will be insignificant; therefore, no specific mitigation measures are required.

Lesser spotted woodpecker (Dryobates minor)

Lesser spotted woodpecker is a resident bird species that remains within its territory throughout the year or undertakes short-distance movements. Globally, the species population is not considered threatened (Least Concern – LC) and its population trend is stable. In Latvia, the species population is assessed as vulnerable (VU), and the population is declining both in the long and short term. Although lesser spotted woodpecker is not currently a specially protected species, the negative population trend requires increased attention to this species.

Three observations of lesser spotted woodpecker were recorded within the study area in 2023 and 2024. Based on observation data, experts estimate that the lesser spotted woodpecker population within the study area may consist of 1 – 2 pairs. The lesser spotted woodpecker observations used for the wind farm assessment included breeding indicators. Since the species breeding territory is relatively compact (15 – 25 ha), the observation locations can be considered confirmed breeding territories. According to the HiQBioDiv habitat suitability modelling results, suitable habitats for lesser spotted woodpecker occur within and near the wind farm area. Within 1 km of the wind turbines, there are 166 ha of low to medium suitability habitats (T – Q2) and 43 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for slightly more than 0.01% of such habitat area in Latvia.

According to experts, construction of wind turbines would negatively affect lesser spotted woodpecker habitats, and construction-related disturbance could hinder or even prevent

breeding of the species. To assess how wind farm construction affects the species status in the area, experts recommend monitoring this species before wind farm construction and continuing monitoring during operation.

Black woodpecker (Dryocopus martius)

Black woodpecker is a resident bird species that remains within its territory throughout the year. Globally, the species population is not considered threatened (Least Concern – LC) and its trend is stable. In Latvia, the species population is declining in the long term, while the short-term population trend is stable. The Latvian population is also not considered threatened (LC). Black woodpecker is a specially protected species included in Annex I of the Birds Directive.

A targeted black woodpecker survey using playback methods was not carried out; however, the species' behaviour allows sufficient information on its occurrence to be obtained without dedicated surveys. Overall, the species is relatively frequently observed within the study area, and based on observation data experts estimate that the black woodpecker population within the study area may consist of 4 – 10 pairs. According to the HiQBioDiv habitat suitability modelling results, suitable habitats for black woodpecker occur within the wind farm area, with the majority located in the forest complex south of the wind farm. Within 1 km of the wind turbines, there are 444 ha of low to medium suitability habitats (T – Q2) and 92 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for slightly more than 0.01% of such habitat area in Latvia.

According to experts, construction of wind turbines would negatively affect black woodpecker habitats, and construction-related disturbance could hinder or prevent breeding of the species. However, experts conclude that the impact of the planned wind farm on the status of the species in the area will be insignificant; therefore, no specific mitigation measures are required.

Grey-headed woodpecker (Picus canus)

Grey-headed woodpecker is a resident bird species that remains within its territory throughout the year. Globally, the species population is not considered threatened (Least Concern – LC) and the population is considered stable. In Latvia, the species population is also not considered threatened (LC). The Latvian population is increasing in the long term, while the short-term population trend is uncertain. Grey-headed woodpecker is a specially protected species included in Annex I of the Birds Directive.

A targeted grey-headed woodpecker survey using playback methods was not carried out during the wind farm study; however, the species' behaviour allows sufficient information on its occurrence to be obtained without dedicated surveys. Based on observation data, experts estimate that the grey-headed woodpecker population within the study area may consist of 1 – 5 pairs. According to the HiQBioDiv habitat suitability modelling results, suitable habitats for grey-headed woodpecker have been identified within and around the wind farm area. It should be noted, however, that suitable habitats are highly fragmented, while larger continuous areas are located around the Seda River. Within 1 km of the wind turbines, there are 116 ha of low to

medium suitability habitats (T – Q2) and 32 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for less than 0.01% of such habitat area in Latvia.

According to experts, wind farm construction would negatively affect grey-headed woodpecker habitats; however, experts conclude that the impact of the planned wind farm on the species status in the area will be insignificant. Therefore, no specific mitigation measures are required.

Wryneck (Jynx torquilla)

Wryneck is a long-distance migratory bird species that winters in tropical Africa. Globally, the species population is not considered threatened (Least Concern – LC) and its population is increasing. In Latvia, the species population is assessed as endangered (EN); however, the long-term population trend is increasing, while the short-term trend is considered stable. Wryneck is a specially protected species.

According to the HiQBioDiv habitat suitability modelling results, suitable habitats for wryneck occur within and around the wind farm area. Within 1 km of the wind turbines, there are 238 ha of low to medium suitability habitats (T – Q2) and 50 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.01% of such habitat area in Latvia. Historical observations of the species occurrence in the area do not allow conclusions regarding the potential population size within the territory. However, considering the species' wide and even distribution in Latvia, habitat preferences (often associated with cultural landscapes), and availability of suitable habitats, there is no basis to conclude that the species status would significantly deteriorate due to wind farm construction.

According to experts, the impact of the planned wind farm on wryneck status in the area will be insignificant, and no specific mitigation measures are required.

Stock dove (Columba oenas)

Stock dove is a short-distance migratory bird species that also winters in Latvia, mainly in the western part of the country. Globally, the species population is not considered threatened (Least Concern – LC) and is increasing. In Latvia, the species population is also not considered threatened (LC), although the long-term population trend is unknown and the short-term trend is uncertain. Stock dove is a specially protected species.

The landscape within the wind farm area provides suitable conditions for stock dove breeding. Field observations confirm that stock dove occurs as a breeding species within the wind farm area. Based on observation data, experts estimate that the stock dove population within the study area may consist of 3 – 5 pairs. Within the HiQBioDiv project, suitable habitat modelling for stock dove was not carried out.

Experts indicate that the impact of the planned wind farm on stock dove status in the area will be insignificant; therefore, no specific mitigation measures are required for this species.

European nightjar (Caprimulgus europaeus)

European nightjar is a long-distance migratory bird species that winters in southern Europe or Africa. In Europe, the species population is not considered threatened (Least Concern – LC), although the population trend is unknown. In Latvia, the species is also not considered threatened (LC); however, the population trend is unknown both in the long and short term. European nightjar is a specially protected species included in Annex I of the Birds Directive.

Similarly to other suitable forest areas in Latvia, European nightjar is a relatively common breeding species within and around the planned wind farm area. During the study, targeted nightjar surveys were carried out in suitable habitats, and field observations confirm that European nightjar occurs as a breeding species within the wind farm area. Observations indicate that the most suitable habitats are located in the forest complex south of the wind farm, where coniferous forest stands dominate. Nightjars were not observed in the remaining parts of the territory, and experts conclude that the species does not occur there due to the lack of suitable forest habitats. Based on observation data, experts estimate that the European nightjar population within the study area may consist of 10 – 20 pairs (males).

The HiQBioDiv habitat suitability modelling results also indicate that the forest complex south of the wind farm is suitable habitat for European nightjar, while other forest areas within and around the park are of lower suitability. Within 1 km of the wind turbined, there are 381 ha of low to medium suitability habitats (T – Q2) and 140 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.04% of such habitat area in Latvia.

According to experts, the impact of wind farms on European nightjar is insufficiently studied. The Report authors consider that this is related to the generally limited scientific research base regarding wind farm impacts on forest bird species. Only several older publications include hypotheses regarding nightjar activity near wind turbines, explaining it through possible insect attraction and noise effects on birds. Although experts indicate a specific noise level in decibels above which impacts are expected, the Report authors consider that there are no publications directly linking such thresholds to European nightjars.

Experts indicate that in areas with particularly high densities of European nightjars within natural habitats, wind farm construction is generally recommended to be avoided. A threshold of more than 2 pairs per km² is used as a criterion. Considering the situation within the study area, experts conclude that the observed number of nightjars corresponds to a considerably lower density, and that part of the nightjar population does not occupy natural habitats but rather managed forests – mainly young stands – and frequently vocalises in clear-cut areas. In such managed forest conditions, nightjars are expected to move to other young forest stands when existing habitats mature.

According to experts, to reduce negative impacts on European nightjar, deforestation required for construction of wind turbines and associated infrastructure should be carried out outside the nightjar breeding season (01 May – 31 July). During wind turbine operation, monitoring should

be carried out to determine whether increased nightjar concentration occurs near turbines due to increased insect abundance. If such cases are repeatedly identified, relevant wind turbine operational restrictions should be applied – wind turbines should be stopped from sunset to sunrise during 01 May – 31 July. To assess how wind farm construction affects the species status in the area, monitoring of this species is recommended in priority conservation areas before construction and during operation. The Report authors consider that expert recommendations regarding restrictions on deforestation works and monitoring of actual impacts should be taken into account; however, the proposal for wind turbine shutdowns is based on hypotheses that are not supported by sufficient research. Restrictions on turbine operation would be justified if monitoring identifies nightjar mortality due to collisions with wind turbines.

Red-backed shrike (Lanius collurio)

Red-backed shrike is a long-distance migratory bird species. Globally, the species population is not considered threatened (Least Concern – LC) and is stable. In Latvia, the species population is assessed as vulnerable (VU), with a negative population trend both in the long and short term. Red-backed shrike is a specially protected species included in Annex I of the Birds Directive.

The agricultural landscape within the wind farm area, including tree groups, drainage ditches and overgrown floodplain meadows, provides suitable conditions for red-backed shrike breeding. Field observations confirm that red-backed shrike occurs as a breeding species within the wind farm area. The HiQBioDiv habitat suitability modelling results also indicate that suitable habitats for red-backed shrike occur within and around the wind farm area. Within 1 km of the wind turbines, there are 192 ha of low to medium suitability habitats (T – Q2) and 56 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for approximately 0.01% of such habitat area in Latvia.

Experts indicate that there is no basis to conclude that the status of this species would significantly deteriorate due to wind farm construction. The greatest risk to the species in the area is deterioration or destruction of habitats suitable for breeding. Considering the species' wide and even distribution in Latvia, broad availability of occupied habitats (agricultural lands, forest edges, clear-cuts, farmsteads), and adaptability in breeding habitat selection, it can be assumed that even if operation of specific wind turbines affects individual red-backed shrike territories, birds will be able to relocate to suitable nearby areas. Experts conclude that the impact of the planned wind farm on red-backed shrike status in the area will be insignificant. Therefore, no specific mitigation measures are required.

Woodlark (Lullula arborea)

Woodlark is a short-distance migratory bird species. Globally, the species population is not considered threatened (Least Concern – LC) and is increasing. In Latvia, the species population is increasing in the long term and stable in the short term. The Latvian population is also not considered threatened (LC). Woodlark is a specially protected species included in Annex I of the Birds Directive.

The landscape within the wind farm area provides suitable conditions for woodlark breeding, and field observations confirm that woodlark occurs as a breeding species within the wind farm area,

although the total number of observations is relatively low. The HiQBioDiv habitat suitability modelling results also indicate that suitable habitats for woodlark occur within and around the wind farm area. Within 1 km of the wind turbines, there are 353 ha of low to medium suitability habitats (T – Q2) and 122 ha of high to excellent suitability habitats (Q2 – 1). High to excellent suitability habitats near the wind farm account for slightly less than 0.03% of such habitat area in Latvia.

Observation data do not allow conclusions regarding the potential woodlark population size within the territory; however, there is no basis to conclude that the species status would significantly deteriorate due to wind farm construction. According to experts, the greatest risk to the species status in the area is deterioration or destruction of breeding habitats. Due to the high and prolonged display flights of woodlarks, there is also a potential collision risk with wind turbine blades; however, no data on such impacts are available in scientific literature. Considering the species' wide and even distribution in Latvia and the broad availability of habitats it occupies (forests, including clear-cuts, forest edges, and agricultural lands), it can be assumed that even if operation of specific wind turbines affects individual woodlark territories, birds will be able to relocate to suitable nearby areas. Experts consider that the impact of the planned wind farm on woodlark status in the area will be insignificant. Therefore, no specific mitigation measures are required.

3.3.5.3. Mitigation measures

When assessing the impact of the planned wind farm on birds, experts conclude that, although intensively managed forests dominate within the study area, suitable conditions for breeding of specially protected bird species occur both within established micro-reserves and nature reserves, as well as in old forest stands, which is clearly reflected in the observations. The impact of the proposed activity on specially protected birds is assessed as negative in the southern part of the wind farm, while in the central and northern parts of the wind farm the impact on specially protected birds is assessed as potentially neutral, provided that risk mitigation measures are implemented.

According to experts, the wind turbines that potentially cause lower impacts on protected bird species are wind turbines No. 1, 2, 3, 4, 5, 6, 9 and 14. The expert assumption is also supported by the habitat impact analysis performed (see more in Chapter 3.3.5.4). At the same time, construction of these wind turbines is only possible if measures to reduce impacts on birds are implemented.

To reduce the collision risk of grouse species and corncrake with wind turbine towers, experts recommend painting the towers in a colour contrasting with low-visibility conditions – not white or light grey. As previously indicated, in the opinion of the Report authors, the effectiveness of such a mitigation measure has not been scientifically demonstrated for the grouse species recorded within the wind farm area, and studies regarding impacts on other species do not indicate high effectiveness. Based on the above, the Report authors consider that there are grounds to establish the following recommendation for implementation of the proposed activity: **The lower part of the planned wind turbine towers, covering the height of 1 – 2 tower sections, should be painted using a gradual colour transition from a darker shade to a lighter shade,**

provided that the use of such a solution is not opposed by Valka Municipality in the context of landscape protection. The selected colouring solution shall be coordinated with Valka Municipality and the Nature Conservation Agency.

To reduce impacts on several bird species, experts have recommended that necessary deforestation works are carried out outside the relevant bird breeding periods. The Report authors consider this mitigation measure justified and propose it as a mandatory implementation condition: **To reduce impacts on birds during their breeding period, deforestation works at wind turbine construction sites and associated infrastructure locations shall be carried out outside the breeding season of protected bird species. The exact deforestation restriction period shall be determined based on the results of pre-construction monitoring, taking into account the breeding periods of protected bird species observed near WTG construction locations during monitoring. The timing of deforestation works shall be coordinated with the Nature Conservation Agency.**

To reduce mortality of specially protected and sensitive bird species due to collisions with wind turbines, experts recommend using camera systems that provide species recognition capabilities and, where necessary, can stop operation of specific wind turbines or significantly reduce rotor speed. The Report authors consider that the use of such technologies is a scientifically justified and effective solution that can reduce bird mortality; however, the effectiveness of these technologies depends both on the technical performance of the system itself and on the selected settings. It should be noted that camera systems supplemented with bird deterrent solutions are also available on the market. In their expert opinion, experts have identified the following bird species for which wind turbine operation should be stopped when approaching lesser spotted eagle; white-tailed eagle; black stork; white stork; crane; western marsh harrier; hen harrier; goshawk. Although the species list is based on field observation data, the Report authors consider that it should be refined, as several potentially sensitive species that were not observed within the wind farm area – for example, osprey and golden eagle – are not included, while the collision risk for cranes is considered low. The Report authors consider that the following mandatory conditions should be established for implementation of the proposed activity:

- **To reduce bird mortality caused by collisions with wind turbines, equipment/systems for automatic bird flight detection, flying bird recognition and automatic wind turbine shutdown or significant reduction of rotor speed shall be installed within the wind farm when a collision with sensitive bird species is predicted. When selecting the equipment, the project proponent shall take into account that the list of detectable species may be modified based on monitoring results.**
- **The list of sensitive bird species shall be determined during pre-construction monitoring by performing collision risk modelling, within which predicted bird mortality rates shall be assessed. The list shall include diurnal birds of prey and other threatened bird species for which a high collision risk is predicted. The list of detectable species shall be coordinated with the Nature Conservation Agency.**
- **Based on operational monitoring results, including bird fatality surveys, the Nature Conservation Agency shall have the right to modify the list of detectable bird species if mortality rates are assessed as high in the context of species population conservation.**

If high mortality is recorded for bird species for which impacts cannot be reduced using detection equipment/systems, the project proponent, in cooperation with relevant experts and the Nature Conservation Agency, shall determine alternative mitigation or compensation measures.

- **The use of equipment/systems designed to deter birds from wind turbines is prohibited within the wind farm.**

Experts recommend using detection equipment capable of identifying large (>100 individuals) migrating bird flocks consisting of geese or wader species and recording such events. Recorded events and the number of individuals killed in collisions shall be assessed in operational monitoring Reports, with damage reduction measures implemented if necessary. The Report authors consider that such a solution can only be partially implemented, as it is limited by the technical capabilities of detection systems. One of the species mentioned as potentially forming larger flocks within the wind farm area is the European golden plover. According to information available to the Report authors, no detection system has currently been developed that can identify bird movements of this size while also recognising the specific species. At the same time, it should be noted that mortality of any bird species will be recorded within post-construction monitoring, and the previously established requirement regarding revision of the detectable species list already includes provisions for actions related to impacts that were not assessed during the EIA process.

To reduce noise impacts on birds, experts recommend installing wind turbines with the lowest possible noise emissions or wind turbines equipped with aerodynamically improved blades (serrated trailing edges). Based on the assessment of the wind turbines analysed during the EIA process, the Report authors consider that there are grounds to establish the following mandatory condition for implementation of the proposed activity: **The maximum noise emission level of wind turbines installed at the "Valka" wind farm shall not exceed 107.8 dB(A).** Although experts apply the condition regarding the use of aerodynamically improved blades (serrated trailing edges) specifically to wind turbine No. 8 and 12, primarily to reduce impacts on hazel grouse habitats, the Report authors consider that this condition should apply to all wind turbines.

When assessing the impact of the planned wind turbines on areas important for birds, experts recommend abandoning the construction of wind turbines No. 7, 10, 13 and 11. These wind turbines will clearly cause the greatest impacts, primarily on forest-breeding bird species, which is also demonstrated by the habitat impact assessment results included in Chapter 3.3.5.4. At the same time, it should be noted that impacts on birds are not the only aspect assessed within the EIA process. In the opinion of the Report authors, there are grounds to provide the following recommendation: **If the number of planned wind turbines is reduced, from the perspective of bird protection priority should be given to removing those wind turbines that cause the highest impact on areas important for birds, according to the total impact level defined in Table 3.3.5.1.** At the same time, it should be noted that wind turbines located in the northern part of the wind farm, which are closer to Valka, represent a less favourable solution from the perspective of public health protection and landscape protection. In the opinion of the Report authors, the institution responsible for adopting the decision on acceptance of the proposed activity should equally consider not only nature conservation interests, but also public health protection and safety

interests. The expert opinion does not indicate that any of the assessed wind turbines locations would cause a significant adverse impact on birds that, within the framework of the EIA process, would constitute grounds for imposing a mandatory condition requiring rejection of construction of specific wind turbines.

The experts have included requirements for further monitoring in their opinion, generally describing the pre-construction monitoring phase. Considering that any prediction of impacts on natural values is associated with a high level of uncertainty, the Report authors consider that the requirement to conduct monitoring is justified. However, this requirement should be expanded with the following condition: **The project proponent, in cooperation with relevant sector experts and the Nature Conservation Agency, shall carry out monitoring to assess the actual impact on ornithofauna. The monitoring shall include:**

- **At least one year of monitoring before the commencement of construction works, during which up-to-date information on bird species occurring within the wind farm area shall be obtained. Particular attention during pre-construction monitoring shall be given to observations within the forest complex located south of the planned wind farm. During monitoring, collision risk modelling is recommended in order to refine the list of bird species to which detection equipment/systems shall apply.**
- **Monitoring during wind farm construction, during which up-to-date information on bird species occurring within the wind farm area shall be obtained and the impact of construction works on bird breeding territories or bird resting/occurrence areas shall be assessed.**
- **Monitoring during wind farm operation, recommended for at least the first five years, during which data on the actual impact of the wind farm on ornithofauna shall be obtained. Monitoring shall assess the impact of wind farm operation on bird breeding territories or resting/occurrence areas, as well as include surveys of bird fatalities. The Nature Conservation Agency shall have the right to revise the monitoring duration if monitoring identifies significant impacts on birds resulting in changes to operational conditions.**

3.3.5.4. Assessment of alternatives

Within the EIA process, five technological alternatives have been assessed, including wind turbines with standard and aerodynamically improved blades. Although there is no basis to assume that noise does not cause disturbance to any bird species, experts have identified several bird species for which noise disturbance may be significant, creating a risk of abandonment of breeding territories. The difference between the loudest and quietest wind turbines assessed is less than 5 dB (see more in Chapter 3.1 of the Report). At first glance, this may appear to be an insignificant difference, considering that the sound power level generated by all assessed wind turbines at nominal capacity exceeds 100 dB. However, considering noise propagation relationships, it should be noted that a 5 dB difference is significant, as such a difference in noise level occurs when the distance from the source is doubled.

When comparing the assessed technological alternatives, from the perspective of bird protection, a better solution would also be considered the installation of wind turbines with lower noise

emission levels. If a specific wind turbine model is selected, preference should be given to wind turbines equipped with aerodynamically improved blades.

Potential bird collision risk with wind turbines may increase if wind turbines with larger rotor diameters are installed within the wind farm, as the airspace area in which collisions may occur increases. This initially suggests that installation of wind turbines with smaller rotor diameters would be a preferable alternative. However, overall, the difference in impact level is considered insignificant, and the wind turbine location has a much greater influence on the increase in collision risk.

Experts have also assessed wind turbine construction locations as alternatives, identifying those WTGs whose construction should primarily be avoided for bird protection purposes if the number of wind turbines can be reduced. The assessment was based on identified risk zones for capercaillie, hazel grouse, Ural owl and European nightjar, as well as a high habitat impact indicator that was not analysed in detail. In the opinion of the Report authors, such an assessment approach, which selects specific bird species with different population statuses, is subjective and appears insufficiently justified. It should be noted that experts have also defined risk zones around species observation locations, which do not necessarily characterise the overall habitat distribution of these species.

Considering the information provided in Chapter 2 regarding the possible reduction of the number of wind turbines, and while generally supporting the expert objective of identifying turbines that are less favourable from the perspective of bird protection, a more detailed analysis of the impacts of wind turbine location alternatives on bird-suitable habitats was carried out during preparation of the Report. The assessment used spatial data from the HiQBioDiv project bird habitat suitability modelling. The assessment included all species for which modelling data were available and which were observed within the study area. To assess the impact of each wind turbine both on individual species and on birds overall, spatial data were indexed according to the following approach:

1. Suitable habitats for species within a 1 km radius around each wind turbine were selected and divided into four value groups according to the quartile method.
2. Depending on the habitat quality class assigned to each model cell, index values were assigned within a range from 1 to 4.
3. Considering that species population conservation statuses differ, habitat suitability index values were multiplied according to population status, assigning the highest values to critically endangered (CR) populations and the lowest values to least concern (LC) populations, within a range from 1 to 16.
4. Considering that the available habitat areas for different species vary across Latvia, calculations included the total area of habitats of the respective quality class available in Latvia.

The results of the calculations are presented in Table 3.3.5.1. As shown in the table, from the perspective of habitat and population conservation, the greatest impact on species would result from construction of wind turbine No. 7, followed by wind turbines No. 13, 11, 10 and 12. Although the detailed calculations also indicate that, from the perspective of bird protection, the

least favourable turbines are those planned near the boundary with the forest complex located south of the wind farm, unlike the buffer-zone approach used by experts, these calculations assign different conservation importance to individual species. For example, while experts highlight European nightjar as one of the important species, the performed calculations, considering the species conservation status and the total available habitat area in Latvia, indicate that its importance is relatively low compared with other species not specifically highlighted by experts, such as: black grouse; common redshank; goshawk; three-toed woodpecker; and even common buzzard. The calculation results indicate that other species usually considered highly important, such as white-tailed eagle, lesser spotted eagle, black stork, etc., are of relatively low importance in terms of habitat conservation. However, this does not invalidate the previously provided recommendation regarding the need to implement collision risk reduction measures.

In the opinion of the Report authors, the performed calculations will support a balanced decision when selecting specific wind turbine construction locations if the number of turbines is reduced, particularly from the perspective of bird protection. However, it should be noted that the calculations represent only a relative comparison between wind turbines planned for the "Valka" wind farm and cannot be used to compare impacts with other wind farms. Comparable data between different wind farms could only be obtained if an identical methodology were applied across all projects.

Table 3.3.5.1. Results of the assessment of bird-suitable habitats for each planned wind turbine

Species	Wind turbine No.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
TETURO	0.28	0.02	1.18	1.70	0.44	2.86	16.78	7.07	0.59	9.53	14.68	8.81	13.57	4.26
LYRTET	2.73	5.15	7.39	8.53	3.08	5.80	8.71	7.23	6.62	11.78	12.49	10.92	12.50	9.54
BONBON	1.05	0.47	2.38	1.69	1.22	2.86	11.81	6.11	1.33	8.96	13.35	10.74	13.06	5.45
PERPER	0.22	1.69	0.07	2.30	0.41	1.23	0.95	0.49	0.39	0.03	1.40	0.97	0.14	0.60
CYGCYG	0.12	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.01	0.02	0.04	0.02
ANSANS	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
GRUGRU	0.42	0.25	0.35	0.30	0.45	0.54	0.56	0.48	0.52	0.37	0.30	0.26	0.18	0.23
CRECRE	2.60	7.13	2.95	5.98	2.20	4.05	3.24	1.91	2.44	1.71	4.18	3.24	2.13	3.35
COTCOT	0.00	2.57	0.27	2.84	0.00	0.01	0.00	0.00	0.00	0.01	1.35	1.47	0.10	1.25
PORPOR	0.02	0.01	0.06	0.05	0.01	0.07	0.13	0.11	0.05	0.14	0.03	0.06	0.06	0.06
NUMARQ	0.12	0.40	0.14	0.44	0.21	0.29	0.18	0.22	0.25	0.10	0.25	0.24	0.11	0.21
TRITOT	10.58	6.50	7.96	2.67	8.92	8.82	8.19	8.96	12.59	5.68	1.31	2.49	2.23	3.94
PLUARP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.24	0.00
TRIGLA	4.55	2.43	3.37	0.45	2.40	0.78	1.57	1.63	3.23	2.57	0.34	0.48	0.56	1.20
CICNIG	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CICCIC	0.03	0.21	0.04	0.19	0.02	0.09	0.13	0.02	0.02	0.02	0.07	0.03	0.04	0.04
STRURA	0.02	0.01	0.27	0.25	0.03	0.53	2.67	1.38	0.14	2.28	2.35	2.03	2.93	1.03
GALPAS	0.23	0.10	0.54	0.16	0.27	0.49	1.95	1.31	0.29	2.23	2.77	2.54	3.31	1.20
AEGFUN	0.00	0.00	0.14	0.05	0.00	0.86	3.25	1.45	0.11	1.40	1.67	0.99	1.45	0.40
CLAPOM	0.53	0.19	0.92	0.47	0.65	0.50	0.20	0.66	0.62	1.04	0.29	0.73	0.77	0.96
CIRAER	0.18	0.02	0.02	0.05	0.00	0.00	0.01	0.00	0.00	0.04	0.05	0.06	0.05	0.05
ACCGEN	6.95	1.61	3.41	2.19	6.78	7.53	11.77	9.05	5.86	9.64	9.03	8.03	11.27	4.75
HALALB	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MILMIG	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUTBUT	2.66	0.68	2.94	1.76	2.76	2.15	1.11	2.78	2.48	3.89	1.97	3.32	3.85	3.62
FALTIN	0.06	0.68	0.11	0.42	0.08	0.26	0.21	0.08	0.11	0.04	0.16	0.13	0.06	0.13

Species	Wind turbine No.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PICTRI	1.01	0.52	1.04	1.40	1.46	1.53	3.90	2.14	0.70	4.07	5.84	5.90	7.93	4.07
DENLEU	0.01	0.02	0.02	0.01	0.09	0.05	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
DRYMIN	1.26	0.52	1.96	1.05	3.00	2.67	1.45	2.03	1.90	2.37	0.78	1.62	1.75	2.08
DRYMAR	0.07	0.03	0.13	0.06	0.08	0.19	0.56	0.34	0.09	0.35	0.57	0.39	0.46	0.20
PICCAN	0.09	0.02	0.26	0.11	0.36	0.44	0.27	0.42	0.33	0.41	0.18	0.20	0.30	0.28
JYNTOR	2.62	1.17	0.62	0.75	2.40	3.61	3.60	1.74	1.41	0.72	1.07	0.55	0.62	0.65
CAPEUR	0.01	0.05	0.05	0.09	0.02	0.54	1.93	1.23	0.08	0.45	0.97	0.45	0.63	0.17
LANCOL	0.46	0.71	0.61	0.77	0.30	1.62	2.18	0.68	0.59	0.75	1.61	0.47	0.57	0.47
LULARB	0.04	0.10	0.06	0.07	0.09	0.78	1.69	0.52	0.13	0.16	0.54	0.13	0.12	0.08
Kopā:	39.0	33.3	39.3	36.8	37.8	51.2	89.0	60.1	42.9	71.0	79.6	67.3	81.0	50.3

3.4. LANDSCAPE AND VISUAL IMPACT

This chapter of the Report evaluates the impact of the planned "Valka" wind farm on the surrounding landscape and provides recommendations for mitigating or avoiding such impacts during the implementation of the proposed activity. The assessment was prepared in collaboration with landscape experts from Latvia and Estonia. In preparing the assessment, site inspections were conducted in both Latvian and Estonian territory, while conclusions on the significance of changes are based on the results of visual impact zone modeling and prepared photomontages.

3.4.1. Landscape protection policy and legislative framework

Latvia

Landscape protection policy in Latvia is based on the European Landscape Convention, ratified in 2007, committing to implement the measures set out therein by applying the principles indicated for landscape protection, preservation, and development. To achieve the objectives defined in the Convention, corresponding national legislation, including laws and Cabinet of Ministers regulations, would be required to regulate landscape assessment, planning, and use, as well as management of protection; however, such legislation has not been developed in Latvia. In practice, landscape management in Latvia is primarily implemented through spatial planning, by defining landscapes of national, regional, and local significance, identifying valuable territories, sites, and objects, and developing regulations for their use and protection.

In the Valka Municipality Sustainable Development Strategy, the PLA "Ziemeļgauja" is highlighted as a landscape of national significance, established to preserve the mosaic landscape of the Ziemeļgauja valley. Additionally, in the Valka Municipality spatial development plan, the area around Ērģeme is marked as a landscape of local value, partially overlapping the Ērģeme mosaic landscape, the Seda bog landscape, and the Seda forest landscape areas. In rural development areas, emphasis is placed on preserving, protecting, and managing landscape diversity, thereby promoting population retention in rural areas[67].

The Valka Municipality Development Programme highlights the most valuable landscapes in each parish:

- Ērģeme Parish: aesthetically and culturally significant landscape elements include oak alleys, manor houses and old farm buildings, parks, stone masonry buildings and their ruins, and homestead plantings;
- Kārķi Parish: notable landscapes include the road section from "Naglas" to "Vēveri," the surroundings of Lake Veckārķi, Lake Cepši, and Lake Bezdibenis, the Augstais (White) Hill, Spaļu Alley, and a row of old trees along the road section before the Kārķi center when approaching from Rūjiena;
- Vijciems Parish: rich in field-specific plantings (tree groups) around homesteads, old alleys, stone masonry buildings, winding country roads following the terrain, and manor houses;

[67] Valkas novada dome. 2014. *Valkas novada ilgtspējīgas attīstības stratēģija 2013.-2037. gadam.* Valka, Valkas novada dome. Available: https://www.valka.lv/lv/media/2114/download?attachment

- Zvārtava Parish: visually attractive forest landscapes along the Valka – Vireši road, with a wide view of the Gauja valley landscape near the Cirgaļu forest massif. Important landscape elements include park-like meadows in Valka and Zvārtava parishes, the inland dune massif near Cirgaļi, and Gauja riverbank outcrops[68].

The municipal spatial plan does not define protected landscape territories, but regulations exist for scenic roads where construction or planting is prohibited, and forest growth that could block views from publicly accessible viewpoints and scenic roads is restricted. It should be noted, however, that scenic roads are regulated only within the PLA "Ziemeļgauja" (Valka, Vijciems, and Zvārtava parishes), and these are not shown in the graphical part of the regulations[69].

South of the planned "Valka" wind farm lies the PLA "Ziemeļgauja," whose main values are the Gauja valley and surrounding forest, which are minimally affected by economic activities, and where inland dunes occur (see Figure 3.4.1) [70].

Northwest of the planned wind farm is the North Vidzeme Biosphere Reserve (hereinafter – NVBR), which has an ecological landscape plan, though it was developed over 15 years ago. One of the objectives of the landscape ecological plan is to find a balance between non-traditional landscape elements, such as wind turbines within the biosphere reserve, while preserving biological and cultural-historical values.

Within the significant impact zone of the wind farm are the undulating plains landscape of Valka, the Valka biocentre, the Ērģeme hills landscape, and the Valka – Seda corridor. Figure 3.4.2 illustrates that within the potential impact zone are the core zones of cultural-historical landscapes associated with the aesthetic and cultural-historical value of the Ērģeme landscape[71].

[68] Valkas novada pašvaldība. 2022. *Valkas novada attīstības programma 2022.-2028. gadam. I daļa, pašreizējās situācijas raksturojums, 2. redakcija.* Valka, Valkas novada pašvaldība. Available: https://www.valka.lv/lv/media/1732/download?attachment

[69] Valkas novada teritorijas plānojuma (no 2017. gada) grozījumi https://geolatvija.lv/geo/tapis?document=open#document_22074

[70] Latvijas Dabas fonds. 2007. *Aizsargājamo ainavu apvidus "Ziemeļgauja" dabas aizsardzības plāns*. Rīga, Latvijas Dabas fonds. Available: https://www.daba.gov.lv/lv/media/1213/download?attachment

[71] Ziemeļvidzemes biosfēras rezervāts https://www.daba.gov.lv/lv/ziemelvidzemes-biosferas-rezervats

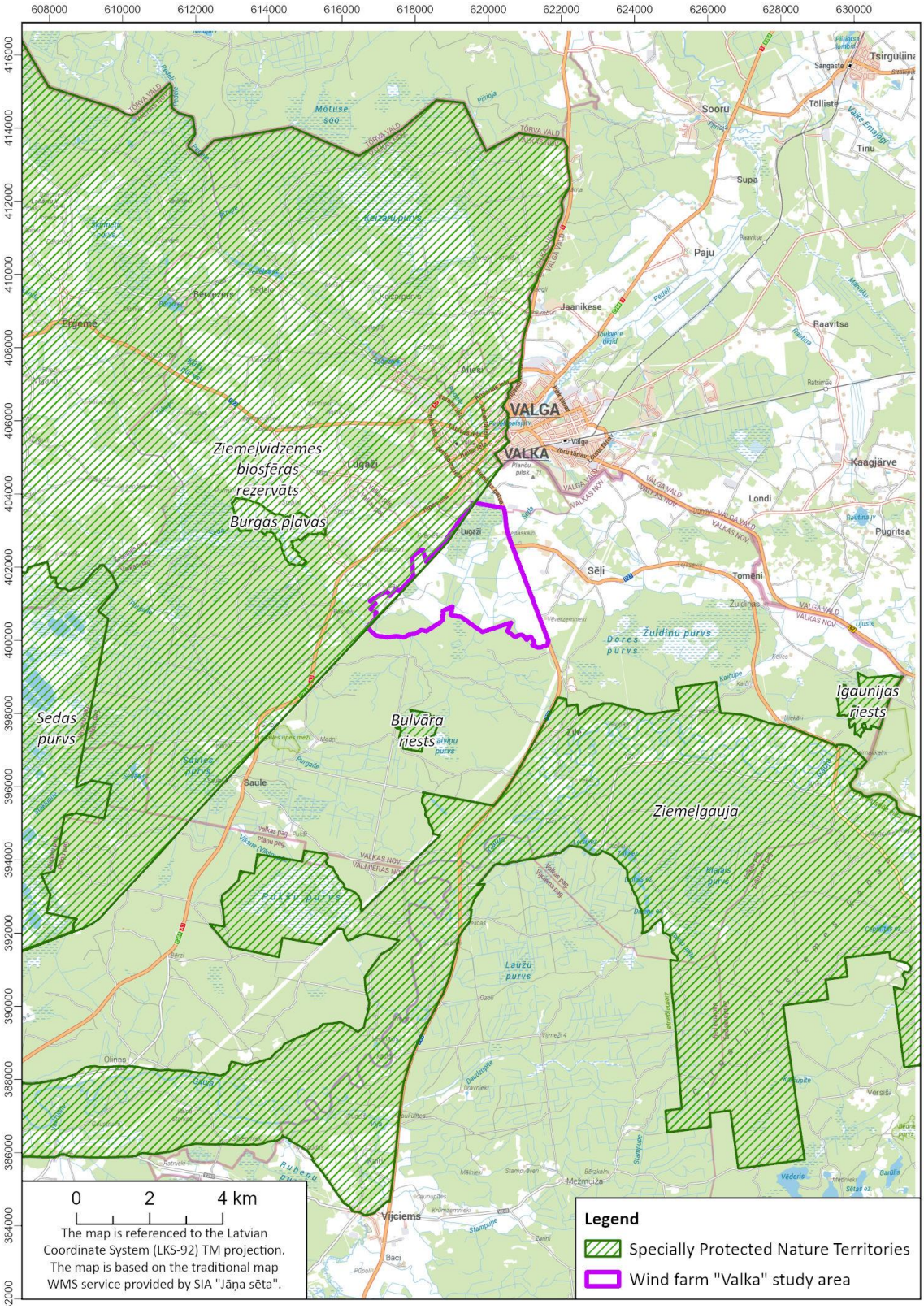


Figure 3.4.1. Planned "Valka" wind farm – Specially Protected Nature Territories (SPNT) in the surrounding area

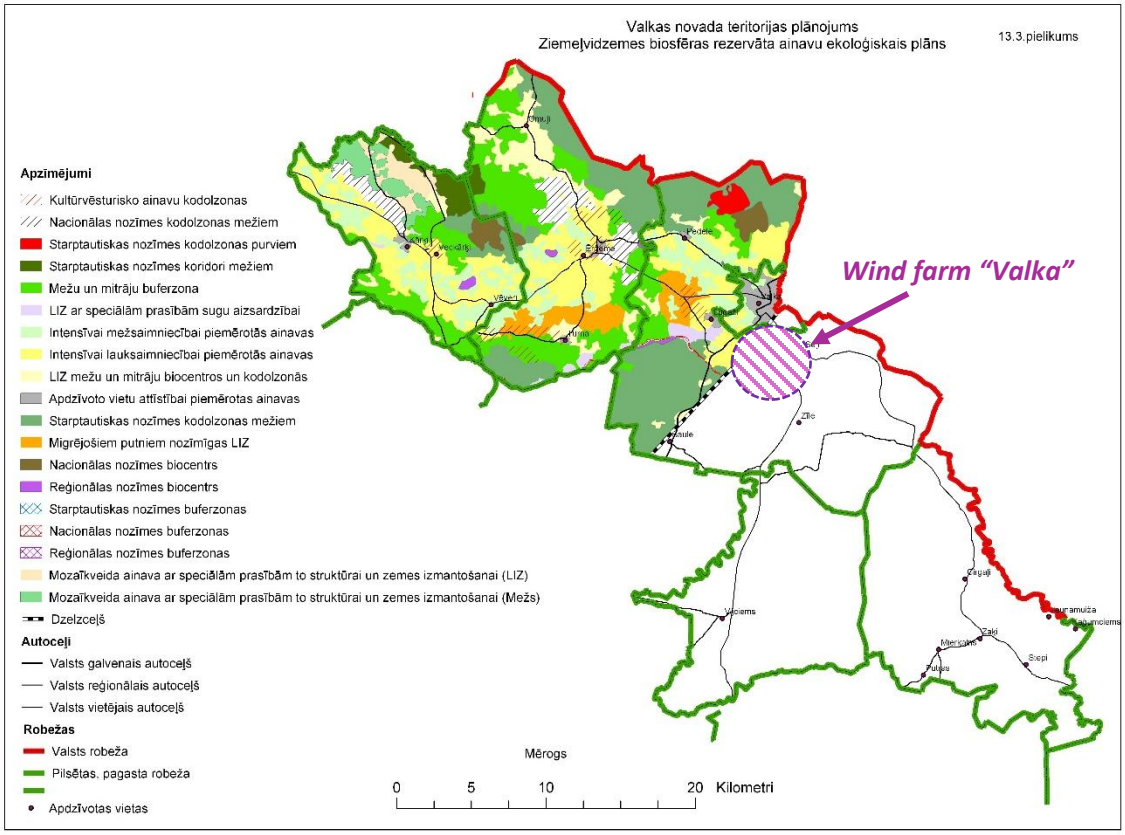


Figure 3.4.2. Scheme of the North Vidzeme Biosphere Reserve (NVBR) Landscape Ecological Plan (Annex 13.3 of the Spatial Plan of Valka Municipality)

Highlighting the most outstanding values of the Latvian landscape, the nearest landscapes of the Latvian Cultural Canon are the Latvian forest landscape, noting that approximately 59% of the territory of Valkas Municipality is covered by forests, as well as the Gauja ancient valley landscape (from Valmiera to Vangaži), located about 50 km from the planned project area[72]. According to evaluations of landscape treasures by Latvian residents and landscape experts, the nearest nationally significant landscape treasure, the "Burtnieki Lake landscape with churches and manor centers," is located approximately 40 km from the planned activity[73].

Estonia

For general landscape characterization, Estonia is divided into geographic landscape regions; however, this division does not have a legal or official planning status. The most widely used and recognized landscape zoning in Estonia was developed by Ivar Arold in cooperation with the University of Tartu[74], through a detailed analysis of the national territory and identification of geographic landscape regions. Although this division is not established in regulatory acts, it is used

[72] Available: https://kulturaskanons.lv/list/?l=8#landscapes
[73] Available: https://ainavudargumi.lv/saraksts/?section=3
[74] Ivar Arold. 2005. EESTI MAASTIKUD. Available: https://dspace.ut.ee/server/api/core/bitstreams/3c8e0043-bf56-4d8f-8d14-8489cb957d2a/content

as a methodological basis for conducting landscape characterization and assessment of a territory.

Looking at the legislation, the official protection status is, firstly, assigned to landscape protection areas, which have legal protection status under the Nature Conservation Act. Secondly, in Estonia, valuable landscapes are also designated as a planning-based category – defined in county thematic plans and/or municipal spatial plans. In the Valga County plan, several valuable landscapes are identified with varying values and land-use conditions or recommendations, primarily concerning the areas themselves; however, in the visual impact assessment, it is important to also consider views toward and from these areas, including scenic viewpoints represented on maps.

3.4.2. Impact assessment approach

Planning documents and guidelines used in the landscape impact assessment

The landscape assessment has been carried out in accordance with the requirements of the EIA program, which stipulates evaluating the impact of the planned activity on the landscape, including the assessment of the significance of landscape effects. In preparing the assessment, the "Guidelines for conducting an initial EIA for wind turbine construction,"[75] developed in Latvia, were partially used. These guidelines include recommendations for landscape impact assessment and some measures to mitigate impacts.

For the assessment of the wind farm's impact across both Latvian and Estonian territories, an analysis of legislation and development planning documents at various levels was conducted. This considered landscapes recognized at the national level (e.g., protected landscape areas) as well as landscapes designated at regional and municipal levels (e.g., scenic areas, scenic roads), as, as noted above, spatial planning documents play a primary role in landscape management.

Since Latvian legislation does not specify a detailed procedure for landscape impact assessment, and the guidelines issued by the SES only include general requirements for assessment, this landscape impact assessment also relied on the guidance and methods from NatureScot (Scottish Natural Heritage), which provide a detailed approach to landscape and visual impact assessment:

- NatureScot (2017) Siting and Designing Wind Farms in the Landscape, Version 3a;
- Scottish Natural Heritage (SNH) (2018) A Handbook on EIA, Appendix 2: Landscape and Visual Impact Assessment, Version 5;
- SNH (2017) Visual Representation of Wind Farms, Version 2.2;
- NatureScot (2024) Guidance on Aviation Lighting Impact Assessment.

Landscape Sensitivity

[75] Vadlīnijas ietekmes uz vidi sākotnējā izvērtējuma veikšanai vēja elektrostaciju būvniecības radīto ietekmju uz vidi izvērtēšanai (Guidelines for carrying out initial environmental impact assessments for evaluating environmental impacts caused by the construction of wind power plants). Available: https://www.vvd.gov.lv/lv/jaunums/izstradatas-vadlinijas-veja-parku-ietekmes-uz-vidi-sakotnejo-izvertejumu-veiksanai

Areas with high landscape quality and value are more sensitive to changes than landscapes of lower quality and value, both in terms of human perception and the ecological significance of landscape structures. Criteria for assessing landscape sensitivity to planned changes are summarized in Table 3.4.1. In evaluating the landscape space, the landscape regions identified in the Latvian Landscape Atlas were used. The value of these regions has been assessed based on the importance assigned by national, regional, and/or local authorities or the public.

Table 3.4.1. Criteria for assessing landscape sensitivity

Criteria	High	Medium	Low
Landscape value	Landscapes recognised at the national level (protected nature areas, cultural heritage areas, landscapes included in the Latvian Cultural Canon, etc.)	Landscapes recognised at the regional and municipal level (landscapes recognised by planning regions, valuable landscapes defined in thematic landscape plans, etc.)	Undistinguished (unassessed) landscapes
Landscape quality	The current condition of the landscape particularly highlights and characterises the cultural environment and processes of the region; high degree of landscape naturalness	The landscape is partially transformed, but elements characterising the cultural environment and processes of the region or the naturalness of the landscape have been preserved	The landscape is fragmented and lacks distinct landscape or cultural-historical significance; it lacks internal integrity, and its spatial pattern has been affected

Visual Impact Assessment

The map of the visual impact zones of the wind farm has been prepared for both Latvian and Estonian territories, based on the study of the degree of visible change (DVC)[76]. Following the methodology, the impact of the planned wind turbines was calculated in the horizontal and vertical planes, and then these parameters were combined to determine visual visibility and visual impact based on human field-of-view limitations. In this study, five visual impact zones were identified: very low, low, medium, high, and very high impact (see Table 3.4.2). The visual impact zones map was prepared using GIS software and a 3D model of terrain and vegetation, incorporating data on natural vegetation, trees, forests, buildings, and other physical obstacles that may affect visibility up to 2 meters above ground level. The model includes information on the turbine locations and technical parameters.

Table 3.4.2. Classification of visual impact levels

Assessment	Description
Very high impact	The development proposal significantly changes the character of the landscape and becomes the dominant element within the most important view corridors, unquestionably becoming the most prominent feature of the landscape. It

[76] Available: https://gispoint.de/fileadmin/user_upload/paper_gis_open/DLA_2022/537724062.pdf

Assessment	Description
	creates substantial changes to views or increases the level of disharmony, significantly reducing the visual comfort of the scene.
High impact	The development proposal creates changes in the landscape and is visible within the most important view corridors, unquestionably becoming an important landscape element. It creates changes to views and may increase the level of disharmony, significantly reducing the visual comfort of the scene.
Medium impact	The development proposal is a visible and easily noticeable element and/or may cause certain disturbances in landscape perception or increase the level of disharmony, thereby reducing the visual comfort of views.
Low impact	The development proposal is visible, but may go unnoticed by a casual observer, and/or the proposed activity will not significantly affect the visual comfort of the scene.
Very low impact	The development proposal is barely noticeable and/or does not reduce visual comfort.

Guidelines indicate that for wind turbines exceeding 150 meters in total height, visual impact zones should be modeled up to a distance of 45 km[77]. However, even at distances shorter than this, given Latvia's terrain and vegetation conditions and using the methodology described above, the visual impact is considered very low. In this assessment, visual impact zones were analyzed up to 30 km, since the significance of the impact is determined not by theoretical visibility but by potentially significant visual influence on receptors. Although turbines may theoretically be visible at greater distances, experience and methodological guidelines show that beyond this range, the visual impact is generally negligible and not considered significant in the context of landscape perception. Therefore, the visual impact zones in this assessment are limited to a 30 km radius, focusing on the area where the wind farm's visual presence may have a significant effect and where a detailed assessment is necessary.

Visual Change Modeling

The viewpoints used to assess the visual impact of the wind farm in both Latvian and Estonian territories were selected based on the following criteria[78]:

1) Viewing points and scenic areas defined in planning documents;
2) Views from settlements, farmsteads, and potentially sensitive landscapes;
3) Popular locations with significant visitor numbers;
4) Elevated panoramic viewpoints (terrain, observation towers, etc.);
5) Landscapes with a high degree of naturalness (ecological value);
6) Views with historical, cultural, or spiritual significance and landscape elements;
7) Residents' daily movement routes.

[77] Visual Representation of Wind Farms, Version 2.2, NatureScot (2017)

[78] An Bord Pleanála. 2021. LANDSCAPE AND VISUAL IMPACT ASSESSMENT. Available: https://www.pleanala.ie/publicaccess/EIAR-NIS/310567/EIAR/Volume%202/Chapter%2013%20-%20Landscape%20and%20Visual%20Impact%20Assessment.pdf

The assessment also includes viewpoints with limited visibility but which are more representative of everyday landscape perception. Additionally, visualizations were prepared corresponding to each defined visual impact zone to provide a comprehensive depiction of the wind farm's visual impact.

Photomontages were prepared using the WindPRO 4.1 visual modeling software, where images are generated using 3D modeling tools that account for the terrain relief and vegetation height of the study area, as well as projecting the planned turbines at a realistic scale. WindPRO 4.1 considers both the location and timing of image capture to depict the turbines under appropriate lighting conditions.

An additional approach to assess visual impact is the use of the EnergyPlanner online software for wind farm visualization. This software uses similar principles to WindPRO, but the key difference is the use of Google Maps and Google Earth cartographic data and photography to create photomontages based on platforms widely used by the public.

The visualizations are used in the assessment as informative representations, not as exact reproductions of reality. Regardless of the visualization method, they cannot fully convey the actual experience in the field. Their purpose is to provide a sufficiently accurate understanding of the planned development to assess potential visual impacts. They serve as one of the information sources in the impact assessment process and do not, by themselves, provide a complete picture of the potential impact.

Visual Change Assessment at Night

In the landscape impact assessment, the potential visibility of aviation lighting must be considered, taking into account the planned maximum turbine hub height and estimating its perceptibility within the surrounding wind farm area. The assessment is not based on quantitative light intensity measurements, but on an expert qualitative evaluation of what the human eye would be able to perceive. Additionally, the sensitivity of receptors is considered, based on their location and existing illumination level, classified as high, medium, or low. The highest sensitivity is associated with dark, remote, and SPNTs, while the lowest corresponds to urban areas with significant existing lighting.

To assess the impact of aviation lighting, areas within a 20 km radius of the planned project site were analyzed for potential visibility of lights mounted on turbine nacelles. Using cartographic analysis, the locations from which turbines would be visible were modeled, along with the number of turbines visible from each viewpoint, thereby estimating the number of aviation lights potentially perceptible from a single location. The results were then combined with the areas classified by receptor sensitivity levels, divided into three categories:

1) High sensitivity – areas with no artificial lighting, including natural territories and SPNTs, with no permanent residents and restricted access for tourists.
2) Medium sensitivity – rural areas with limited existing lighting, including tourist-visited locations.

3) Low sensitivity – urban areas with relatively higher population density, proximity to settlements, major transport corridors, and areas with significant artificial lighting.

It is important to note that the aviation lighting assessment does not include quantitative data but is based on theoretical calculations of where and how far receptors could perceive the lights under a worst-case scenario, assuming completely clear meteorological conditions.

For illustrative purposes, visualizations were prepared using the photomontage method applied in the landscape impact assessment, converting photographs to a nighttime view. These visualizations serve as a tool to understand potential impacts but do not fully replicate individual perception in real conditions. Due to variability in human perception under low light and darkness, no visualization can consistently depict what individuals would actually experience.

Determining Impact Significance

Considering the planned location of the "Valka" wind farm relatively close to the towns of Valka and Valga, the presence of residents within the visual range of the wind farm is a key factor — the more people live or stay within the visibility zone, the greater the potential effect on visual perception. Therefore, the assessment of the significance of landscape and visual impacts was carried out based on a combined evaluation of landscape sensitivity and receptor sensitivity.

Landscape sensitivity was determined as the sum of landscape value and landscape quality, while receptor sensitivity was assessed based on the number of people:

1) High receptor sensitivity is assigned to areas with high population density, including urban residential areas, public outdoor spaces, parks, and promenades where residents are permanently present and regularly perceive the surrounding landscape.
2) Medium sensitivity is assigned to areas with moderate population density, such as small towns and villages, where the presence of people is regular, but visual perception is not the primary aspect of land use.
3) Low receptor sensitivity is assigned to rural areas and zones with low population density, where the presence of people is rare and the visual impact affects a limited number of receptors.

Assessment criteria are presented in Table 3.4.3.

3.4.3. Table. Criteria for assessing receptor sensitivity

Sensitivity	Population density	Receptor sensitivity
Augsts	0 – 5 km zone; urban settlements, recreational areas and parks	Nearby residents, tourists
Vidējs	5 – 15 km zone; villages	Residents, tourists
Zems	15 – 30 km zone; rural areas	Sparsely populated areas or low-activity zones

The significance of visual impact is determined by combining landscape sensitivity (landscape value + landscape quality) with receptor sensitivity. This approach ensures that both landscape quality and the presence of residents are taken into account in the assessment. Thus, a higher significance level is identified in areas where high landscape sensitivity coincides with high

receptor sensitivity, whereas lower significance is observed in areas with low landscape and receptor sensitivity.

3.4.3. Description of the existing situation

According to the general landscape classification in Latvia[79], which delineates landscape regions based on large-scale relief forms, the planned project area is located between the North Vidzeme and Gauja landscape regions. In the framework of the national research program "Sustainable Land Resources and Landscape Management," the smallest spatial unit for landscape classification is the landscape area, which forms part of larger landscape districts and regions. In this assessment, landscape areas are used as the primary scale for describing the landscape.

Based on the landscape area classification, the planned wind farm site is located within the Ērģeme Mosaic Landscape and the Seda Forest Landscape, while potentially significant landscape impacts are expected in areas such as Valka town, the Seda peatland landscape, the Gauja River landscape from Strenči to the Estonian border, and the Pūpoli – Mežmuiža Forest Landscape (see Figure 3.4.3). The assessment of impact significance is based on the results of visual impact zone modeling (see subsection 4.4.4), which indicate that although the wind farm may be visible from locations farther than 15 km, the visual impact at such distances is considered minor.

Although the planned wind turbines will not be constructed within the NVBR, the project area borders it. Therefore, for a more precise description of the landscape areas, information from the NVBR landscape ecological plan, including maps and landscape passports, was also used. The potential impact of the planned "Valka" wind farm is expected in landscape spaces such as the Valka undulating plain, the Valka forest and wetland biocenter, the Valka – Seda forest and wetland corridor, the Seda forest and wetland biocenter, the Seda River inland water and wetland corridor with buffer zone, the Lugaži cultural landscape, and the Ērģeme Mosaic Landscape (see Figure 3.4.4).

Although the wind farm is planned within Latvian territory, its visual impact is also expected in Estonia. The most widely used landscape classification for Estonia was developed by Professor Ivars Arolds of Tartu University, who analyzed the entire territory and delineated geographical landscape regions. While this classification does not have a formal legal status, it is widely used as a methodological basis for landscape characterization and visual impact assessment. This approach allows for a consistent description of landscape structure and assessment of potential changes in cross-border areas. The potential impact is expected in landscape regions such as Valga nõgu (valley), Karula kõrgustik (highland), Sakala kõrgustik (highland), Võru – Hargla nõgu (valley), and Valga town.

The following text describes the landscape areas located within 15 km of the planned wind turbines.

[79] Ramans, K. 1994. Ainavrajonēšana. Latvijas ainavzemes un ainavapvidi. Latvijas daba. Enciklopēdija „Latvija un latvieši".



Figure 3.4.3. Landscape areas around the planned "Valka" wind farm in Latvia and landscape regions in Estonia

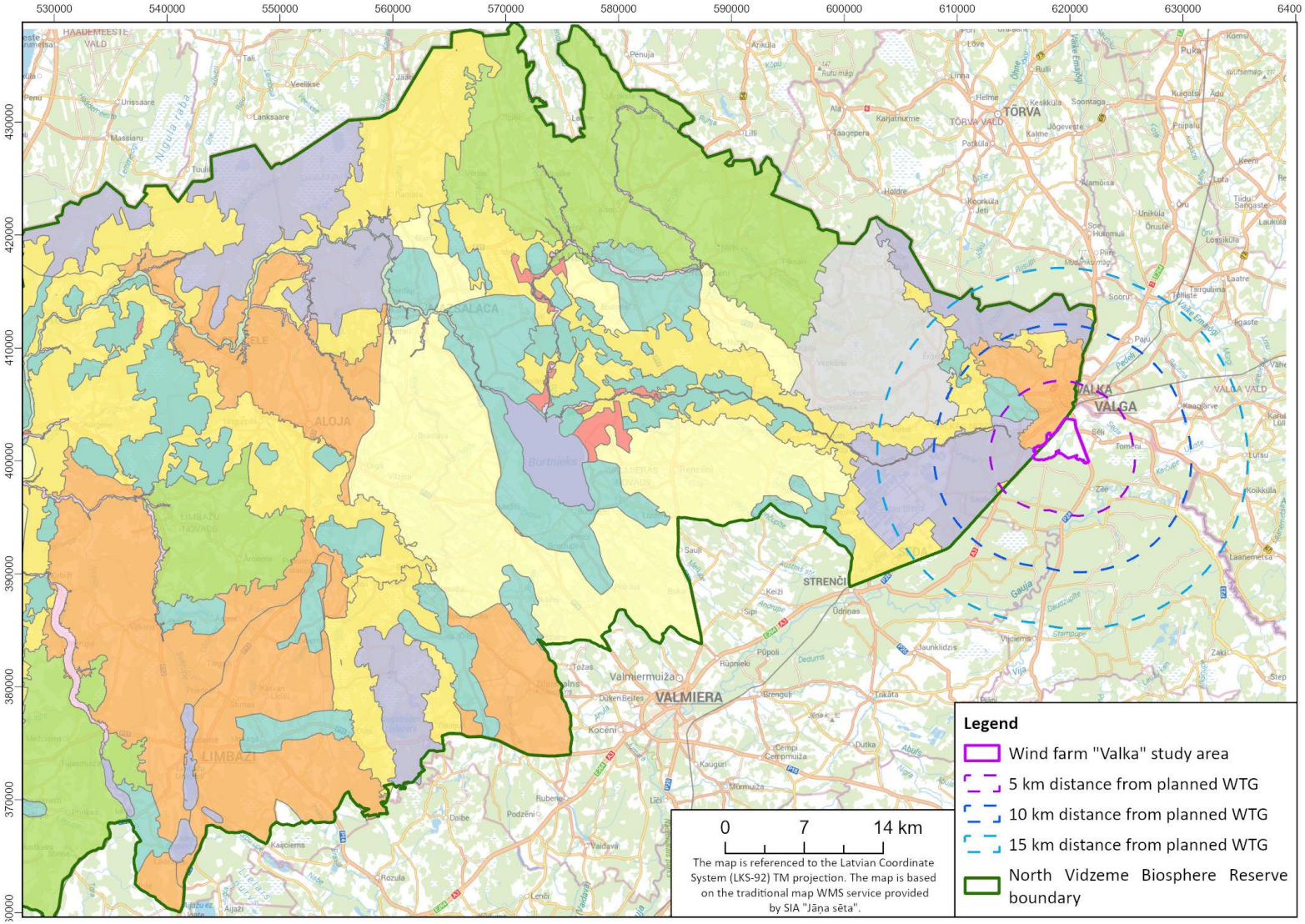


Figure 3.4.4. North Vidzeme Biosphere Reserve landscape ecological plan and the planned wind farm location

Ērģeme Mosaic Landscape

The Ērģeme Mosaic Landscape area covers a relatively large region along the Estonian border, from Valka town to Lode. This area includes villages such as Sēļi, Lugaži, Ērģeme, Lode, Turna, and Vēveri. In parts of the area dominated by agricultural land, a dense pattern of farmsteads is present. Over the past century, the fundamental structure of the landscape has remained largely unchanged – near the state border there is an extensive forest with the Ķeizaru bog and low population density, whereas in the surroundings of Valka and Ērģeme, where agricultural land covers larger territories, population density is higher.

Within the landscape area, there is a relatively high proportion of protected cultural heritage monuments, including:

- Ērģeme hillfort (Garais kalns) (state protection No. 2367, archaeological monument of regional significance);
- Ērģeme Medieval Castle (No. 2362, archaeological monument of national significance);
- Lugaži Medieval Castle (No. 2395, archaeological monument of regional significance);
- Dauguļi Medieval Cemetery and Katrīna Church Hill – place of worship (No. 2365, archaeological monument of regional significance);
- Lejasmuižnieki ancient burial sites (Anna's Church) (No. 2396, archaeological monument of regional significance);
- Bozēni ancient burial sites (No. 2366, archaeological monument of regional significance).

In the cultural landscape surrounding Lugaži and in the Valka undulating plain, agricultural land landscapes dominate, which are relatively intensively used, thereby preserving wide and open views with high aesthetic value. Although there is generally little unmanaged agricultural land in the area, in certain parts there is overgrowth of remote agricultural land and floodplain meadows with shrubs. If this process continues or intensifies, the number of high-value open views may decrease in the future, which would consequently reduce the aesthetic and cultural-historical value of the landscape.

The visual value of the landscape is enhanced by distant horizon views, farmsteads, tree alleys, and individual trees. In the Valka Municipality Development Programme, the surroundings of Ērģeme are highlighted as a valuable landscape, emphasizing old farmsteads, stone masonry buildings, their ruins, and farmstead plantings (see Figure 3.4.5).



Figure 3.4.5. View of the mosaic landscape from Lugaži

The landscape area is partially located within the landscape protection and neutral zones of the North Vidzeme Biosphere Reserve. Within this area, there are fragmented protected habitat territories, nine microreserves primarily established for bird protection, and the "Burgas Meadows" nature reserve, located in the Seda River floodplain. One of the largest biocenters in the area is the high Ķeizaru bog, consisting of a large raised bog and primarily pine forest. Extensive forest areas also extend across the border into Estonian territory. Although these forested areas host high biodiversity, the overall aesthetic value of the landscape is low, as there are no open panoramic views or significant diversity of landscape elements. Considering the small changes in the landscape over a long period, there are practically no cultural heritage sites in the forested parts of the area, and thus the cultural-historical value is also low.

Overall, the Ērģeme mosaic landscape is characterized by high biological and landscape diversity, while the surroundings of Lugaži and Ērģeme are distinguished by cultural-historical features. The Ērģeme mosaic landscape can be considered typical, yet at the same time unique, representing the North Vidzeme hilly landscape with a balance between natural diversity and economic activity.[80,81]

Seda Forest Landscape

The Seda forest landscape is characterized as a hilly forested area, dominated by one of the largest inland dunes in Latvia, as well as wet birch and pine forests. Part of the area falls within the PLA "Ziemeļgauja" and the NVBR. The landscape area is rich in specially protected habitats, and nearly 20 microreserves have been established to protect the natural values present. The large size of the forest mass and the presence of old pine stands provide favorable conditions for high biodiversity. There are no protected cultural monuments in the landscape, as the area has historically been primarily used for forestry.

[80] Description of landscape area. Available: https://drive.google.com/file/d/1TCj_0xENbgcEUKYWK8S79K4VcpkJh3Uf/view

[81] Ziemeļvidzemes biosfēras rezervāta (ZBR) ainavu ekoloģiskais plāna ainavu pases. Available: https://www.daba.gov.lv/lv/ziemelvidzemes-biosferas-rezervats

Changes in the landscape structure are mainly associated with forestry activities, which promote new clearings and young forest growth, as well as a gradual increase in forest fragmentation. Although the landscape area is predominantly composed of closed forest landscapes, in the northeastern part of the territory, around Kaičupe, there are open views of agricultural land and scattered farmsteads. Overall, the forest mass is stable and currently not heavily fragmented by road networks. Particularly high aesthetic value is associated with the forest stands along both sides of the Rīga – Valka highway.[82]

Seda Bog Landscape

The landscape is characterized by the Seda Bog and the adjoining forested areas. Almost the entire area is occupied by the "Seda Bog" nature reserve, and the entire landscape area falls within the North Vidzeme Biosphere Reserve. The landscape features various zones, showing where the bog has been extracted, where it is currently flooded, and areas that have been revitalized. The bog landscape is perceivable from walking trails and bird-watching towers established within the nature reserve. The landscape is divided and delimited by the edges of the extracted peat fields, which currently partially serve as walking trails offering interesting views of the bog in its various stages of extraction. In some places, technical structures are visible, particularly near the town of Seda, as well as a narrow-gauge railway used for peat transportation.

The aesthetic value of the landscape is formed by the extensive bog areas and open water bodies, which provide outstanding sight lines, especially from the observation towers (see Figure 3.4.6).



Figure 3.4.6. Seda bog landscape from observation tower

[82] Description of landscape area. Available: https://drive.google.com/file/d/1Bubl_Sv_ubnPX18nhQAgwZ4_FUovY_Sd/view

The landscape structure consists of the utilized peat fields, now partly converted into water bodies, narrow-leaved birch peat forests along the bog edges, and the wet meadows of the Seda floodplain. The flooded areas are important habitats for nesting and migratory birds, enhancing the bog's biological value. The landscape also contains cultural-historical elements, although only one has a regional-level archaeological protection status – the Ērģeme Cepuru Hillfort (state protection No. 2363). Other cultural-historical values include an ethnographic type of scattered farmsteads and the narrow-gauge railway associated with the history of peat extraction.[83]

Gauja River Landscape from Strenči to the Estonian Border

The Gauja River landscape area overlaps with the PLA "Ziemeļgauja" territory, a unique region along a natural, unregulated, and meandering section of the Gauja River, including old river systems, valuable meadows, and old mixed and deciduous forests (see Figure 3.4.7). The PLA was primarily established to conserve specially protected habitats and species, as well as to maintain the stability of the midstream Gauja ecosystem, defined by historically developed complexes of forests, meadows, and old river systems. Although the territory's name highlights its landscape value, its conservation focus is essentially on biodiversity and habitats of protected species.

The landscape structure is based on a vast forest massif, which encompasses the Gauja Valley and extends beyond the protected area boundaries, while the areas outside the valley are largely occupied by visually striking inland dune landscapes. The river valley features narrow and enclosed views, as it is flanked by forests on both sides, with the river landscape primarily perceivable from organized recreational areas, roads, and selected viewpoints. Landscape significance is also attributed to park-like meadows, floodplain meadows, and ethnographic-type farmsteads. One cultural monument is located within the area – the ethnographic homestead "Ielīcas" (state protection No. 6884, architectural monument of national significance).[84,85]

[83] Description of landscape area. Available: https://drive.google.com/file/d/1RoD-RdYritrI5p6sQMy1rLUGH05igpQI/view
[84] Nature conservation plan of the protected landscape area "Ziemeļgauja". Available: https://www.daba.gov.lv/lv/ziemelgauja
[85] Description of landscape area. Available: https://drive.google.com/file/d/1Ql5ECv67R1iwvySi5MVN2YKxt6Gh4cmP/view



Figure 3.4.7. View of the Gauja River, PLA "Ziemeļgauja" near Vijciems

Pūpolu – Mežmuiža Forest Landscape

The area is characterized as a gently undulating forest landscape with pine and spruce forests and dense undergrowth of deciduous trees. In the central part of the landscape area lies a large inland dune complex. The area partly falls within PLA "Ziemeļgauja." A significant portion of the area comprises specially protected habitats and more than 10 established micro-reserves for the conservation of natural values. The gently undulating terrain highlights the contrasts between the flatlands and the inland dune relief near Cirgaļi. The only openings in the landscape come from agricultural lands and scattered farmsteads, resulting in generally narrow and limited sight lines. Cultural-historical values include the Paukulīši Medieval Cemetery (Miklāva, Church Hill) (No. 2400, archaeological region-level heritage), Vijciema Čiekurkalte (No. 9280, industrial national heritage), and the Bedņu Sacred linden – a sacred site (No. 2403, archaeological region-level heritage).[86]

Valka and Valga

In the Latvian Landscape Atlas, the urban landscape of Valka city is identified as a separate landscape area, encompassing residential areas typical of an urban environment, parks, commercial/industrial zones, street networks, as well as less densely built areas on the city outskirts. In the landscape context, Valka is inseparably linked with Valga, forming a unified urban space. Valka and Valga together form a significant populated center within the potential visual

[86] Description of the landscape area. Available: https://experience.arcgis.com/experience/6c0b5c1cfaaa4bffb3c44b79158cd93c/page/Ainavekolo%C4%A3iskais-nov%C4%93rt%C4%93jums?views=Ainavu-are%C4%81li#data_s=id%3AdataSource_9-190c0dd000a-layer-30-190c5aa83a7-layer-106%3A399

impact area of the planned wind farm. In 2025, the total population of the two cities is projected to reach 16,614 inhabitants[87].

Although urban areas generally do not contain high biodiversity or landscape values, Valka and Valga possess significant cultural-historical importance, having served as key political and administrative centers since the 13th century. The cities' historical development, the establishment of the railway junction in the 19th century, and the unique status as twin cities since 1920 have contributed to a significant cultural-historical heritage, giving the area regional value[88].

In Valka, there is one national-level cultural heritage site: the "Lugaži Lutheran Church" (No. 6883), whose origins date back to the 15th century. Although the church has been rebuilt on its original foundations several times, its historical volume and form have been preserved. The church's architecture combines Baroque and Gothic elements, and its interior retains early 20th-century wooden furnishings and an 18th-century bell[89]. Valka also hosts a regional-level cultural heritage site, the historical location "Vidzemes Teachers' Seminary" (No. 97), where 19th-century seminars for teachers of Vidzeme parishes were held. In the 1970s, this building became the Valka Local History Museum.[90]

Valga contains 37 cultural heritage sites, most of which fall within an archaeological find zone (ID L31178). Valga has one protected natural area – Valga linnapark – although both cities are connected by the Pedele River with a nature trail (promenade) and bicycle paths. Cultural-historical landmarks in Valga also include St. John's Church, the central square, museums, and memorial sites.

Valga nõgu (Valga Valley)

The landscape district is bordered by highlands such as Otepää, Karula, and Sakala, while to the west it includes the valleys of the Pedele and Väikese Emajõgi rivers. Large parts of the area are covered by forests and wet depressions, interspersed with agricultural land; overall, the landscape is relatively uniform but features pronounced river valleys, marshy lowlands, and some forested sandy elevations.

Due to the natural diversity in this region, there are nine Natura 2000 protected areas: Mõneku loodusala, Valli soo loodusala, Kuritse järve loodusala, Tagula loodusala, Kakulaane loodusala, Soontaga-Sauniku loodusala, Sauniku loodusala, Kirbu soo loodusala, and Karula-Pikkjärve loodusala (nature reserves). Additionally, the area contains 98 cultural heritage sites.

Karula Highlands

The Karula Highlands is a landscape region located between the Otepää Highlands and the Gauja (Koiva) ancient valley. In the central and eastern parts of the highlands, medium-sized hills

[87] Available: https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__POP__IR__IRS/IRS051/ un https://andmed.stat.ee/en/stat/rahvastik__rahvastikunaitajad-ja-koosseis__rahvaarv-ja-rahvastiku-koosseis/RV0240
[88] Available: https://visitvalgavalka.com/lv/vesture
[89] Available: https://mantojums.lv/cultural-objects/6883
[90] Available: https://mantojums.lv/cultural-objects/97

dominate, interspersed with frequent wet depressions, small lakes, and bogs. The area is generally sparsely populated and mostly forested. The region includes three Natura 2000 sites – Karula-Pikkjärve Nature Reserve, Aheru Nature Reserve, and Karula Nature Reserve. There are 23 cultural heritage sites in the area, mainly located in the villages of Karula and Lüllemäe.

Sakala Highlands

The Sakala Highlands stretches from central Estonia to the northern border with Latvia, with its highest points reaching 136 – 144 meters above sea level. The landscape's uniqueness is due to its geological formation and varied relief, ranging from ancient valleys to drumlin fields. The region has historically been shaped by intensive agriculture, creating a characteristic cultural landscape with large inhabited areas. More than 175 cultural heritage sites are located in the area, primarily concentrated around the village of Taagepera and the town of Tõrva. The region contains seven Natura 2000 sites – Palakmäe Nature Reserve, Keisripalu Nature Reserve, Tikste Nature Reserve, Roksi Lake Nature Reserve, Koorküla Nature Reserve, and Lasa Nature Reserve.

Võru – Harqla Valley

The Võru – Hargla Valley forms a broad depression that borders the Karula Highlands and connects southwest with the Gauja Valley in Latvia. This region is characterized by a complex system of ancient valleys. Large pine forest massifs dominate the area, while the valley's lower areas consist of marshy floodplains and small lakes. Two Natura 2000 sites are located in the region – Koikküla Nature Reserve and Koiva – Mustjõe Luha Nature Reserve.

Landscape sensitivity assessment

For the above-mentioned landscape areas, which are within the very high and high visual impact zones of the planned Valka wind park, Table 3.4.4 presents and summarizes their sensitivity (landscape value), taking into account the landscape's classification at the national, regional, and municipal levels, as well as public-assigned values and significance.

Table 3.4.4. Landscape area sensitivity assessment

Nr.	Landscape area	Landscape value	Landscape quality
1.	Ērģeme mosaic landscape	Medium	Medium
2.	Seda forest landscape	Medium	Medium/Low
3.	Seda bog landscape	Medium	Medium/Low
4.	Gauja River landscape from Strenči to the Estonian border	High	High
5.	Pūpoli – Mežmuiža forest landscape	High	Medium
6.	Valka and Valga	Medium	Medium
7.	Valga nõgu (valley)	Medium	Low
8.	Sakala kõrgustik (upland)	High	Medium
9.	Võru – Hargla nõgu (valley)	Medium	Medium/Low

The area included in the assessment has been identified as having high biological value, as a significant portion of the area falls within the NVBR and PLA "Ziemeļgauja", and several micro-reserves, protected habitats, and the specially protected nature area "Seda Bog" are present.

At the same time, a relatively high concentration of archaeological and cultural heritage sites is located around Lugaži and Ērģeme, which increases the cultural-historical and landscape significance of the area.

Considering the landscape value, quality, the predominance of closed forest landscapes, and relatively low population density, the overall landscape sensitivity at the planned project site is assessed as medium. At the same time, areas with high landscape value are identified in the PLA "Ziemeļgauja" (Gauja River landscape and Pūpolu – Mežmuiža forest landscape), as well as in the mosaic agricultural landscapes around Ērģeme and Lugaži, where the sensitivity to visual changes is assessed as medium to high.

Although urban areas are usually not assigned high biological landscape value, Valka and Valga possess significant cultural-historical importance. Considering the character of the urban landscape, the landscape value and quality are generally assessed as medium; in this assessment, the population density is additionally considered, giving Valka and Valga a high receptor sensitivity.

In Estonian territory, the impact zone includes several landscape regions – Valga Valley, Karula Highlands, Sakala Highlands, and Võru – Hargla Valley – characterized predominantly by forested, sparsely populated landscapes rich in natural elements, with river valleys, marshy lowlands, and hilly terrain. These regions contain a relatively large number of Natura 2000 sites and cultural heritage sites. Overall, the landscape value and quality in most of the territory are assessed as medium, with certain locations rated as low or high.

3.4.4. Impact on landscape of the wind farm

The wind farm's impact on the landscape is associated with both the wind turbines and the construction of related infrastructure. Changes to the landscape resulting from infrastructure construction – access roads, drainage networks, and the substation – are generally assessed as minor. The construction of linear infrastructure increases landscape fragmentation; however, in the planned wind farm area and its immediate surroundings, a relatively dense network of roads of varying levels already exists, much of the study area is drained with open waterways, and the existing power transmission is primarily via overhead power lines. The construction of new linear infrastructure will have a local effect on the landscape and, outside the wind farm area, these features will have little or no visible impact. The substation, planned within the wind farm area, will not be noticeable from the broader surroundings, though it will be locally visible from the Riga – Lugaži – Estonia railway line. Evaluating the two planned substation location alternatives, there are no aesthetically valuable views nearby that would make changes in the landscape significant. The scale of change is also mitigated by the fact that the substation will be built alongside an existing overhead high-voltage line, which already serves as an industrial linear feature dominating the wider area.

The most significant changes in the landscape will undoubtedly be related to the construction of the wind turbines. Given the planned turbine dimensions, they will affect the landscape across a wide area. A detailed assessment was conducted for 14 wind turbines with the largest dimensions, specifically the Vestas V172 model, with a tower height of 166 m, rotor diameter of 172 m, and a total turbine height of 252 m.

During the assessment of the wind farm's visual impact, visual impact zones were modeled. The visual impact modeling was carried out using three-dimensional data on terrain, vegetation, and built structures, along with the planned turbine locations and their dimensions, determining the areas from which the wind turbines will be visible to a person standing on the ground, and calculating the significance of the visual impact. Five zones of visual impact were distinguished to characterize the landscape: very high, high, medium, low, and very low (see Table 3.4.2).

As shown in Figure 3.4.8, the visibility of the wind turbines within the assessed area is strongly influenced by forest cover; at ground level, the wind farm will not be visible from forested areas. In open landscapes, such as agricultural land and bogs, including peat extraction areas, the planned wind farm will be visible, and under good visibility conditions, the turbines may be seen at distances greater than 20 km. Moving away from the wind farm, it may still be visible, but the portion of visible space gradually decreases, reducing the significance of the visual change.

The visual impact model shows that the wind turbines' visual effect on the surrounding urban areas, Valka and Valga, is assessed as medium, low, and very low. It should be noted that at ground level the wind farm will not be visible from a significant portion of both towns because buildings and landscaping obstruct views. Broader, open views of the wind farm can be obtained from upper floors of buildings. The visual impact for villages such as Sēļi is assessed as high, Lugaži as medium and low, and Ērģeme and Turna as very low. Sēļi is the closest village to the farm, and views from the village are not obstructed by forests or other vertical features.

To characterize the landscape changes caused by the planned wind farm, visualizations showing the turbines' placement within the existing landscape were additionally used, allowing potential assessment of how the wind turbines will alter the landscape's appearance. Based on the criteria listed in the assessment approach, potentially significant or representative viewpoints were selected (see Figure 3.4.9), which were surveyed in the field and photographed. This chapter includes selected visualizations and impact descriptions, while more visualizations from the chosen viewpoints are included in Appendix 1. It should be noted that the prepared visualizations are largely illustrative, used to identify the wind farm's visibility from various viewpoints and understand its scale in the visible landscape, but no single image can fully replicate the view and perception experienced in reality from the same point.

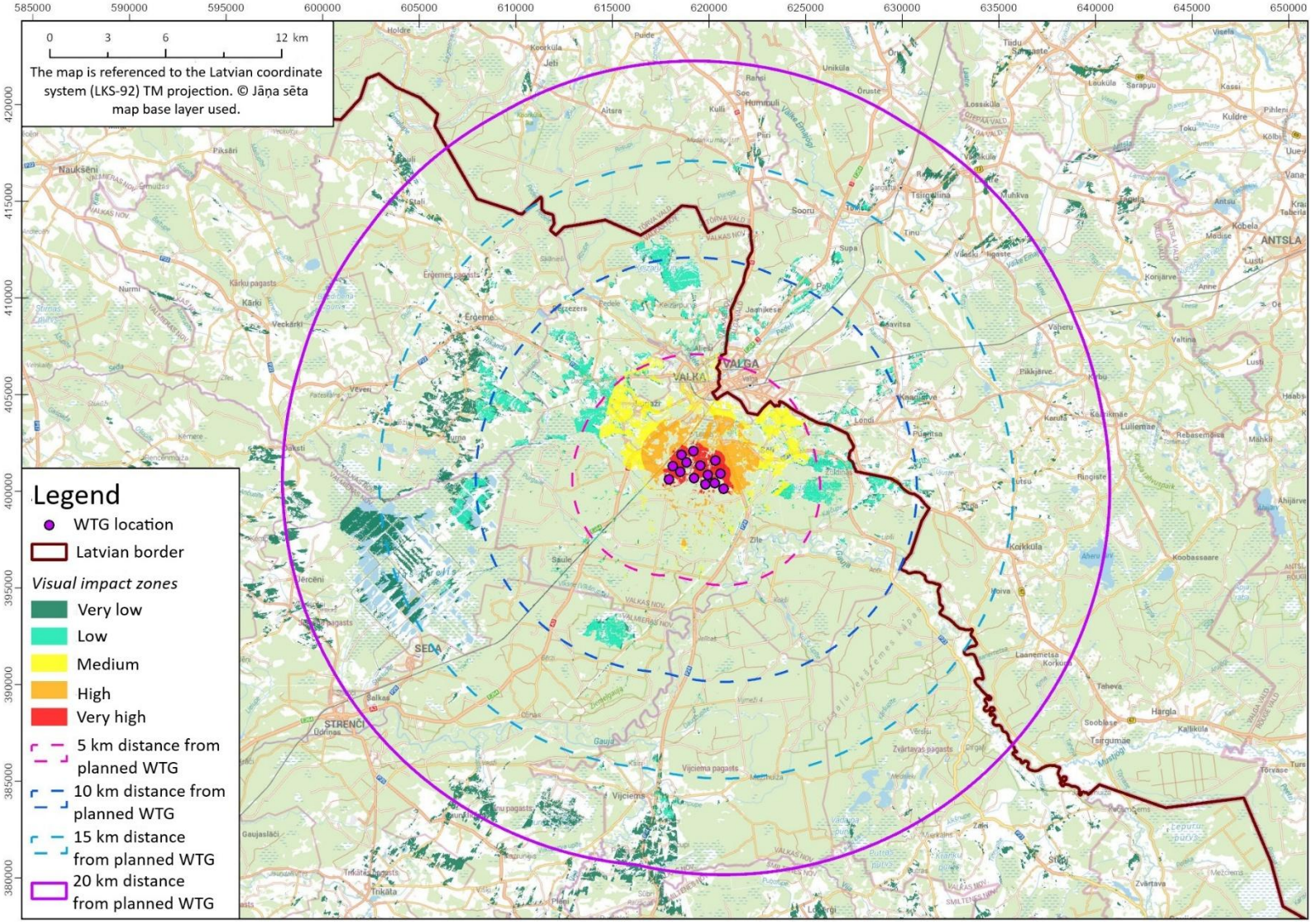


Figure 3.4.8. Visual impact zones of the planned "Valka" wind farm

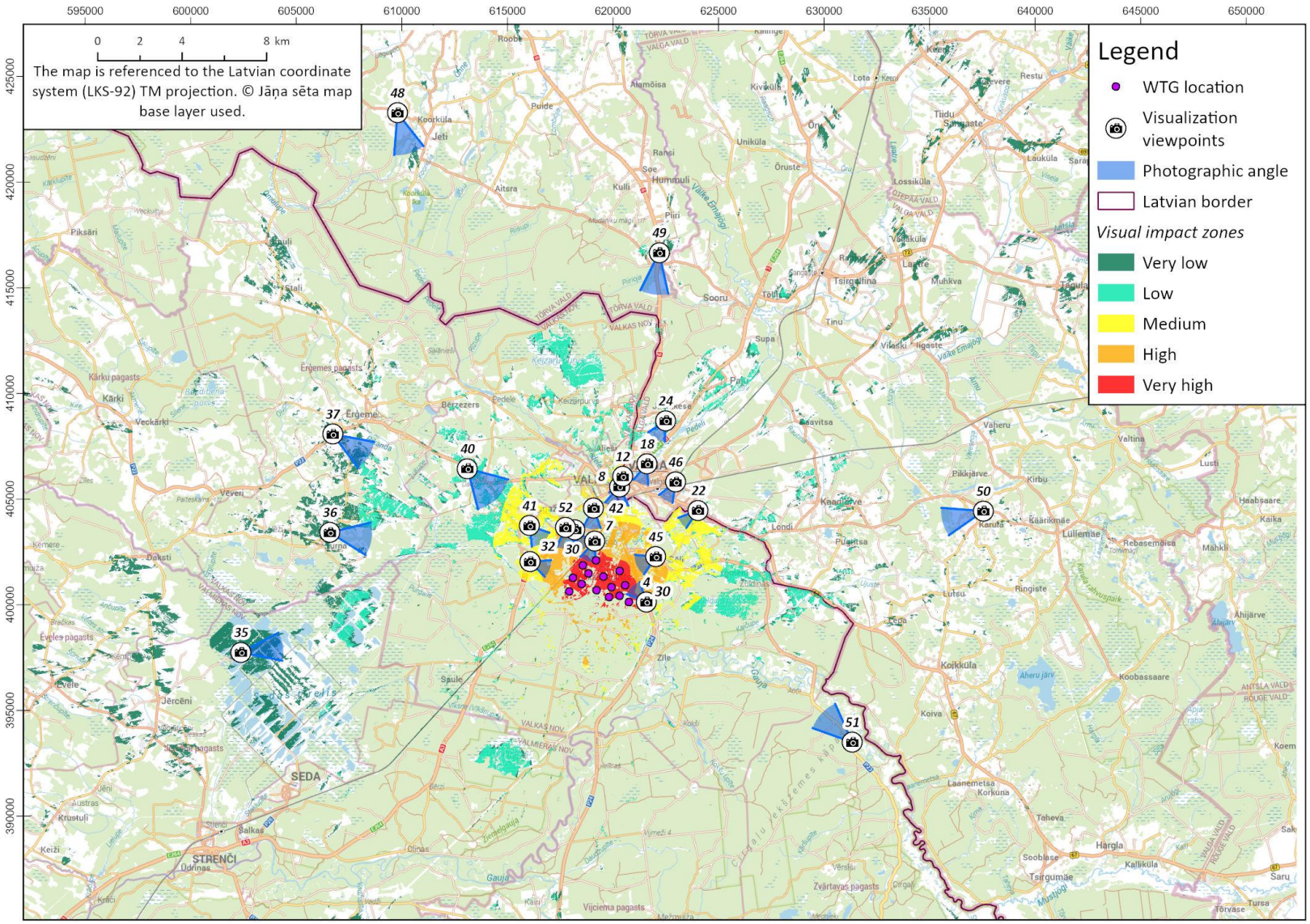


Figure 3.4.9. Visual impact zones of the planned "Valka" wind farm and viewpoints from which visualizations were prepared

Very High and High Visual Impact

Within the very high visual impact zone, which does not extend beyond 800 m from the wind turbines but covers an area where the wind farm is not visible in a single view, there is a single homestead, "Liepkalni," located 547 m from WTG No. 6 and 368 m from WTG No. 7. It is important to note that in this specific case, the wind turbine placement does not comply with the statutory minimum distance of 800 m, and, as mentioned earlier, the construction of the wind turbines would only be permissible if the homestead were no longer used for residential purposes. In the very high visual impact zone, wind turbines create a significant visual burden on residential and public building areas, so the placement of such structures in this zone is not desirable, even if not prohibited by external regulations.

The high visual impact zone, whose outer boundary is largely determined by the overall horizontal extent of the wind farm, stretches approximately 2 to 4 km from the turbines. Within this zone, wind turbines dominate the landscape. Although the overall scale of the wind farm can already be perceived in a single view, the planned wind turbines vertical dimensions exceed the usual size of landscape elements such as buildings, forests, and individual trees. Only from limited viewpoints, where trees, buildings, or other vertically significant elements are nearby, is the visual prominence of the wind turbines diminished. A factor amplifying the visual impact during operation is the movement of the turbine blades, which is clearly discernible within the high visual impact zone and, due to the large size of the structures, inevitably draws the observer's attention to the farm.

To characterize and analyze the high visual impact zone, multiple visualizations of the wind farm were produced, which are described in more detail below. Visualization No. 4 (see Figure 3.4.10) was prepared from the P24 road. Along the planned wind farm, the road crosses an open agricultural area where the nearest turbines do not obscure vertical landscape features. The wind turbines dominate the open rural landscape, significantly altering its character. Other landscape elements – isolated trees, forest strips, or power line supports – become insignificant due to the size of the turbines. Although from a similar distance, the view of the wind farm from Lugaži station is significantly influenced by the spruce plantation strip along the railway (see visualization No. 7, Figure 3.4.11). From Lugaži station, the wind farm is not fully visible, but individual turbines are clearly visible and dominate the landscape. While both visualizations were prepared from points at similar distances from the wind turbines, they illustrate the significant difference in the view between an open and a partially enclosed landscape.



Figure 3.4.10. Visualization No. 4 from the P24 road



Figure 3.4.11. Visualization No. 7 from Lugaži station

Visualization No. 10 (see Figure 3.4.12) is prepared from the village of Sēļi, part of which falls within the high visual impact zone. The nearest wind turbine No. 2 is located approximately 1.8 km from the village. Sēļi is the closest village to the planned wind farm, with a population of 237

as of 2025. It should be noted that within the village, some areas are categorized as medium and low visual impact, which can be explained by factors such as vegetation, building height and density, and line-of-sight restrictions in the built environment that influence wind turbine visibility. Close-range views and the structure of the village often block or limit visibility, making wind turbines perceptibility highly variable depending on the specific location. Thus, from one street or viewpoint, wind turbines may be clearly visible, while from another, they may be completely obscured. Similarly, from other densely built areas near the park, the wind farm will only be visible from certain points.



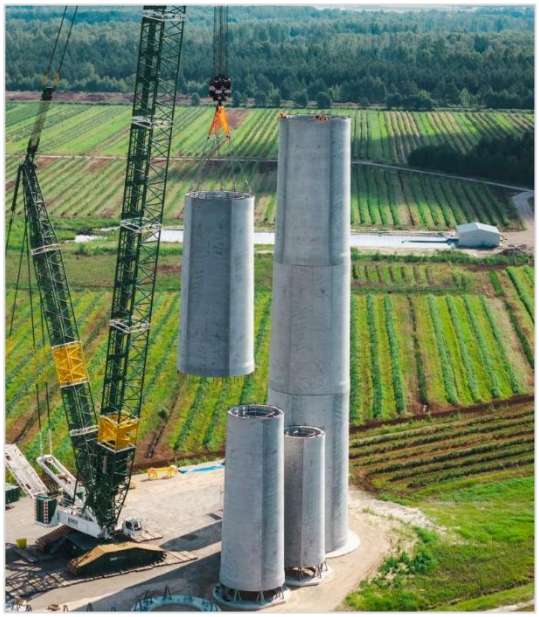
Figure 3.4.12. View of the planned "Valka" wind farm from Sēļi, Visualization No. 10

The high visual impact zone affects not only the regional road P24 but also the state main road A3. Visualization No. 30 (see Figure 3.4.13) is prepared from the A3 road near a fuel station, where the nearest WTG No. 5 is located 1.7 km away. In this case as well, the wind turbines dominate the landscape. Although they are partially obscured from some viewpoints by tree belts, the dimensions of the wind turbine elements reduce the prominence of existing landscape features, making the landscape appear industrial.



Figure 3.4.13. View of the planned "Valka" wind farm from A3 near the fuel station, Visualization No. 30

Currently, construction of the "Laflora" wind farm in the Kaigu bog has been completed, and the wind turbines are visually prominent in the landscape. The height of the wind turbine towers reaches 179 m, while the total height including rotor blades reaches 266.5 m, making them a dominant vertical element across a wide surrounding area. The project used prefabricated concrete towers, considered innovative and sustainable from a construction and development perspective (see Figures 3.4.14 and 3.4.15). However, from a visual impact perspective, this type of tower significantly increases their visual dominance, especially considering the planned "Valka" wind farm location relatively close to the towns of Valka and Valga, as well as A3 and P24 roads. From a landscape impact perspective, it is primarily recommended to choose a steel mast solution, but acknowledging that concrete tower construction may be a critical factor for the developer in implementing the wind farm, the concrete tower solution is acceptable provided the towers are painted in a tone coordinated with steel structures. The use of unpainted concrete towers is considered less preferable.





Figures 3.4.14 and 3.4.15. Prefabricated concrete towers in the "Laflora" wind farm (source: Consolis Latvija SIA)

Medium visual impact

The medium visual impact zone extends approximately from 2 to 6 km from the planned "Valka" wind farm. Within this zone, the wind turbines are visible and easily noticeable elements and can interfere with landscape perception, reducing visual comfort and aesthetic value. Although the proportion of the view occupied by the wind farm decreases with distance, from any viewpoint dominated by open agricultural land, the wind turbines still dominate over other landscape elements due to their significant size.

For characterization of the medium visual impact zone, where the foreground is largely open agricultural land, visualization No. 41 (see Figure 3.4.16) is used, representing wind turbines visibility near the village of Lugaži, which had 239 inhabitants in 2025. The nearest WTG No. 5 is

approximately 3.1 km from the photo location. In this landscape, the wind turbines stand out as visually dominant and clearly perceivable elements. The foreground agricultural lands and rolling topography enhance the visibility of the wind turbines, making their presence a prominent feature that significantly alters the character of the landscape. Although nearby tree stands partially obscure the wind turbines, their mitigating effect on visual impact from this viewpoint is minimal.

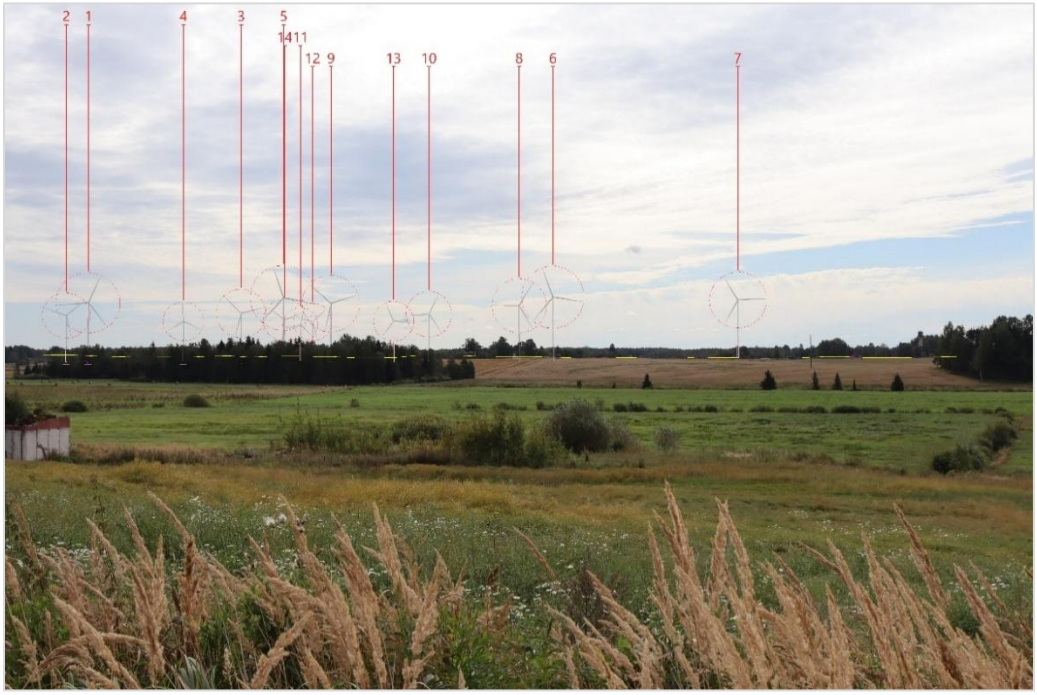


Figure 3.4.16. View of the planned "Valka" wind farm from the Lugaži area, visualization No. 41

A visualization of the medium visual impact zone is also provided as Visualization No. 32, from the intersection of roads V259 and A3 near the turn to Ērģeme (see Figure 3.4.17). The viewpoint is 2.2 km from the nearest WTG No. 6, and analysis of the photomontage indicates that the wind turbines rise above the mixed agricultural and forested landscape, becoming vertically dominant elements in the scenery. Additionally, the irregular wind turbine layout reduces overall visual quality of the landscape.

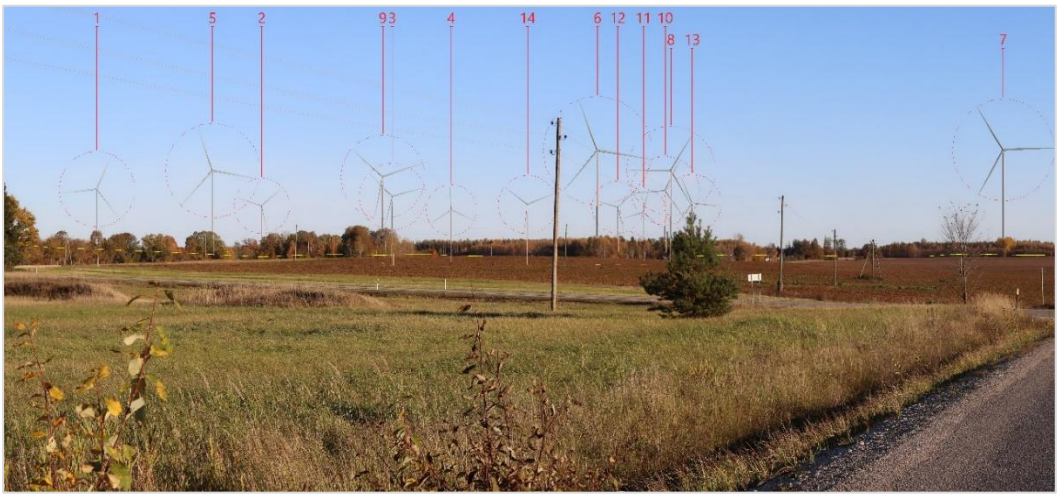


Figure 3.4.17. View of the planned "Valka" wind farm from V259 near the turn to A3, Visualization No. 32

The medium visual impact zone also includes the town of Valka. As noted previously, at ground level in densely built areas, the wind farm will only be visible from selected viewpoints, for example, along the Pedele River promenade in Valka, where the nearest WTG No. 1 is located 4.2 km away. The photo location was chosen to provide the best view of the wind turbines, selecting the highest point on Putraskalns hill (61 m a.s.l.) (see Figure 3.4.18). In the visualization, partially obscured wind turbines and visible rotor tips can be seen. Although the wind turbines are visible, in the urban landscape they are not dominant and create less perceptible changes compared to open landscapes.



Figure 3.4.18. View of the planned "Valka" wind farm from Putraskalns promenade in Valka, visualization No. 12

The urban environment is characterized not only by dense development and landscaping, which limit the view of the wind farm, but also by relatively tall buildings. In the towns of Valka and

Valga, a significant number of multi-story residential buildings have been constructed, from the upper floor windows of which views of the wind farm are not blocked by other buildings or city landscaping. For illustration, visualization No. 8 has been prepared. The photograph used to create this visualization was taken from the Lugaži Church tower, not from a residential building window (see Figure 3.4.19). The nearest planned WTG, No. 1, is approximately 3.7 km from the town.

For comparison, the total height of the church is 42 meters, while the total height of five-story panel buildings is approximately 15 meters, and six- to nine-story buildings reach up to 30 meters. Although the church tower is taller than the upper floors of the five-story buildings, this view represents the mosaic of the city's rooftops and landscaping, over which wind turbines will be visible in the future. The view from the church tower is also important because it potentially represents the wind farm's visual impact on a larger portion of the population, namely the residents of upper floors in multi-story buildings. From this viewpoint, wind turbines are clearly visible above the treetops, and their irregular arrangement in a row can be easily perceived. At the same time, the overall landscape is not considered particularly sensitive, as the background is dominated by residential buildings with modern architecture, their rooflines, and existing anthropogenic elements such as a mobile communication tower. No historically or culturally significant buildings are identified. Given the wind farm's relative proximity to the town, the visual impact from this viewpoint is assessed as significant, although, considering the character of the surrounding landscape, it is not considered substantial.



Figure 3.4.19. Visualization No. 8 from the Lugaži Lutheran Church tower

A significant portion of the area within the medium visual impact zone is covered by forests, with the larger forested areas located to the south and west of the planned wind farm. Although the forest landscape is characterized by enclosed views, and the wind farm will only be visible from select points, the forest landscape is still dynamic. Forest management activities over larger areas may create temporally limited openings in the view toward the wind farm even from within the forested mass.

Low and very low visual impact

The low visual impact zone covers areas up to 15 km from the planned wind farm. In this zone, the visual significance of the wind turbines decreases with distance from the park, although wind turbines remain visible, particularly from areas with open views. Based on the methodology used for determining visual impact zones – which considers not only the height of the wind turbines but also the total size of the park and the portion visible from the viewpoint – the low visual impact zone overlaps with the very low visual impact zone even at distances less than 15 km from the park, specifically in locations where parts of the park are partially blocked by other vertical elements.

Visualization No. 40, created from a photo taken in the low visual impact zone along the P22 road between Lugaži and Ērģeme, near Domēri and Muižnieki farm, represents the park's visibility from a viewpoint approximately 7 km from the planned wind farm (see Figure 3.4.20). In this visualization, it can be observed that in areas where the undulating terrain and agricultural land are visible, wind turbines are clearly seen, providing long views of the turbine structures. However, their visual significance competes with other vertical elements located much closer to the viewpoint – such as power line towers and clusters of trees and shrubs.



Figure 3.4.20. View of the planned "Valka" wind farm from the P22 road, visualization No. 40

As the openness of the landscape decreases, the visibility of the wind farm is reduced. A similar viewpoint at a comparable distance from the park is represented in visualization No. 24, taken near the Jaanikese motocross track in Estonia (see Figure 3.4.21). Looking toward the planned wind farm from the track, the foreground is occupied by individual trees and forest strips, which limit the view of the park as a whole, although individual wind turbines remain clearly visible. By stepping back a few dozen meters toward the road, a wider view opens up, increasing the visibility of the park.

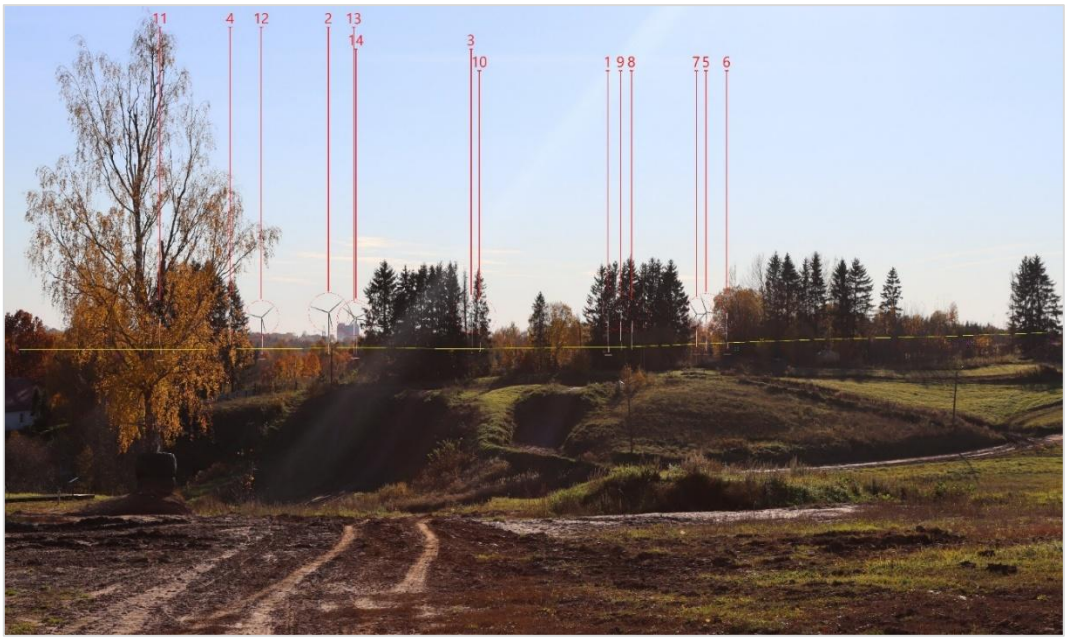


Figure 3.4.21. Visualization No. 24 from the Jaanikese motocross track

While in the medium and high visual impact zones the wind farm will be visible from almost any location without dense forest or buildings, in the low and very low visual impact zones the visibility can be influenced by seemingly minor local conditions. To illustrate this, visualization No. 36 from Turna village (population 81 in 2025) is shown, with the nearest WTG No. 7 approximately 11.7 km away. Although parts of the wind farm may be visible from certain points in the village, in most cases nearby forested areas completely obscure the view of the park (see Figure 3.4.22).



Figure 3.4.22. View of the planned "Valka" wind farm from the V237 road near Turna village, visualization No. 36

Even from Ērģeme village (population 292 in 2025) and its immediate surroundings, which are relatively rich in cultural heritage sites, wind turbines will be visible from certain points. The nearest WTG No. 6 is approximately 12.4 km away. The northwestern part of Ērģeme village, where the Ērģeme Castle ruins and the Lutheran church ruins are located, is situated such that the planned "Valka" wind farm wind turbines will not be visible.

In the assessment, visualizations and visual impact zones are primarily modeled from a 2 m height, representing the human eye level from the ground. However, for a full impact assessment, it is necessary to also analyze wind turbines' visibility from elevated positions, such as observation towers, church towers, and other high points. It is especially important to assess visibility from observation towers in protected natural areas, as they are significant tourist sites and often among the highest publicly accessible locations in these areas.

Within the EIA process, a visualization was also prepared from the Cirgaļi observation tower in the PLA "Ziemeļgauja", which is located 12.5 km from the nearest WTG No. 11 (see Figure 3.4.23). At ground level, wind turbines are not visible from this tower, but from the tower, wind turbines are visible. While the wind turbines do not dominate the view based on the occupied visual field, given the homogeneity of the landscape in the direction of the wind farm, wind turbines become a significant landscape element.



Figure 3.4.23. View of the planned "Valka" wind farm from the Cirgaļi observation tower, PLA "Ziemeļgauja", visualization No. 51

In the "Sedas bog" Nature Reserve, there is a bird-watching tower providing a comprehensive view of the Sedas ponds, including the direction of the planned "Valka" wind farm. The nearest WTG No. 7 is planned 15.8 km away, and the observation tower is in a very low visual impact zone. Although the view in the visualization is distant and partially obstructed by the forest cover beyond the bog, wind turbines' rotor blades will be visible above the treetops (see Figure 3.4.24). Considering the distance and the visual impact zones, wind turbines are not considered a dominant element in this particular landscape.



Figure 3.4.24. View of the planned "Valka" wind farm from the Sedas bog bird-watching tower, visualization No. 35

When assessing visualizations from observation towers and other distant viewpoints, it must be considered that the visualizations were produced using WindPro software, which only partially accounts for real meteorological conditions that may limit wind turbine visibility. As noted earlier, the visualizations are created under relatively clear weather conditions. Analysis of visibility data from the "Rūjiena" observation station from 2015 to 2024 shows that in all months, visibility of 20 km or more is dominant, particularly from May to August (see Figure 3.4.25). In winter months (January, February, November, and December), the visibility distance decreases, and the proportion of observations with visibility up to 10 km increases significantly, especially in the intervals of 0 – 4.99 km and 5 – 9.99 km. It can be concluded that in real conditions, wind turbines will not always be visually perceivable from this viewpoint, and their visibility will depend on the specific weather conditions and seasonal variations in visibility.

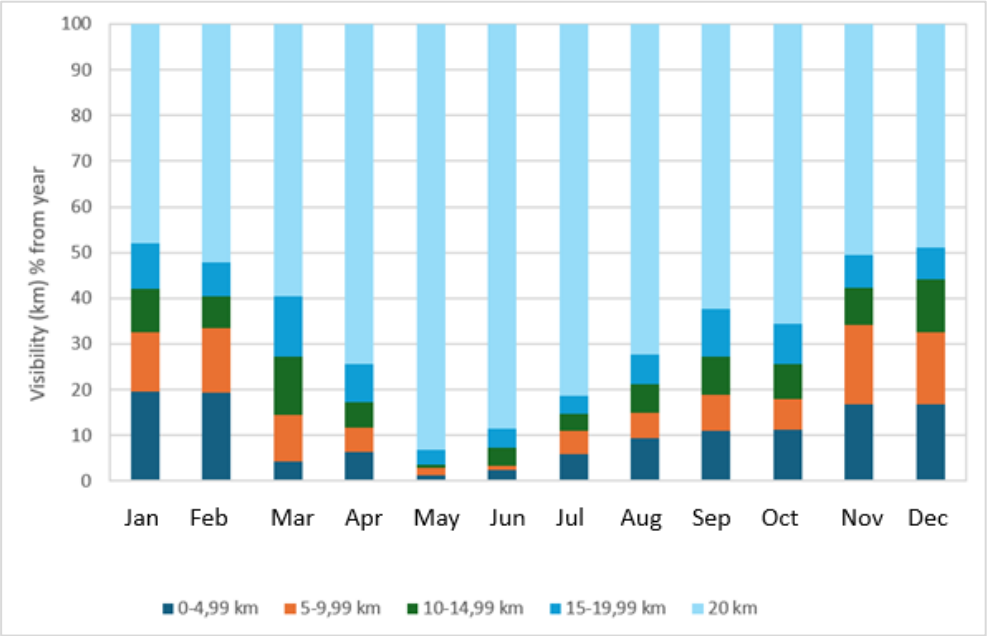


Figure 3.4.25. Visibility (km) from 2015 to 2024 at the "Rūjiena" observation station

The results of the visual impact modeling indicate that from the town of Valka, wind turbines' visibility varies from high (in the parts of the town closest to the wind farm) to low and very low. Across a relatively large portion of the town at ground level, wind turbines will not be visible or visually perceptible (see Figure 3.4.26). This is due to the urban structure, building heights and density, and the limited sightlines in the built environment. In the urban area, nearby views and the spatial layout often block or significantly reduce visibility, so wind turbine perceptibility is highly variable and depends on the specific viewpoint — from some streets or open areas wind turbines can be clearly seen, whereas from others they are completely obscured.

According to the visual impact model results, in Valka city, from locations such as Jānis Cimze Gymnasium, Valka Cultural Centre building, the swing at the Latvia – Estonia border, and the Valka Open-air stage, wind turbines will not be visible. Meanwhile, the yard of the Valka Municipality building, located south of the building, falls within medium and low visual impact zones. Similarly, in Lugaži Square, wind turbines will not be visible except from two locations across the square. The yard of the Valka Local History Museum is within the medium and low visual impact zones.

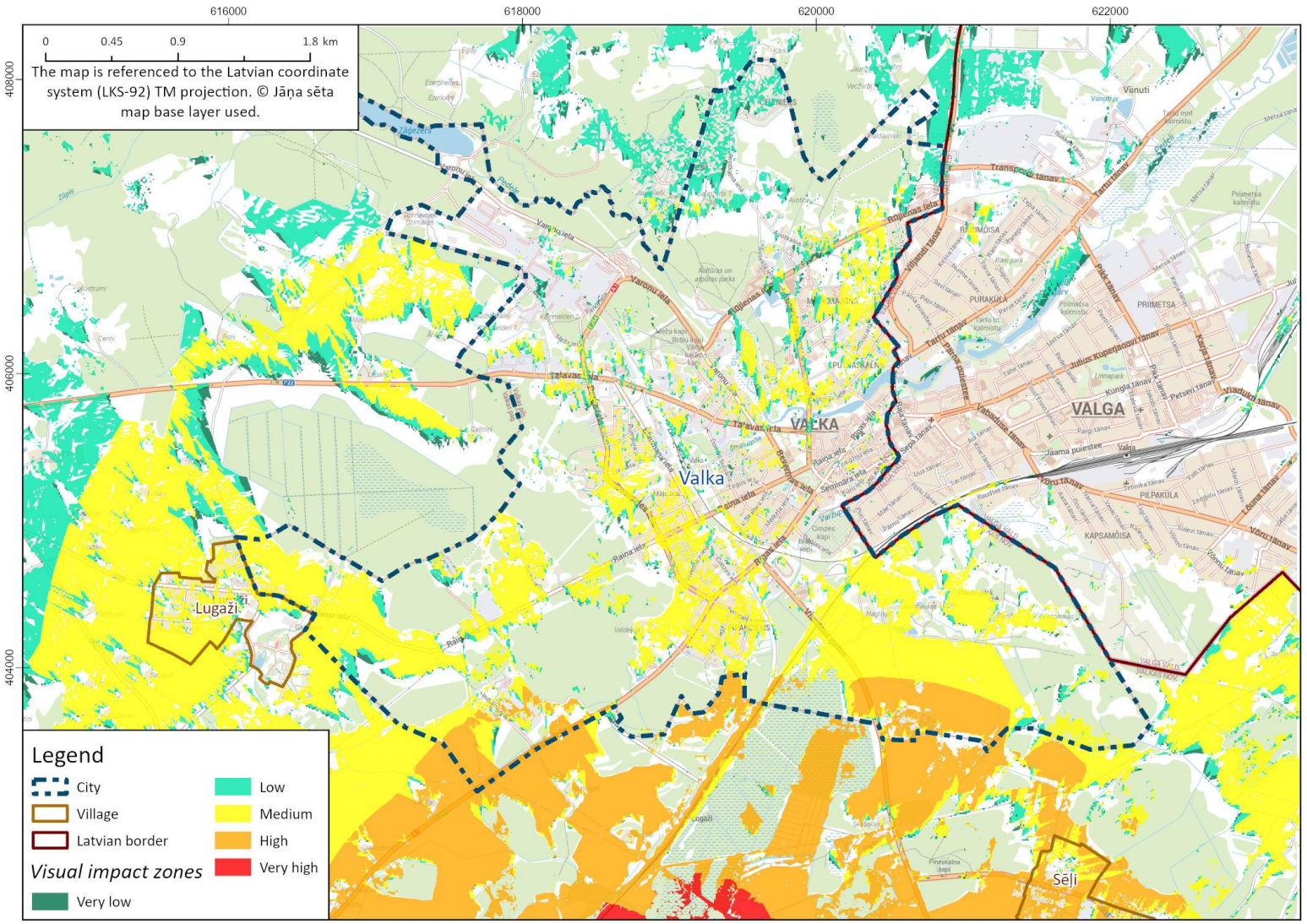


Figure 3.4.26. Potential visual impact zones of the planned "Valka" wind farm in Valka town

It should be noted that assessing visual impacts in urban areas close to a wind farm is methodologically complex due to the presence of multi-story buildings with significantly varying heights and number of floors. Standard modeling from a height of 2 m above ground level represents perception in public outdoor spaces but does not fully reflect the possible visual impact from higher floors, such as the fifth floor of a residential building if the windows face the planned wind farm. It should also be emphasized that the landscape assessment methodology primarily focuses on publicly accessible viewpoints rather than individual views from private premises. Such situations are therefore considered a potential additional consideration but are not a main criterion for determining landscape impact.

Based on suggestions raised during working group meetings, additional visualizations were prepared from Piparciems in Valka and the grounds of the Valka branch of the State Social Care Center "Zemgale" to more closely assess the potential visual impact of the wind farm during both summer and winter seasons (the prepared visualizations are included in Annex 1).

Most significant viewpoint

Considering that the largest number of potentially affected receptors is located in the towns of Valka and Valga, the visual impact assessment has selected the viewpoint from the tower of Lugaži Lutheran Church (see Figure 3.4.19) as the primary and most significant viewpoint. This viewpoint not only represents visual perception from Valka town but is also considered equivalent to the view that could be experienced from the upper floors and apartments of residential buildings in Valka facing the planned "Valka" wind farm, thus providing a representative visual impact assessment in the context of a populated area. Although the choice of the most significant viewpoint is somewhat subjective – as nearly any nearby village or significant object could serve this role – for the purpose of this Report, the selected point represents the largest number of potentially affected residents.

The main purpose of selecting this viewpoint is to analyze the planned wind farm in the context of landscape design. Chaotically placed wind turbines, or wind turbines whose rotors significantly overlap, increase the wind farm's impact on the landscape. Good landscape design cannot be achieved from all viewpoints; however, improving the wind farm's appearance from a single viewpoint is almost always possible. Considering that the number of wind turbines to be installed in the "Valka" wind farm will likely be reduced due to transmission network capacity limitations, various solutions exist for improving the overall visual composition of the wind farm by omitting some wind turbines.

As mentioned earlier, chaotic placement and rotor overlap significantly increase visual impact, whereas a thoughtful selection and arrangement of wind turbines can align with good landscape design practices. The figures below illustrate not a single solution, but several possible wind turbine layout variations (see Figure 3.4.28), reducing the number of turbines while simultaneously improving visual perception (e.g., by grouping turbines or evenly spacing them). Therefore, if the project proponent decides to omit some wind turbines, it is recommended that the new layout follows good landscape design principles, ensuring a more orderly, rhythmic, and visually harmonious composition of the wind farm.



Figure 3.4.27. Visualization No. 8 from the tower of Lugaži Lutheran Church showing the 14 wind turbines evaluated in the EIA



Figure 3.4.28. Visualizations No. 8 from the tower of Lugaži Lutheran Church showing example for wind turbine layouts aimed at minimizing visual impact

3.4.5. Cumulative effects

According to the Scottish Environment Protection Agency guidelines[91] for assessing cumulative landscape and visual impacts of onshore wind energy development, cumulative visual impact can take two forms:

1) **Combined visibility** occurs when multiple wind farms are visible from a single viewpoint. Combined visibility may manifest in two ways: firstly, simultaneously, when several wind farms are visible within a single field of view without moving the head; and secondly, sequentially, when the observer needs to turn their head to see parts of the wind farms or different wind farms.
2) **Sequential visibility** occurs when the observer, moving through the landscape, can see parts of a wind farm or other wind farms. This type of impact is assessed based on commonly used travel routes. The significance of the impact also depends on the observer's movement speed and the distance between viewpoints.

The nearest planned wind farm is "Valmiera – Valka," for which an EIA has been carried out and the Report finalized. The assessment concluded that only Alternative A, with 25 wind turbine locations in Plāņu Parish, Valmiera Municipality, is recommended for construction. Each turbine is planned with a maximum capacity of 8 MW, a maximum hub height of 200 m, and a rotor blade length up to 100 m (total height not exceeding 300 m)[92]. The nearest planned turbine, VV46, from the closest turbine in the "Valka" wind farm (turbine No. 7) is approximately 10.2 km away. It should be noted that onshore turbines of the size assessed in the "Valmiera – Valka" EIA do not currently exist. According to the available information to the authors of this Report, the maximum available turbine tower height currently does not exceed 179 m, and the rotor diameter is 175 m.

Lugaži Lutheran Church Tower

Since the view from the Lugaži church tower is identified as a key viewpoint in this assessment, it is also necessary to evaluate potential cumulative impacts. Although cumulative impact is not detected in the modeling results, as in Valka town, it must be noted that the visibility analysis in the model was carried out based on terrain and assuming a viewing height of 2 m above ground level. In contrast, from the church tower visualization, the situation differs. From this elevated viewpoint in Valka, parts of the "Valmiera – Valka" Alternative A wind farm turbines are visible, even though the nearest turbine is approximately 15.7 km away. The visualization shows that both wind farms will be simultaneously perceptible in the landscape – the "Valka" wind farm will

[91] NatureScot (Scottish Natural Heritage, Scotland`s Nature Agnecy). 2021. Guidance - Assessing the cumulative landscape and visual impact of onshore wind energy developments. Available: https://www.nature.scot/doc/guidance-assessing-cumulative-landscape-and-visual-impact-onshore-wind-energy-developments

[92] Ietekmes uz vidi novērtējums vēja elektrostaciju parka "Valmiera-Valka" un tā saistītās infrastruktūras projekta īstenošanai Valmieras un Valkas novadā IVN Ziņojuma precizētā gala redakcija (Environmental Impact Assessment for the Implementation of the Wind Farm "Valmiera-Valka" and its Related Infrastructure Project in Valmiera and Valka Regions EIA Report, Final Revised Version) 07.11.2025. Available: https://ekos.enviro.lv:777/index.php/s/P93LwE8TddHPgpk

dominate the foreground, while smaller turbines from the "Valmiera – Valka" wind farm will be visible in the background (see Figure 3.4.29), creating a potential cumulative visual impact from this viewpoint.

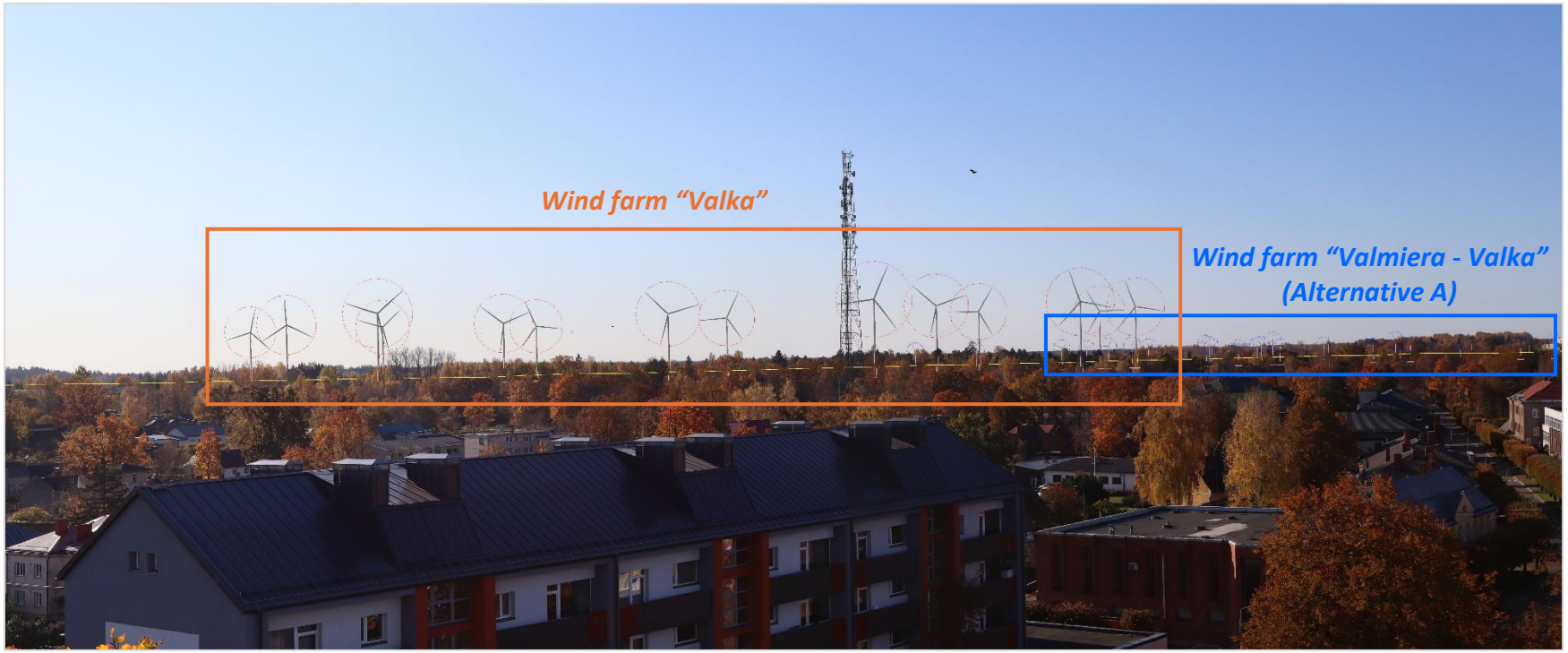


Figure 3.4.29. Visualization No. 8 from the Lugaži Lutheran Church Tower showing turbines of the "Valka" wind farm and Alternative A turbines of the "Valmiera – Valka" wind farm

Lugaži and Ērģeme surroundings

The surroundings of Lugaži fall within the medium visual impact zone of the "Valka" wind farm assessment. In terms of cumulative impact assessment, the Lugaži area has been modeled mainly with high and medium visual impact (see Figure 3.4.30). The assessment for the "Valmiera – Valka" wind farm considered the impact on Lugaži, Ērģeme, and Sēļi, although the landscape assessment was based on the Alternative B layout, in which turbines are closer than in the currently adopted Alternative A.

The area from Sēļi to Tomēni, dominated by open views, has medium to low visual impact from the "Valka" wind farm. In cumulative impact assessment, medium visual impact increases in this area, including in the Žuldiņi swamp and surrounding area (see Figure 3.4.30).

Seda bog

The Seda bog area is assessed with low and very low visual impact from the "Valka" wind farm. The impact of the "Valmiera – Valka" wind farm is expected to range mainly from high to medium (see Figure 3.4.30). According to the "Valmiera – Valka" landscape Report, the nearest turbines would be 4.7 to 5.2 km from the closest observation tower near Sedas, but they would not be visible, as the view from the tower is oriented only to the west and north. The nearest turbines to Jērcēni observation tower would be 7.98 to 8.6 km away. In this tower as well, trees block the view from the southeast, so turbines from both towers do not significantly affect the view. Considering the distance of the planned "Valka" wind farm turbines, they are not regarded as a dominant landscape element in the cumulative impact assessment.

PLA "Ziemeļgauja" and Cirgaļu observation tower

In the case of the construction of both wind farms, no significant cumulative visual impact on the PLA "Ziemeļgauja" is expected. This is due to the extensive forested areas within the territories of Valkas, Plāņu, and Vijciema parishes. Within these forested areas, wind turbines are generally only partially visible, as tree stands, terrain, and forest edge structures form a natural visual barrier, reducing view openings and the visual dominance of turbines in the landscape. At the same time, it should be noted that in certain locations where clear views open up within or along the forested areas, turbines may be visible to the north and south, which is not positively perceived by receptors, thereby reinforcing the presence of turbines and reducing the perception of the natural landscape.

The highest viewpoint in PLA "Ziemeļgauja" is the Cirgaļu observation tower, which was also assessed in the "Valmiera – Valka" landscape report. Although the impact was evaluated for the B layout alternative, the turbines planned in the direction of the Cirgaļu dune massif will be visible in clear weather but are considered background elements. Considering that the A layout alternative is planned further away than the assessed B alternative (with the nearest turbine from the tower approximately 17.1 km away), and that the planned turbines in the "Valka" wind farm will be visible but not considered highly prominent elements, the cumulative impact on the landscape is assessed as negligible.

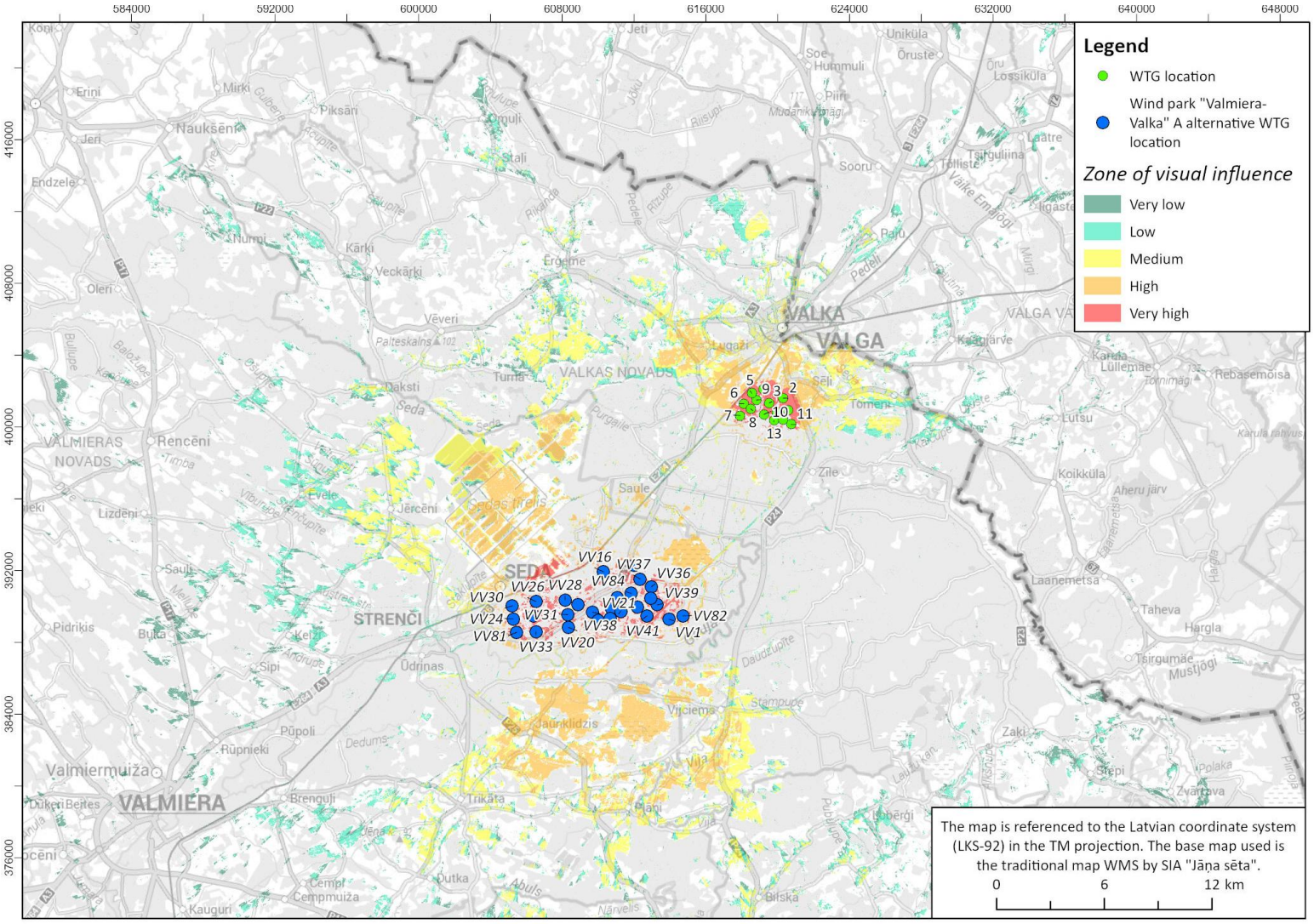


Figure 3.4.30. Visual impact zones of the "Valka" wind farm considering cumulative impact with the planned "Valmiera – Valka" A layout alternative

From both planned wind farms, visual impact zones will increase in the NVBR (areas around Ērģeme, Lugaži, Turma, and Seda bog), due to the extended lines of sight across agricultural lands and hilly terrain. In contrast, in the forested areas of Valkas, Plāņu, and Vijciema parishes, including PLA "Ziemeļgauja," the visual impact zones will not increase or expand.

3.4.6. Aviation lighting assessment

According to the Cabinet of Ministers Regulations No. 570 of 21 July 2008, "Regulations on the marking of objects and their equipment with aviation warning lights"[93], objects whose height above the surrounding terrain reaches 100 meters or more must be marked and equipped with warning lights. Since the total height of the assessed wind turbine technology alternatives exceeds 150 meters, Type A high-intensity aviation warning lights are required for marking. These lights are white and flash at a frequency of 40 – 60 times per minute. Regulation point 31 provides an exception: if lighting causes environment-related issues in populated areas, a dual-object lighting system may be used, employing Type A or B high-intensity lights, or, if necessary, Type A medium-intensity lights during the day and twilight, and Type B or C medium-intensity lights at night. In this case, the B and C lights are red, with different flash intensities.

Such lighting can be visible over a wide area and may potentially affect the landscape, especially at night. The visible aviation lights do not themselves create sky glow but may contrast with natural darkness and attract attention, particularly in areas with little or no artificial lighting. Under clear weather conditions, aviation lights are usually perceived as sharply defined red points, especially against dark skies or dark terrain (see Figure 3.4.31).



Figure 3.4.31. Example of aviation lighting on a wind turbines (source: Burgenland Energie/Richard Neubauer)

[93] Pieejams: https://likumi.lv/ta/id/178748-noteikumi-par-objektu-markesanu-un-aprikosanu-ar-aizsarggaismam

Human perception of light decreases with distance, as light spreads over a larger area. Although the actual light intensity remains constant, the perceived brightness and apparent size of the light source change depending on distance, viewing angle, and atmospheric conditions. Fog, haze, rain, snow, high humidity, or low cloud cover reduce perceived brightness, while in clear conditions, lights can be seen from greater distances.

Considering these factors (also noted in the Scottish guidelines[94]), significant landscape and visual impacts from aviation lighting are expected at approximately 20 km from the turbines. Another example from Eastern Scotland shows that on a dark night without moonlight, white aviation lights can be visible up to 40 km away[95]. In early 2026, aviation lighting was installed at the "Laflora" wind farm near Jelgava, where turbines are approximately 260 m tall. Observations in the surrounding area at night confirmed that the wind farm's lights are visible at distances greater than 20 km under clear conditions. However, at greater distances, the lights are noticeable only if the viewer knows the exact direction, and the lighting intensity and potential disturbance are minimal.

Current situation description

The impact assessment focused on the level of natural darkness and artificial lighting, as these are key factors in the perception of aviation lighting and in receptor sensitivity to potential environmental changes. To reflect the sensitivity of the area, information on light pollution levels in the vicinity of the planned development was analyzed. The nearest area with relatively high radiance is the urban environment of Valka and Valga cities, which forms the main source of artificial lighting in the wider area (see Figure 3.4.32).

At the same time, it can be seen that in the southern and western directions from the planned development, no significant areas with elevated light emission have been identified, indicating a distinctly dark environment with low urbanization and low population density. Such areas are characterized by a high degree of naturalness and a low background of artificial lighting, and are therefore theoretically more sensitive to new lighting sources, including aviation lights.

[94] Guidance on Aviation Lighting Impact Assessment. Available: https://www.nature.scot/doc/guidance-aviation-lighting-impact-assessment
[95] Dunside Wind Farm EIA Report. Appendix 4.3: Aviation Lighting Assessment. Available: https://dunsidewindfarm.co.uk/wp-content/uploads/2023/06/Volume-4-Appendix-4.3-Aviation-Lighting.pdf

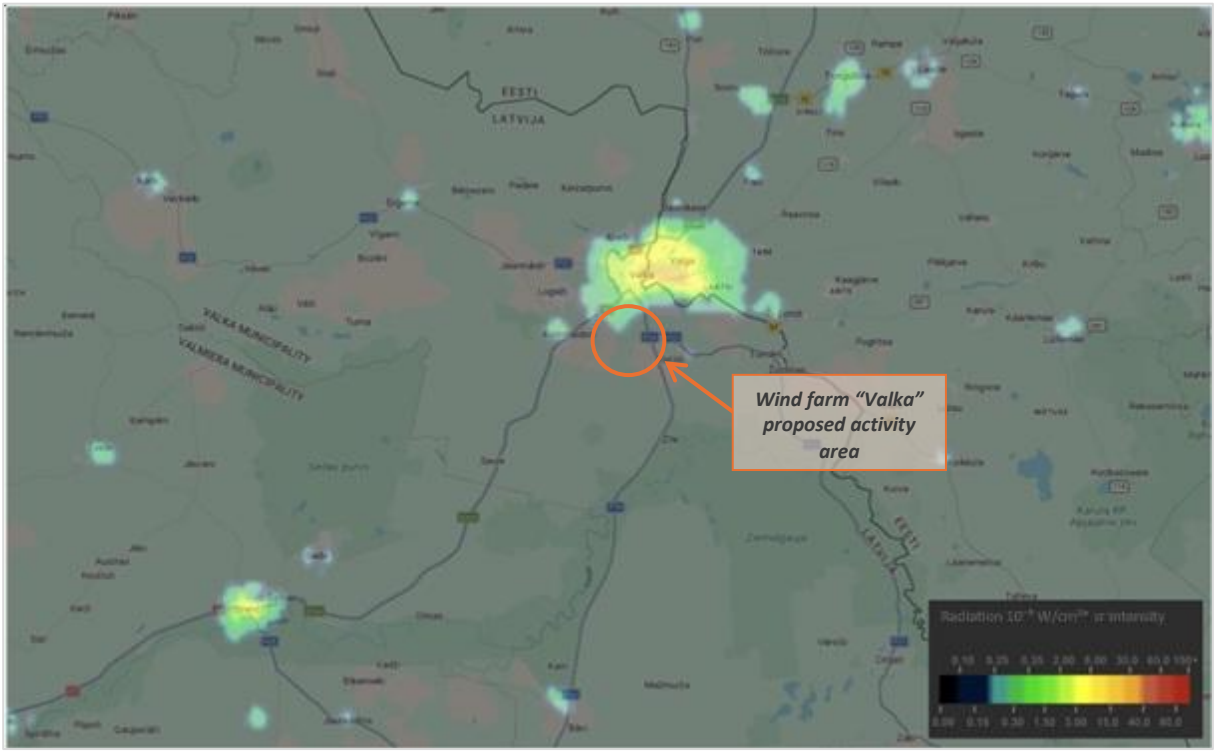


Figure 3.4.32. Light pollution map in the vicinity of the planned "Valka" wind farm in 2024 (VIIRS satellite data)[96]

Impact during wind farm operation

The impact on the landscape may mainly occur during short periods at dawn and dusk when terrain features are still visible and both existing lights and aviation lighting can be perceived. Although this period is relatively limited, more significant impacts may potentially occur at night on receptors (residents) located in areas with low existing artificial light levels.

For the assessment of aviation lighting, a map was developed modeling the visibility of wind turbine towers (166 m) up to a 20 km radius, showing the number of turbines visible from a single viewpoint (i.e., the number of aviation lamps). These modeling results were combined with areas classified by receptor sensitivity levels. The results indicate that natural areas with the highest sensitivity and no artificial lighting cover relatively small areas, from which the turbines' aviation lights will be visible (see Figure 3.4.33). The greatest potential impact is in the Lugaži area, where agricultural lands dominate and open views are typical. The urban areas of Valka and Valga are assessed as low sensitivity, due to existing artificial lighting and urbanization.

[96] Available: http://www.lightpollutionmap.info

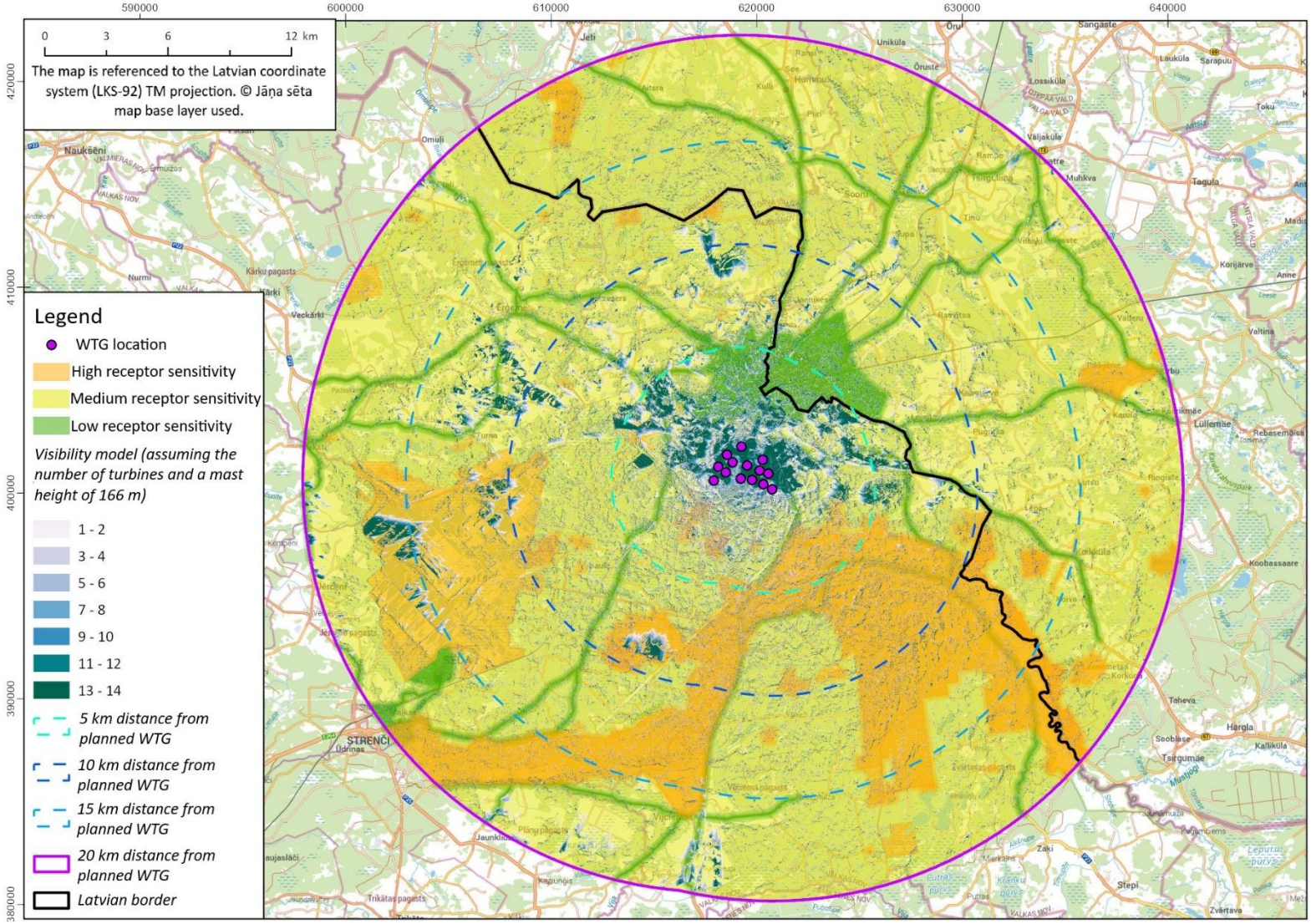


Figure 3.4.33. Theoretical visibility of wind turbine aviation lighting within a 20 km radius of the planned "Valka" wind park together with areas classified by receptor sensitivity

3.4.7. Cross-border impact on the landscape

To thoroughly assess the potential impact of the planned wind farm in Latvia on landscapes in Estonian territory, taking into account Estonian legislation, visually sensitive areas, and culturally and historically significant sites, Estonian landscape experts were also involved in the preparation of this Report. The cross-border impact assessment was conducted by certified Estonian landscape architects Heiki Kalberg and Keith Oras to evaluate the potential impact of the "Valka" wind farm on the landscape context in Estonia. The original assessment in Estonian is available in Annex 2.

3.4.8. Mitigation measures

When preparing the assessment of the planned wind farm's construction impact on the landscape, no limiting factors arising from legislation or spatial planning documents were identified that would restrict the implementation of the planned activity. At the same time, it should be noted that both Latvian and Estonian experts recognized that the construction of the planned wind farm will change the landscape over a wide area, especially in locations with open views dominated by agricultural land. From viewpoints closest to the wind farm, including the regional road P24 and the main national road A3, landscape changes will be significant, and after the construction, wind turbines will be dominant features in the rural landscape.

Reducing visual impact

Summarizing the main conclusions of the landscape assessment, the Report authors consider it appropriate to give the following recommendations for implementing the planned activity to reduce its impact on the landscape: **when designing the planned wind farm, including if the number of wind turbines is reduced, the layout of wind turbines should, as far as possible, follow good landscape design principles, primarily considering the view from Valka city.** The layout should avoid chaotic wind turbine placement and rotor overlap, and, where possible, ensure a visually organized, rhythmic, and perceptually uniform composition (e.g., grouping wind turbines or leveling the distances between them), evaluating the view from the main viewpoint – the Lugaži Lutheran Church tower – to minimize potential negative impacts on landscape quality and the visual perception of the urban environment (see Figures 3.4.40 and 3.4.41). **When changing the layout or omitting some wind turbines, it is necessary to obtain an expert landscape assessment regarding whether the revised plan complies with the landscape design principles and mitigation measures defined in this assessment.**



Figure 3.4.40. Visibility of wind turbines from the Lugaži Lutheran Church tower (without mitigation measures)



Figure 3.4.41. Visibility of wind turbines from the Lugaži Lutheran Church tower (example with mitigation measures)

When preparing visualizations from different viewpoints around the planned wind farm, it was found that the visual impact, especially in low to medium visual impact zones, can be effectively reduced by creating green (vegetation) belts. Although spatial planning documents do not identify specific viewpoints where wind turbine visibility should be restricted, such points can be identified after the wind farm construction. Even if the wind farm is not visible from large areas at ground level in urban areas, considering that Valka and Valga cities lie in low to high visual impact zones, where sensitive objects may be or may in the future be located, from which the view to the wind farm should be limited, **it is recommended to involve a certified landscape architect when planning new landscape-sensitive objects or mitigating the impact on an existing viewpoint. The expert can provide recommendations on creating additional vegetation, modifying existing plantings, or creating other green elements in the urban environment to fully or partially screen wind turbines while improving the aesthetic quality of the urban area.**

To reduce visual impact, it is primarily recommended to use steel mast structures. If modular concrete towers are chosen, it is recommended to paint them in a tone coordinated with the steel masts to reduce visual contrast and the perceived massiveness of the towers in the landscape.

Mitigation of aviation lighting impacts

Automatic intensity reduction

Aviation lighting lamps can be equipped with visibility sensors that automatically reduce intensity to approximately 10% of maximum in clear weather. Maximum intensity is used only in poor visibility conditions, where actual perceived brightness is limited anyway. If such a solution is accepted by the competent authority – the Civil Aviation Agency of Latvia – it is recommended for use in the "Valka" wind farm.

Radar-based activation

Lighting can be activated only when an approaching aircraft is detected, thereby significantly reducing constant light presence at night. If accepted by the competent authority – the Civil Aviation Agency of Latvia – this solution can also be applied in the "Valka" wind farm.

3.4.9. Assessment of alternatives

Within the EIA process, the parameters of the evaluated technological alternatives are equivalent in terms of landscape protection, and therefore there is no basis to consider any of the assessed WTG models as more favorable for the landscape. Considering that 14 wind turbines construction sites were evaluated in the planned "Valka" wind farm, but due to available grid capacity limitations the number of installed WTGs may be lower, Chapter 6 of the EIA Report provides an evaluation of these site alternatives, also taking into account landscape aspects.

3.5. ENVIRONMENTAL RISKS AND EMERGENCY SITUATIONS

Within this section of the Report, the potential risk of accidents associated with wind turbine operation and its significance is assessed in detail, evaluating the necessity of implementing mitigation measures.

Based on information on accidents with wind turbines worldwide, recommendations from other countries, and information and recommendations provided in the "Guidelines for conducting an initial EIA for wind turbine construction"[97], the following potential hazards associated with wind turbine operation have been identified:

- Formation of ice on wind turbine rotor blades with subsequent ice throw in the surrounding area;
- Mechanical damage / collapse of wind turbine with resulting distribution of debris in the surrounding area;
- Defects in the lubrication system causing oil leakage;
- Wind turbine fires.

Such accidents may pose a risk to human health and life as well as cause environmental pollution. In a wider area, threats to public safety may be caused by wind turbine accidents resulting in detachment of structural components, which during falling may endanger people or property within their impact zone. As another potential risk source in the Valka wind farm, BESS on lithium-ion battery modules, is considered.

3.5.1. Regulatory framework

The safe siting distance of wind turbines from residential and public buildings in Latvia is ensured by Regulation No. 240 of the Cabinet of Ministers of 30 April 2013, "General Regulations for the Planning, Use and Building of the Territory" (Cabinet Regulation No. 240), where Section 163.2 stipulates that for wind turbines with a capacity exceeding 2 MW, the minimum distance from the boundary of the wind farm to residential and public buildings shall be at least 800 m.

[97] Available: https://www.vvd.gov.lv/lv/media/9969/download?attachment

In the planned wind farm "Valka" development project, it is envisaged to install 14 next-generation wind turbines, each with a maximum capacity of up to 7.2 MW. The total installed capacity of the wind farm may reach 100.8 MW, which means that, in accordance with Sub-paragraph 2.3.4 of Regulation No. 563 of the Cabinet of Ministers of 19 September 2017 "Procedures for Identifying and Determining Objects of Increased Danger, as well as for the Planning and Implementation of Civil Protection and Disaster Management", the wind farm will be classified as a Category C high-risk object.

At the same time, it should be noted that when assessing the necessity of risk mitigation measures, the potential limitation of the total installed capacity of the wind farm has been taken into account (as further described in Chapter 2 of the Report).

Battery Energy Storage Systems (BESS) are not subject to Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC (the Seveso Directive), nor to Regulation No. 131 of the Cabinet of Ministers of 1 March 2016 "Industrial Accident Risk Assessment Procedures and Risk Reduction Measures", nor to the requirements of Regulation No. 563 of the Cabinet of Ministers, as BESS does not contain hazardous chemical substances falling within the scope of the above-mentioned directive and regulations.

However, taking into account that chemical reactions may occur within lithium-ion batteries resulting in the release of such substances, and that the quantities released may be comparable to an industrial accident, discussions are currently ongoing at European Commission level regarding the necessity and feasibility of extending Seveso Directive requirements to such systems[98].

3.5.2. Impact assessment approach

In Latvia, there is no established procedure, principles, or criteria for the assessment of wind turbine accident risks; therefore, the assessment of the planned situation is based on experience from other countries and the guidelines developed therein in this field.

One of the leading countries in Europe in industrial risk assessment and in the application of risk assessment results for spatial planning purposes is the Netherlands. Similarly to other industrial facilities, Dutch national institutions also require the performance of accident risk analyses for wind energy development projects. One of the accepted methods for carrying out this task is the set of guidelines developed on behalf of the Netherlands Enterprise Agency for wind turbine risk assessment[99].

[98] Available: https://circabc.europa.eu/ui/group/045e5d49-d835-4a1d-8cae-4b1ea23f8c80/library/f3dde7c0-c06e-4c08-89bd-e48d99bacb0a/details

[99] Handreiking Risicozonering Windturbines (Infomil) un Handleiding Omgevingsveiligheid Module IV Specifieke rekenvoorschriften (RIVM)

The method developed in the Netherlands has also been used as a basis for the preparation of wind turbine risk assessment guidance[100] by the Department of Regional Development, Spatial Planning and Projects of the Ministry of the Environment of Belgium.

Mechanical Failure and Accident Risk Assessment of Wind Turbines

For the preparation of the risk assessment of the planned "Valka" wind farm, the above-mentioned Belgian wind turbine risk assessment guideline and the associated mathematical models for the evaluation of wind turbine accident consequences[101] have been applied.

According to the methodology, the following most common wind turbine failure scenarios are considered:

- detachment of rotor blades;
- structural failure of the tower;
- damage to the rotor and/or nacelle.

The assessment of accident consequences is based on several key structural and operational parameters: total turbine height, rotor diameter, and hub height, as well as the total mass of the installation, maximum rotor rotational speed, and the wind speed at which the turbine automatically shuts down. The interaction between these parameters determines the potential energy released during an accident and the spatial distribution of potential damage.

The distance to the potential impact boundary is measured from the central axis of the wind turbine tower, assuming that the propagation of accident consequences occurs radially and uniformly in all directions.

In the case of rotor blade detachment, the expected impact distance is determined by calculating the maximum falling distance of the blade's centre of gravity and adding the distance from the centre of gravity to the blade tip. The calculations take into account rotor rotational speed, azimuth angle, the distance of the centre of gravity from the rotor axis, hub height, and gravitational acceleration, both under nominal operating conditions and under increased operational intensity conditions.

In the case of tower structural failure, the maximum expected impact distance is assumed to be the sum of the tower axis height and the distance to the structural centre of gravity. In addition, it is assumed that objects located beneath the nacelle or rotor may be affected within a distance of up to half the rotor diameter.

Taking into account the expected extent of accident consequence propagation for the considered failure scenarios, the guidelines define minimum setback distances to the following elements:

1) High-risk installations:

[100] Vlaamse overheid, Departement Omgeving, Afdeling Gebiedsontwikkeling, Omgevingsplanning en – Guidelines for the risk calculations of wind turbines

[101] Vlaamse overheid, Departement Omgeving, Afdeling Gebiedsontwikkeling, Omgevingsplanning en – projecten, Rekenblad Windturbines.

a) SEVESO establishments[102];
b) liquefied natural gas (LNG), compressed natural gas (CNG), liquefied petroleum gas (LPG) refuelling stations, as well as LNG ship bunkering facilities;
c) hydrogen refuelling stations;
d) gas pressure regulation stations;
e) above-ground pipelines transporting hazardous chemicals.

2) Underground pressure vessels.
3) Underground pipelines transporting hazardous chemical substances.
4) Public outdoor areas with high occupancy, where more than 10 persons may be simultaneously exposed in an open-air environment.
5) Public areas where people are present inside buildings.
6) Main national roads.

In cases where the above-defined hazard zones overlap with the listed elements, Belgian practice requires a detailed quantitative risk assessment to be carried out.

The guidelines further define that minimum setback distances to the above-mentioned elements are determined as follows:

- Distance to high-risk installations – based on the impact zone of rotor blade detachment at a rotational speed corresponding to twice the normal operating speed;
- Distance to underground pressure vessels – based on the impact zone in the case of tower structural failure;
- Distance to underground pipelines transporting hazardous chemical substances – calculated according to the equation: $H_m + 2{,}15 \cdot 10^{-4} \cdot m^{0,77} \cdot H_m^{0,385}$, where: Hm is the tower height and m is the nacelle mass;
- Distance to public outdoor areas with high occupancy (more than 10 persons simultaneously exposed in one location) – based on the impact zone for rotor blade detachment under normal operating rotational speed;
- Distance to public indoor occupancy areas – based on the impact zone for tower structural failure;
- Distance to main national roads – based on the total height of the wind turbine.

Assessment of Ice Throw Hazard from Wind Turbines

Under certain air humidity and temperature conditions, ice may form on wind turbine rotor blades. Similar icing can also be observed on other objects exposed to the same environmental conditions, such as buildings, trees, and overhead power lines. Two types of icing are distinguished depending on the formation conditions:

- rime ice (formed due to changes in ambient temperature conditions);
- glaze ice (formed in the case of freezing precipitation).

[102] Sites subject to the requirements of Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC (the Seveso III Directive)

Ice formation on wind turbine components creates a potential hazard, as under certain conditions this ice may detach from the structure. This is particularly relevant in situations when the turbine restarts after shutdown, as well as during periods of increased wind influence or rising ambient temperatures. In such cases, falling ice fragments may pose a risk to nearby persons and objects.

In the Netherlands and Belgium, icing events on wind turbines are relatively rare, which is one of the reasons why the above-mentioned guidelines do not yet include calculation models for assessing the spatial extent of this type of hazard. At the same time, the risk assessment manuals of these countries indicate that risk analyses should also consider the potential for falling ice fragments and other smaller debris, such as bolts.

According to assessments performed using the guidelines of the above-mentioned countries, ice throw is considered only for a stationary (non-operating) turbine. Based on field observations, ice fragments are typically dispersed within the area directly beneath the rotor and up to approximately 10 – 15 m beyond it.

The wind turbine risk assessment guidance indicates that the risk associated with falling ice fragments can be minimised by restricting access to the area beneath the rotor of the wind turbine. As an additional mitigation measure in the case of icing conditions, turbine shutdown during icing events is also recommended.

International studies[103] indicate that an impact energy of approximately 40–60 J applied to the head, or greater than 80 J if the impact is received to the body, may be life-threatening to humans (corresponding to a 1% lethality threshold). For comparison, a vehicle windscreen can typically be shattered by an impact energy of approximately 140 J, while an impact energy of 180 J is considered a threshold for life-threatening conditions for occupants inside a vehicle.

The distance at which an ice fragment detached from a wind turbine may produce the above-mentioned impact energy level is influenced by a number of factors. The most significant of these include the size and density of the ice fragment, fall height, wind speed, wind direction, rotor rotational speed, and other relevant parameters.

The most comprehensive studies and available empirical data on actual impact distances are found in northern countries such as Canada, Norway, Sweden, and Finland. In addition, studies and publications describing methods and recommendations for assessing ice throw impact and associated risk have been developed by the International Energy Agency Wind Technology Collaboration Programme (IEA Wind TCP[104]).

For the ice throw risk assessment of the "Valka" wind farm, a simplified trajectory model has been used, which calculates potential impact distances based on the mass of the ice fragment,

[103] Bredesen, R.E., and Refsum, H.A., (2015) Methods for evaluating risk caused by ice throw and ice fall from wind turbines and other tall structures, presented at IWAIS 2015, 16th International Workshop on Atmospheric Icing of Structures, Uppsala, Sweden, June 28-July 3, 2015
[104] IEA Wind TCP - International Energy Agency Wind Technology Collaboration Programme

its initial velocity, and environmental parameters (wind speed, wind direction, and fall height). Conservative assumptions ensure sufficient accuracy while reducing the required amount of input data and computational resources.

Detailed technical information regarding the selected turbine model will be available at the detailed design (construction design) stage, which will also allow for more detailed dispersion modelling. However, the simplified trajectory model applied during the EIA process enables the rapid identification of potential hazard zones and the determination of necessary protective measures, while ensuring compliance with applicable regulatory requirements.

The calculations are based on general ballistic equations[105], as well as supplementary information and research included in a publication issued by Uppsala University[106], which enables the calculation of the flight distance of a projectile taking into account the following parameters:

- tower hub height;
- rotor diameter;
- rotor rotational speed;
- wind speed perpendicular to the rotor plane;
- mass and density of the ice fragment;
- air density and aerodynamic drag;
- gravitational acceleration;
- the launch angle at which the object begins its motion, i.e. is released from the rotor blade.

The equations described in the literature enable the determination of a body's motion in three coordinate axes (x, y, and z), taking into account two fundamental forces acting on an ice fragment after it has detached from the rotor blade: gravitational force and aerodynamic drag.

The gravitational force is always directed downward, while the aerodynamic drag acts in the opposite direction to the motion of the ice fragment through the air.

The gravitational force is expressed as: $$F_g = -mg$$

The aerodynamic drag is expressed as: $$F_D = -C_D \cdot \rho \cdot A \cdot V^2$$

where:
m – mass of the ice fragment (kg);
g – gravitational acceleration;
Cd – drag coefficient of air resistance;
A – cross-sectional area of the ice fragment (m^2);
ρ – air density (kg/m^3);

[105] Available: https://web.physics.wustl.edu/~wimd/topic01.pdf
[106] Modelling of Ice Throws from Wind Turbines. Joakim Renström. Uppsala University. 2015

V – relative velocity of the ice fragment in air (m/s).

The following equations describe motion in three dimensions (x, y, and z):

$$m \cdot \frac{d^2x}{dt^2} = -\frac{1}{2} \cdot \rho \cdot C_D \cdot A \cdot \left(\frac{dx}{dt} - U\right) \cdot |V|$$

$$m \cdot \frac{d^2y}{dt^2} = -\frac{1}{2} \cdot \rho \cdot C_D \cdot A \cdot \left(\frac{dy}{dt}\right) \cdot |V|$$

$$m \cdot \frac{d^2z}{dt^2} = -m \cdot g - \frac{1}{2} \cdot \rho \cdot C_D \cdot A \cdot \left(\frac{dz}{dt}\right) \cdot |V|$$

The relative wind speed is defined by the following equation:

$$|V| = \sqrt{\left(\frac{dx}{dt} - U\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2}$$

where U is the wind speed at height z above ground level.

The calculations also take into account other important parameters, such as the surface area of the ice fragment, the angle at which the ice fragment detaches from the rotor blade (45°, considered as the worst-case scenario), rotor rotational speed, and other relevant factors.

Assessment of Hazard from BESS Accidents

Based on publicly available literature, the primary hazard associated with the operation of Battery Energy Storage Systems (BESS) is the potential development of uncontrolled thermal runaway reactions in lithium-ion batteries contained within these systems. This is an exothermic chemical reaction during which a large amount of heat is released, resulting in a rapid increase in temperature and internal pressure.

During thermal runaway, several stages of battery degradation occur, including decomposition of the solid electrolyte interphase (SEI), reaction between anode and cathode materials, and degradation of electrode structures.

The progression of a thermal runaway event can be divided into stages based on internal battery temperature:

- 0 – 60 °C (normal operating conditions) – lithium-ion intercalation into the anode (typically graphite);
- 70 – 80 °C – decomposition of lithium salt $LiPF_6$, resulting in the release of hydrogen fluoride (HF), a toxic gas; initial breakdown of the interphase layer begins;
- 80 – 150 °C – intensive decomposition of the interphase layer. This process is exothermic and releases heat. In addition, the separator begins to melt, leading to

contact between anode and cathode, which causes an internal short circuit and rapid heat generation;
- 150 – 200 °C – thermal decomposition of alkyl carbonate electrolytes occurs, and flammable gases (H_2, CH_4, C_2H_4, C_2H_6, etc.) begin to form. Oxygen (O_2) is also released, acting as an oxidising gas that enables the reaction to continue even in a closed, oxygen-deficient environment;
- 200 – 300 °C – the cathode structure fully collapses and metal oxides begin to decompose, triggering further chemical reactions and leading to the release of toxic gases such as NOx, CO, HCl, and HCN.

The heat released during thermal runaway may heat adjacent battery cells, triggering thermal runaway in neighbouring units as well, thereby resulting in a cascading chain reaction within the BESS system.

During this process, toxic and flammable gases are released, and there is also a risk of explosion. The accident may therefore be associated both with toxic exposure hazards and with physical impacts such as thermal radiation and overpressure.

Studies and investigations of past accidents indicate that the most common causes of BESS-related incidents that may lead to thermal runaway include:

- short circuits;
- process failures or improper operation (e.g., overcharging);
- manufacturing defects;
- damage to batteries during transport or operation;
- external impacts.

For the assessment and characterisation of hazards associated with BESS accidents, the Dutch PGS 37.1 guideline[107] has been applied. This guideline defines measures for controlling risks associated with lithium-based energy storage systems based on scenario-based risk analysis. In addition, the risk assessment methodology developed by the Dutch National Institute for Public Health and the Environment (RIVM) for lithium-based energy carriers has been used, as well as a study published by the Dutch Ministry of Infrastructure and Water Management related to lithium-based energy carriers (hereinafter referred to as the Dutch study).

For the purpose of assessing the potential hazard of the planned "Valka" wind farm BESS, numerical modelling of accident consequence propagation has been carried out using the Gexcon AS software Effects (version 13.0.1) (SIA "Estonian, Latvian & Lithuanian Environment" licence ID 66730890787096783).

Based on the analysis of possible BESS accident scenarios, and taking into account guidance provided in the Gexcon technical documentation[108] and the above-mentioned lithium energy

[107] Lithiumhoudende energiedragers: energieopslagsystemen (EOS). Richtlijn voor de veilige opslag van elektriciteit in energieopslagssystemen, PGS, 2023.
[108] Battery Thermal Runaway Consequance Modelling with the X-Suite. Gexcon, 2025 (https://www.gexcon.com/resources/white-papers/battery-thermal-runaway-consequence-modelling-with-the-x-suite/)

storage system guidelines, the following BESS accident scenarios are considered in this assessment:

- thermal runaway with release of toxic and flammable gases;
- fire induced by thermal runaway;
- thermal runaway followed by explosion.

Other Wind Turbine Related Accidents and Their Causes

This assessment also includes an evaluation of other accidents associated with wind turbine operation, considering the following scenarios:

- defects in lubrication systems resulting in oil leakage;
- wind turbine fires and their potential impacts, including lightning strikes as one of the contributing ignition hazards.

The hazard potential, spatial extent, and likelihood of these accident scenarios are characterised based on the analysis of previously occurred incidents, studies from other countries, and publications by various authors.

Hazard Risk Assessment

The level of potential hazard risk for the identified accident scenarios has been assessed using a hazard risk matrix, in which two risk components are considered simultaneously:

- probability of occurrence of an incident/accident;
- potential consequences in the event of such an incident/accident.

The probability of occurrence is characterised by indicating the likelihood of the considered incident occurring within a defined time period. The probability assessment is based on information provided in the Dutch and Belgian guidelines used in the risk assessment, regarding the likelihood of similar events, adjusted to the intensity of the proposed activity. In addition, statistical data from publications of other national authorities and authors has been used, as well as expert judgement and assumptions regarding the likelihood of similar types of incidents.

The probability of occurrence is classified according to the following five-point scale based on recurrence frequency:

1) ≥ 1 event per year
2) < 1 per year and > 1 per 10 years
3) < 1 per 10 years and > 1 per 100 years
4) < 1 per 100 years and > 1 per 1000 years
5) ≤ 1 per 1000 years

For the characterisation of potential consequences, information on impact distances for each analysed accident scenario is used. The primary criterion for consequence assessment is the impact on humans or objects and infrastructure where people may be present, or where an accident may pose a risk to human safety.

The following five-point scale is used for the assessment of impact distances:

1) up to 50 m
2) 50 – 100 m
3) 100 – 200 m
4) 200 – 500 m
5) > 500 m

Technical Parameters of Equipment and Operational Characteristics Used in the Assessment

In this assessment, an in-depth analysis of the accident risk of five different wind turbine models has been carried out, comparing them from the perspective of their potential hazard contribution. All technical parameters used in the comparative analysis of the specific wind turbine models have been compiled in Table 3.5.1., based on information provided by the project developer.

Table *3.5.1. Data used in the risk assessment to characterise wind turbines*

Parameter	Characteristics of WTG models				
	Nordex N163 - 7.0 MW	Nordex N175 - 6.8 MW	Vestas V172 - 7.2 MW	Vestas V162 - 6.2 MW	Siemens SG 7.0-170 MW
Total WTG height (m)	245,5	249,5	252	247	250
Rotor diameter (m)	163	175	172	162	170
Planned mast height (m)	164	162	166	166	165
Maximum rotor speed (rpm)	10,7	10,8	11	11	9,22
Wind speed (m/s) at which the WTG is stopped	26	26	25	25	23

The calculations have been performed based on the following assumptions:

- the total mass of a single wind turbine is 800 tonnes;
- nacelle length is 15 m;
- width is 5 m;
- height is 7 m.

In the assessment of risks associated with BESS operation, it has been assumed that the energy storage system will consist of 80 lithium-ion battery ISO[109] containers with a total capacity of 400 MWh. Considering that a BESS manufacturer has not yet been selected during the EIA preparation process, the number of modules per container has been assumed based on information from the most commonly used market solutions, where 48 modules are typically installed per container.

[109] ISO – Intermodal container

In such a configuration, the energy storage capacity per ISO container is 5 MWh, while the energy capacity of a single module is 0.1042 MWh. The BESS is planned to utilise lithium iron phosphate ($LiFePO_4$) batteries.

For the purposes of the assessment, a worst-case scenario has been assumed in which the BESS is not equipped with additional safety systems or emergency mitigation systems that would reduce the probability of failures and accidents compared to standard configurations.

3.5.3. Description of the project area

In the context of environmental risk and emergency management, it is important not only to identify risks associated with the operation of the wind farm itself, but also to determine whether conditions exist in which the coexistence of two or more different objects may create favourable preconditions for cumulative impacts. Such cumulative effects may increase the significance, magnitude, and consequences of a potential hazard. During the risk analysis, information has been collected on other high-risk installations, economic activity sites, transport infrastructure, and other sensitive receptors within and in the vicinity of the project area that could be affected by an accident occurring at the "Valka" wind farm.

The closest national watercourse to all wind turbines is the Seda River, which flows through the wind farm study area. The nearest turbines are planned at the following distances from the river:

- Wind turbine No. 1 – approximately 287 m;
- Wind turbine No. 9 – approximately 307 m;
- Wind turbine No. 8 – approximately 323 m.

According to the Valkas Municipality Spatial Plan (2017), the Seda River is designated as a protected buffer zone for natural watercourses between 25 and 100 km in length, with a minimum protection zone of 100 m on each river bank.

The study area is crossed by the railway line Riga – Lugaži – state border. Wind turbine No. 5 is planned at a distance of approximately 307 m from the railway line, while WTG No. 6 is planned at approximately 345 m from it.

Within the project area, there are two unnamed municipal roads, near which the planned wind turbines are located at the following distances:

- Wind turbine No. 4 – 99 m;
- Wind turbine No. 5 – 314 m;
- Wind turbine No. 6 – 100 m;
- Wind turbine No. 14 – 145 m from the municipal road.

To the north of the wind farm, a 110 kV high-voltage transmission line is located, with the nearest turbine (wind turbine No. 1) planned at a distance of approximately 575 m. To the east, a 330 kV high-voltage transmission line is located, with the nearest wind turbine No. 11 planned at approximately 1.4 km distance.

The nearest high-risk installation, according to Cabinet Regulation No. 46 of 21 January 2021 "List of High-Risk Installations", is the fuel station "Valka Lugaži" operated by JSC "VIRŠI-A". Wind turbine No. 1 is planned at a distance of approximately 1.8 km from this fuel station.

The closest settlement to the project area is the village of Sēļi, located approximately 1.2 km from the planned location of wind turbine No. 2. The nearest individual residential buildings are:

- Residential house "Liepkalni" – approximately 368 m from wind turbine No. 7;
- Residential house "Dūmiņi" – approximately 809 m from wind turbine No. 2;
- Residential house "Lejas Ģērķi" – approximately 827 m from wind turbine No. 7;
- Residential house "Dzelzceļš 162. km" – approximately 870 m from wind turbine No. 7.

Three location alternatives for the BESS installation have been considered (A/1, B/1, and C/1), for which the distances from the relevant land parcels to the Riga – Lugaži – state border railway line are:

- 34 m in the case of location alternative A/1, whereby part of the land parcel designated for BESS installation falls within the operational protection zone of the railway line;
- 255 m in the case of location alternative B/1;
- 558 m in the case of location alternative C/1.

In the case of BESS location alternative B/1, the planned land parcel is intersected by the protection zone of a 110 kV high-voltage transmission line. At the closest point, the distance between the land parcel and the transmission line is 18 m. In contrast, the land parcel proposed for BESS alternative C/1 is located on the bank of the Seda River, at a distance of approximately 9 m from the river.

When planning the placement of the BESS or associated infrastructure within the operational protection zones of other infrastructure objects, the restrictions defined within such protection zones must be taken into account, and in cases defined by the Law on Protection Zones, the planned activity must be coordinated with the owner of the protection zone.

3.5.4. Results of environmental risks and emergency situations

Wind Turbine Mechanical Failures and Accidents

In the assessment of the wind turbines planned within the "Valka" wind farm using the Belgian calculation sheet, the minimum allowable distances applied in Belgium between wind turbines and other relevant or potentially hazardous objects have been determined (see Table 3.5.2).

Table 3.5.2. Minimum distances from planned wind turbines to other adjacent objects

Object	Calculated safety distance (m)				
	Nordex N163-7.0 MW	Nordex N175-6.8 MW	Vestas V172 - 7.2 MW	Vestas V162-6.2 MW	Siemens SG 7.0-170 MW
Objects of increased hazard	644	717	721	657	550

Object	Calculated safety distance (m)				
	Nordex N163-7.0 MW	Nordex N175-6.8 MW	Vestas V172 - 7.2 MW	Vestas V162-6.2 MW	Siemens SG 7.0-170 MW
Underground pressure reservoirs	194	194	197	196	196
Underground pipelines for transportation of hazardous chemicals	218	216	220	220	219
Public buildings with a large number of people outdoors	592	661	666	605	496
Public buildings with a large number of people indoors	194	194	197	196	196
Main national roads	246	250	252	247	250

It should be noted that in Belgium and the Netherlands, legislation provides that distances from wind turbines to residential and public buildings are determined based on the results of risk assessments. In contrast, Cabinet Regulation No. 240 of 30 April 2013 "General Regulations for the Planning, Use and Building of the Territory" stipulates that for wind turbines with a capacity exceeding 2 MW, the minimum distance from the nearest planned wind turbine and from the boundary of the wind farm to residential and public buildings shall be at least 800 m.

Accordingly, Latvian regulatory requirements ensure the necessary safety distance from residential and public buildings for the considered wind turbine models, as the distances presented in Table 3.5.2. are smaller than 800 m. In accordance with the information provided in the Belgian wind turbine risk assessment guideline, Table 3.5.3. summarises the probability of mechanical failure accidents, taking into account the number of wind turbines installed in the "Valka" wind farm.

Table 3.5.3. Probability of wind turbine mechanical failure accidents

No.	Accident scenario	Baseline probability (per year)	Accident probability (per year) in the "Valka" wind farm
1.	Detachment of a rotor blade during normal operation (rotor rotational speed corresponds to the parameters specified by the manufacturer)	$6{,}2 \times 10^{-4}$	$8{,}68 \times 10^{-3}$
2.	Detachment of a rotor blade at a rotational speed exceeding the normal operating rotational speed by 2 times	$5{,}0 \times 10^{-6}$	$7{,}0 \times 10^{-5}$
3.	Failure (fracture) of the wind turbine tower structure	$5{,}8 \times 10^{-5}$	$8{,}12 \times 10^{-4}$
4.	Damage to the rotor and/or nacelle	$1{,}8 \times 10^{-5}$	$2{,}52 \times 10^{-4}$

Lubrication System Defects with Oil Leakage

Wind turbines are mechanical installations in which various lubricants and oils are used. The largest volume of oil is contained in the gearbox located within the nacelle. Typically, forced lubrication systems are used in WTG gearboxes, where a pump ensures continuous oil circulation within the lubrication system. The lubrication system also performs a cooling function for the gearbox. The oil volume specified by manufacturers in such systems may reach up to 1,500 litres.

Despite implemented safety systems, there remains a minimal risk that oil may leak outside the nacelle, resulting in local environmental contamination. Such leakage risk may occur both during normal operation, for example in the case of lubrication system failure, and in scenarios involving tower structural failure or other major structural damage.

Risk assessments assume that the maximum potential contamination radius may reach a distance corresponding to the height of the wind turbine tower. Among the assessed turbine models in the EIA, the largest tower height is 166 m, corresponding to the Vestas V162 – 6.2 MW and Vestas V172 – 7.2 MW models.

To reduce environmental contamination risks, wind turbine manufacturers place significant emphasis on nacelle sealing systems, which provide additional protection against oil entering the tower or rotor area in the event of lubrication system failure. In addition, control systems are installed within the nacelle that, in the event of oil leakage, automatically shut down the turbine, including stopping lubrication system pumps.

For monitoring oil quality within the lubrication system, wind turbines are equipped with sensors that allow continuous monitoring of oil viscosity, water content, and the presence of chemical elements. Lubricants and oils in the gearbox are replaced regularly to ensure efficient operation and reduce the likelihood of failures. The replacement intervals are defined by the equipment manufacturer. According to information compiled in a study conducted in Spain on wind turbine gearbox lubrication practices, oil change intervals are typically approximately once every 2 – 5 years.

Used oil from wind turbines is extracted using tanker trucks and transported to a licensed waste treatment facility. Regarding the frequency of oil and other working fluid leaks, two accident scenarios are distinguished in this risk assessment:

- small-scale leakage of oil or other working fluids during operation or maintenance, with impacts in the immediate vicinity of the turbine – the probability of such an event is characterised as occurring between < 1 per 10 years and > 1 per 100 years;
- large-scale leakage of oil and other working fluids – the probability of such an event is considered equivalent to the probability of wind turbine tower structural failure.

Wind Turbine Fire Impact on the Environment

Operational data from existing wind turbines indicate that their operation may also be associated with a fire risk. Structural components of wind turbines made of epoxy resins reinforced with fiberglass are combustible, and fire may propagate within these materials. In

addition, the nacelle contains electrical installations and a gearbox system, whose lubrication is provided by oils and other lubricants that are also flammable substances.

The following potential causes of wind turbine fires have been identified[110]:

- defects in electrical installations and equipment;
- mechanically induced sparks;
- hot surfaces or overheating of components, for example temperature increases caused by the mechanical braking system;
- careless handling of fire during maintenance and repair activities;
- lightning strikes.

Information regarding the probability of wind turbine fires is not unequivocal. Publicly available sources indicate fire occurrence rates ranging from 1 fire per 15,000 wind turbines to 1 fire per 2,000 wind turbines per year[111], based on 2014 statistics. Data available from 2020 similarly indicate a fire probability of approximately 1 in 2,000 wind turbines per year[112]. However, it should be noted that wind turbine fire safety and fire suppression systems are continuously being improved, and new turbines are increasingly equipped with more efficient automatic fire detection and extinguishing systems.

Despite the improved capabilities of modern systems to detect and suppress fires, the possibility of failure of fire protection systems remains, which may result in further fire development. Extinguishing fires in wind turbine nacelles and rotors is complex, as firefighting operations cannot be performed at turbine height; none of the equipment available to fire and rescue services is designed for operations at heights of 166 m.

One of the fire ignition sources is also lightning strikes. Based on studies using lightning activity data in Europe from 2011 to 2021[113] and from 2008 to 2012[114], lightning activity in Latvia is relatively low, with discharge frequency ranging between 1 – 4 strikes per km² per year. Specifically, within the project area and its surroundings, lightning frequency is estimated at 1 – 2 strikes per km² per year. This level of lightning activity occurs mainly during the summer season (June to August), while during the remaining months (September to May) lightning activity is below 1 strike per km² per year. The available information, together with the fact that all turbines are equipped with lightning protection and grounding systems, indicates that lightning does not significantly increase the wind turbine fire risk in the project area.

In the event of a fire development, debris and combustion residues from burning wind turbines will be dispersed in the surrounding area, while combustion gases will be released

[110] CFPA-E Guideline No 22:2022 F - Wind turbines fire protection guideline
[111] Seifert, H., A. Westerhellweg & J. Kröning: Risk analysis of ice throw from wind turbines. DEWI, 2003
112 Available: https://www.windsystemsmag.com/turbines-and-fire-risk/
[113] Cui, R., Thurnherr, I., Velasquez, K., Brennan, K.P., Leclair, M., Mazzoleni, A., Schmid, T., Wernli, H., Schär, C. 2025. A European Hail and Lightning Climatology From an 11-Year Kilometer-Scale Regional Climate Simulation. *ournal of Geophysical Research: Atmospheres*, 130(14)
[114] Anderson, G., Klugmann, D. 2014. A European lightning density analysis using 5 years of ATDnet data. Natural Hazards and Earth System Sciences, 14(4)

into the atmosphere. This means that a wind turbine fire will result in environmental pollution, and there is a possibility of secondary fire development in the surrounding area.

An effective measure for reducing fire-related impacts is minimising the likelihood of fire occurrence and increasing the effectiveness of emergency response. Wind turbine fire safety documentation shall define procedures for fire response, including operational actions in the event of fire detection, covering both notification of emergency services and mobilisation of necessary resources for fire containment and suppression.

Considering that a civil protection plan must be developed for the installation and approved by the State Fire and Rescue Service, it will be ensured that the adequacy of planned response measures and resources is assessed by a competent state authority, which may impose additional requirements or operational restrictions if necessary.

According to available information, wind turbines No. 7, No. 9, No. 10, No. 11, No. 12, and No. 13 are planned to be constructed within forest stands classified as fire hazard Class I or II, or in their immediate vicinity (see Figure 3.5.1.). According to applicable regulations and additional information provided by the Forest State Service, where wind turbines are constructed in forest stands with fire hazard Class I and II, access to water extraction points must be ensured for fire-fighting vehicles.

When planning associated infrastructure (roads), provision shall be made for the construction of access routes to forest compartments, water abstraction points for forest fire protection and land management purposes, while maintaining access to natural roads and firebreaks.

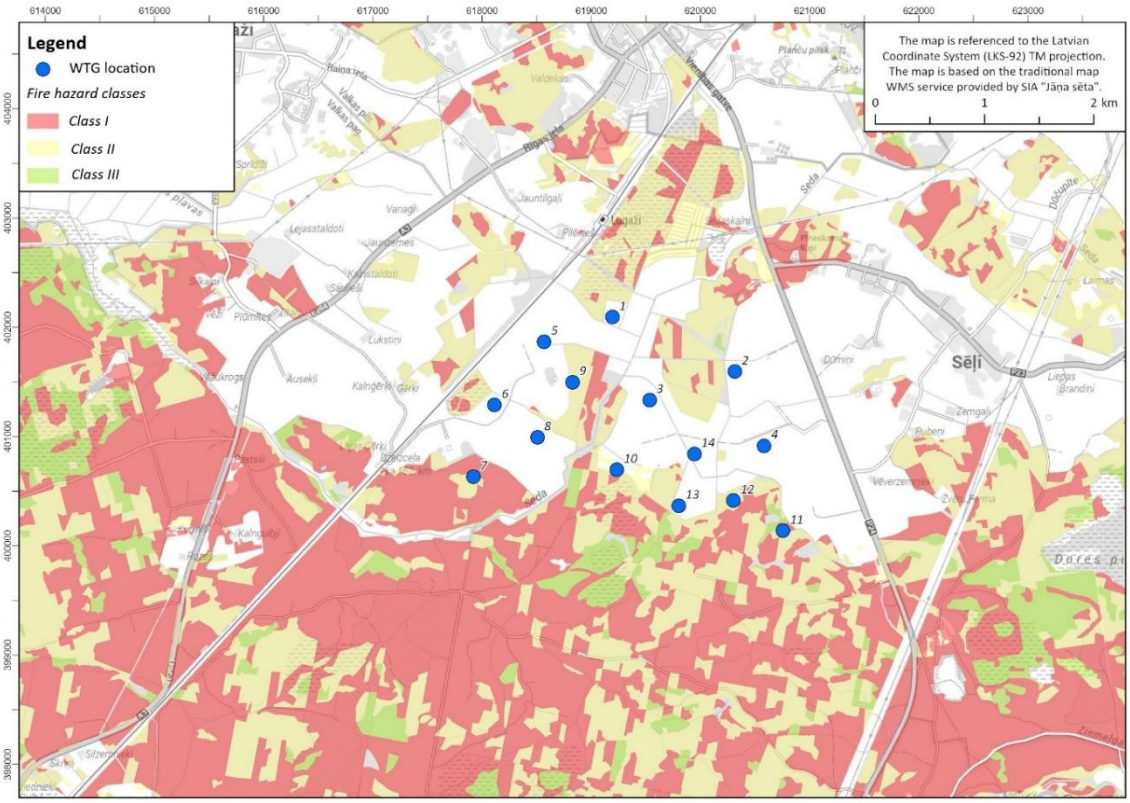


Figure 3.5.1. Forest fire hazard classes in the surroundings

When planning the construction of wind turbines and associated infrastructure, the requirements set out in Cabinet Regulation No. 238 "Fire Safety Regulations" must be taken into account. Section 27 of these regulations stipulates that the territory of the facility must be kept free from combustible waste, while a 10 m wide zone around the facility must be cleared of dry grass and crop residues.

According to information provided by the State Forest Service, in areas where the planned wind turbine site borders forest or forest land, mineralized strips with a minimum width of 4 m must be established. These strips are required to ensure access for specialised forest fire-fighting vehicles and to enable effective fire suppression operations in the event of a forest fire.

During the design of wind turbines and planning of preparedness for fire emergencies, it is necessary to define and ensure the adequacy and availability of resources required for fire containment and suppression. In accordance with applicable regulatory requirements, the civil protection plan, which includes specific response actions, evacuation distances, notification procedures, and other fire emergency response measures, must be coordinated with the State Fire and Rescue Service.

Ice Formation on Wind Turbine Rotor Blades and Ice Throw

In accordance with the methodology, the potential ice dispersion distance from wind turbines has been determined, taking into account the technical parameters of all assessed wind turbine models. The calculations have been performed assuming maximum operational intensity of the turbines, i.e. maximum rotor rotational speed. According to information provided in the literature, the most typical ice fragment size observed and used in calculations ranges from 0.1 to 1 kg, which has also been adopted in this assessment.

Table 3.5.4. Ice dispersion distance at maximum operational speed

Le Weight of ice chunks (kg)	Exposure distance (m)				
	Nordex N163-7.0 MW	Nordex N175-6.8 MW	Vestas V172-7.2 MW	Vestas V162-6.2 MW	Siemens SG 7.0-170 MW
0,1	306	314	305	298	262
0,3	291	304	296	286	249
0,5	292	306	299	288	248
1	299	317	312	297	256

For the performance of the calculations, several parameters characterising air resistance have been assumed[115]:

- air density: 1.3 kg/m³;
- drag coefficient: 0.6;
- ice density: 800 kg/m³;

[115] Róbert-Zoltán Szász, Alexandre Leroyer and Johan Revstedt, (2019). Numerical Modelling of the Ice Throw from Wind Turbines

- wind speed at which turbine operation is shut down (according to Table 3.5.1.);
- maximum rotor rotational speed (according to Table 3.5.1.).

The results of the performed calculations confirm findings from other information sources, indicating that ice fragments of 0.1 kg and above may pose a threat to human life if released from wind turbines. The calculations show that, under unfavourable combinations of conditions, ice fragments may be projected along a trajectory resulting in landing at distances exceeding 300 m from the tower.

However, field studies indicate that ice throw from wind turbines does not typically follow an ideal ballistic trajectory, and the majority of ice fragments are deposited in the immediate vicinity of the turbine. Studies conducted in Finland[116] indicate that 70% of ice fragments fall within 70 m of the turbine. A study carried out in Switzerland[117] found that 50% of ice fragments were located in the area directly beneath the rotor blades. Field investigations conducted by Swedish experts[118] indicate that 75% of ice fragments are distributed within a distance equal to one rotor diameter, while only 1% of fragments are found beyond 1.5 rotor diameters. Recommendations issued by the Canadian Wind Energy Association also indicate that, for stationary objects, ice drop distances may reach up to 50 m around the structure, and personnel working within this zone during icing conditions must be warned of associated hazards.

Under Latvian climatic conditions, rotor blade icing may occur during winter periods. Based on literature source[119], the "Valka" wind farm is located in a region where icing conditions may occur on average 5 – 10 days per year. This is also confirmed by the VTT Technical Research Centre of Finland Wind Energy Ice Atlas[120], according to which the project area is located in a zone where icing may occur for up to 3% of the year.

However, taking into account the probability of turbine operation at maximum rotational speed, the probability of icing conditions, and the probability of ice being released along an ideal trajectory, the overall probability of an event resulting in an ice fragment striking a location where a person is present is considered low. As indicated in Dutch risk assessment guidelines, such an assessment is to be performed qualitatively.

Summarising the above information and calculations, it can be assumed that the area with the highest potential hazard from falling ice is the zone beneath the rotor (in the case of the largest turbine with a rotor diameter of 175 m, the hazard area is assumed as a radius of 87.5

[116] Andersen E., Börjesson E., Vainionpää P., Undem L.S., (2011) Report – Wind Power in cold climate, WSP Environmental for Nordic Energy Research, Norway
[117] Ice throw studies, Gütsch and St. Brais, February 8, 2012. Available: http://winterwind.se/2012/download/6b_winterwind_icethrow_cattin.pdf
[118] Göransson, B. Lundén, J., Hultin, K., Aretorn, E., Sundström, J., Odemark, Y., Montgomerie, B., (2017). ICETHROWER - ICE THROWER Evaluation and Risk Analysis Tools. Pöyry Sweden.
[119] Elforsk (2008) "Mapping of Icing for Wind Turbine Applications: A feasibility study"
[120] Available: https://vtt.maps.arcgis.com/apps/instant/minimalist/index.html?appid=6d93b5e284104d54b4fb6fd36903e742

m around the turbine). For the assessed wind turbine models, ice fragment dispersion may potentially occur up to a distance of 317 m from the turbine.

Considering that the distance to residential and public buildings is ensured in accordance with spatial planning regulatory requirements and exceeds the ice throw distance, the risk to human health and life would primarily concern persons moving within or carrying out work activities in the project area. Non-project-related human presence is possible along nearby roads or roads crossing the project area. Therefore, ice throw distances are relevant for defining safety distances to roads as well as areas where continuous economic activities are carried out.

Assessment of Hazard from BESS Accidents

For the assessment of potential accident consequence dispersion in the event of a BESS failure, the Gexcon AS consequence modelling software Effects has been used. This software currently enables the modelling of dispersion of toxic gases emitted during uncontrolled thermal runaway of lithium-ion batteries, including carbon monoxide (CO), hydrogen chloride (HCl), hydrogen cyanide (HCN), hydrogen fluoride (HF), and nitrogen dioxide (NO_2).

In contrast, the dispersion modelling of flammable gas release and the associated explosion and fire consequence models are still under development. Therefore, the potential extent and dispersion of explosion and fire scenarios are characterised based on information provided in Gexcon technical documentation.

For modelling toxic gas dispersion during uncontrolled thermal runaway, two accident scenarios have been considered in accordance with recommendations from the Dutch study:

- development of uncontrolled thermal runaway in a single battery module (without affecting other modules within the container);
- an accident resulting in uncontrolled thermal runaway of one entire BESS container.

In the modelling process, and in accordance with Gexcon technical documentation, a thermal runaway duration of 5 minutes per module and 30 minutes per container has been assumed.

The modelling also takes into account meteorological data included in Cabinet Regulation No. 432 of 17 September 2019 "Regulations on the Latvian Building Standard LBN 003-19 'Building Climatology'", which defines the long-term average relative humidity observed at the "Rūjiena" meteorological station as 81% and the average annual air temperature as +6.2 °C.

In accordance with recommendations included in Dutch quantitative risk assessment guidelines[121], modelling has been performed for the following meteorological conditions:

- wind speed 1.5 m/s and atmospheric stability class F – denoted as 1.5 F;
- wind speed 5 m/s and atmospheric stability class D – denoted as 5 D.

The hazard zone of the accident consequences is characterised using the 1% fatality criterion, which reflects the combined effect of exposure intensity and exposure duration. In the Effects

[121] Committee for the Prevention of Disasters, Guidelines for quantitative risk assessment, "Purple Book" CPR 18E, Hague: Committee for the Prevention of Disasters, 1999

software calculation models, the probit functions used for defining the 1% lethality threshold are implemented based on the Dutch "Green Book".

The resulting 1% lethality zone represents the area within which the probability of fatality is calculated based on the expected concentration of toxic gases in the air and exposure time.

The lithium-ion BESS thermal runaway module in the Effects software uses published data to estimate the quantity of toxic gases released during uncontrolled thermal runaway events. For the modelling of the planned "Valka" wind farm BESS accident scenarios, an average gas emission rate with a low conservatism level has been applied. The modelling results are summarised in Table 3.5.5.

Table 3.5.5. Dispersion distances of 1% lethality for toxic gases in case of uncontrolled BESS thermal runaway

Toxic gas	Maximum 1% lethal exposure distance (m)			
	Uncontrolled thermal runaway in one battery module		Uncontrolled thermal runaway in one container	
	1,5F	5D	1,5 F	5 D
CO	-	-	71	9
HCN	28	-	259	43
HF	51	5	502	88
HCL	-	-	35	-
NO_2	26	-	207	33

The results of the performed modelling describe the dispersion characteristics of light gases. The greatest dispersion distances are reached under stable atmospheric conditions at low wind speeds (1.5 F), when there is no active mixing of polluted air masses with clean air masses. Such atmospheric conditions are not considered typical; however, when planning emergency response measures, the possibility of extended consequence distances must also be taken into account.

The results of the modelling indicate that the furthest dispersion distance at the 1% lethality concentration level is expected for hydrogen fluoride (HF). The potentially affected areas for BESS layout alternatives are shown in Figures 3.5.2., 3.5.3., and 3.5.4.

It should be noted that the figures indicate the potentially affected area in all directions around the BESS installation site; however, in the case of an actual accident, the dispersion of pollutants will occur from the specific source location and will be significantly narrower, forming a sector influenced primarily by wind speed and wind direction.

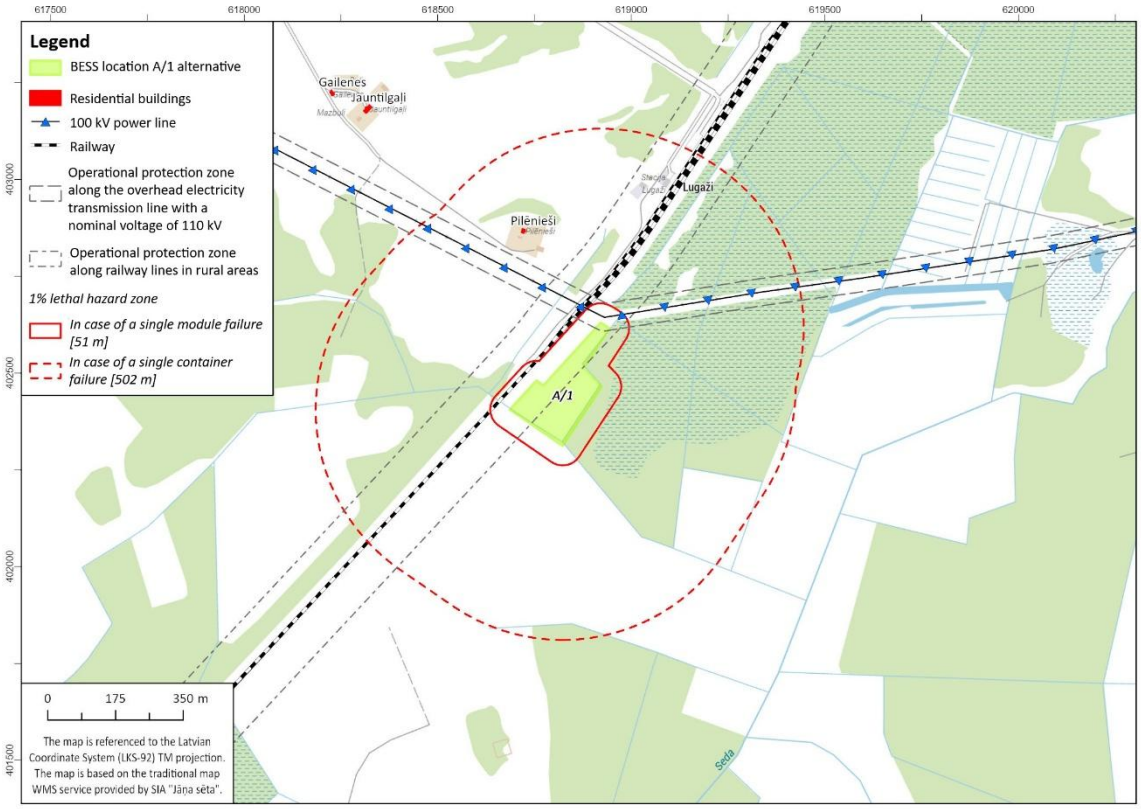


Figure 3.5.2. Potentially affected area for A/1 BESS layout

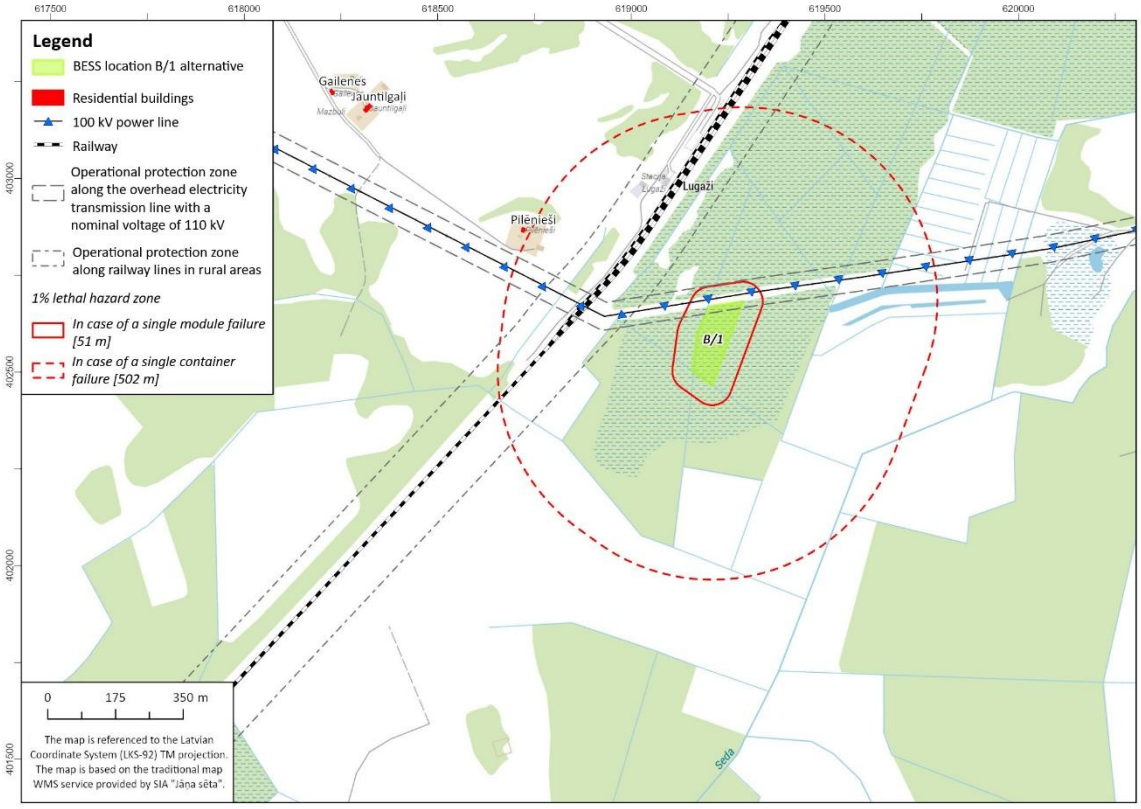


Figure 3.5.3. Potentially affected area for B/1 BESS layout

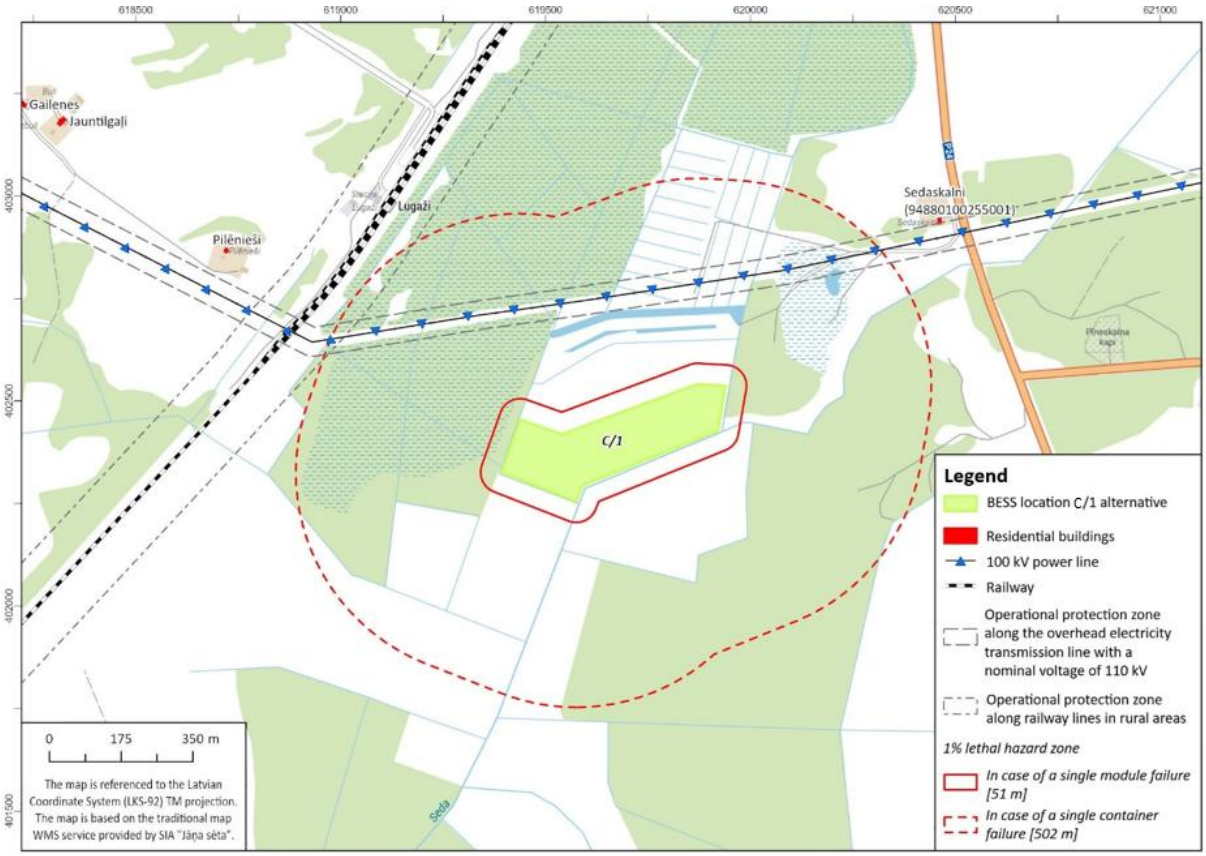


Figure 3.5.4. Potentially affected area for C/1 BESS layout

Given that the Gexcon company has not yet developed a separate fully validated model for the simulation of flammable gas release during lithium-ion BESS thermal runaway events, quantitative modelling of flammable gas formation and the associated thermal radiation impacts in case of fire is not included in this assessment. Based on the analysis provided in Gexcon technical documentation and the Dutch study, which includes calculations performed using the DNV GL software Safeti-NL, the hazard zone for fire resulting from a single module rack with an energy capacity of 80 kWh may reach up to 22 m. The number of individual modules and racks per container in the planned "Valka" wind farm BESS, as well as their total capacity, is not yet defined. However, preliminary information indicates that the system capacity will be higher than that assumed in the above-mentioned Dutch study. Therefore, the results of that study cannot be directly applied to the planned development. Nevertheless, based on these results, it may be assumed that the fire-related hazard zone in the event of a BESS accident could fall within the consequence category of 50 – 100 m used in the risk assessment matrix.

The BESS explosion modelling module is also not directly implemented in the Gexcon AS Effects software, as no dedicated algorithm has yet been developed for modelling flammable gas dispersion during lithium-ion battery thermal runaway events. Therefore, the explosion

consequence assessment is based on the Dutch study, in which the initial assessment was carried out using the methodology described in PGS-2 "Yellow Book" [122].

In the Dutch study, the explosion scenario is defined as a delayed ignition case, in which flammable gases released during thermal runaway accumulate in a confined or semi-confined space prior to ignition.

The calculations in the study assume a worst-case scenario in which flammable gases accumulate throughout the entire BESS container, with a volume of 34,000 litres (gas accumulation volume defined without accounting for equipment and structural obstructions). It is assumed that gases released during thermal runaway do not ignite immediately but accumulate to form an explosive mixture. It is also assumed that no CO_2 is present in the gas mixture, thereby increasing its reactivity and resulting in ignition under the most unfavourable conditions.

The explosion consequence calculations included in the Dutch study indicate that the zone affected by a 10 kPa overpressure may extend up to 57 m. The study notes that this calculated distance is greater than values reported in literature for real and simulated cases[123]; however, it concludes that this approach may be used for preliminary characterisation of BESS container explosion hazards.

In accordance with the information provided in the Dutch study, Table 3.5.6 summarises the probability of BESS accidents for the planned "Valka" wind farm BESS.

Table 3.5.6. Probability of BESS accidents in the "Valka" wind farm

No.	Accident scenario	Accident	Baseline probability of uncontrolled thermal runaway development (per year)	Accident probability (per year) in the "Valka" wind farm
1.	Development of uncontrolled thermal runaway in one battery module	Release of toxic gases	$1{,}07 \times 10^{-6}$	$4{,}10 \times 10^{-4}$
2.	Accident causing uncontrolled thermal runaway in one BESS system container	Release of toxic gases	$1{,}37 \times 10^{-6}$	$1{,}10 \times 10^{-5}$
		Fire		$4{,}93 \times 10^{-5}$
		Explosion		$4{,}93 \times 10^{-5}$

Risk Assessment Using the Hazard Risk Matrix

[122] Methods for calculation of physical effects, "Yellow Book" CPR 14E, Third edition, Hague: Committee for the Prevention of Disasters, 1997.
[123] Barowy, A., et al. 2021. UL 9540A Instalation Level Tests with Outdoor Lithium-ion Energy storage System Mockups un Jin, Y., et al.2021. Explosion hazards study of grid-scale lithium-ion battery energy storage station.

Taking into account the previously described accident scenarios, the expected dispersion distances of their consequences, and the characterisation of their likelihood of occurrence, a hazard risk matrix for the "Valka" wind farm has been developed (see Table 3.5.10.).

The risk level within the matrix is represented using increasing colour intensity within the matrix fields. The more intense the colour of a matrix cell, the more significant the associated hazard risk is considered to be.



Very significant hazard risk
High hazard risk significance
Moderate hazard risk significance
Low hazard risk significance
Very low hazard risk significance

The results of the risk matrix assessment are used for determining priority levels of hazard significance and for planning appropriate risk mitigation measures. The higher the hazard risk significance, the greater the need to focus on measures aimed at preventing accidents or reducing the number of people and sensitive receptors exposed to potential consequences.

The calculated mechanical impact distances for the assessed wind turbine model alternatives differ; however, within the context of the applied hazard assessment, these differences are not considered significant. Therefore, in the risk matrix, the maximum hazard distance is defined as the furthest impact distance among all evaluated wind turbine models.

Table 3.5.5. Wind farm "Valka" hazard risk matrix

		Distance				
		Līdz 50 m	**50-100 m**	**100-200 m**	**200-500 m**	**>500 m**
Probability	≥ 1 per year		Ice fragment throw below the rotor			
	< 1 per year > 1 per 10 years				Ice fragment throw from an operating wind turbine	
	< 1 per 10 years > 1 per 100 years	Small-scale leakage of oil or other operating fluids				
	< 1 per 100 years > 1 per 1000 years				Wind turbine fire	Rotor blade detachment during normal operating rotational speed
	≤ 1 per 1000 years		Fire or explosion in case of BESS accident Release of toxic gases in case of BESS battery module accident	Large-scale leakage of oil and other operating fluids	Failure of wind turbine tower structure	Rotor blade detachment at twice the normal rotational speed Release of toxic gases in case of BESS container accident

3.5.5. Cumulative effects

The "Valka" wind farm is located at a sufficient distance from other planned wind farms in the surrounding area to ensure that, in the event of an accident, wind turbines located within other wind farm areas are not affected. To the south-west, adjacent to the project area, the "Valmiera – Valka" wind farm is located, for which EIA process is currently ongoing, including a detailed layout of 27 wind turbines. The nearest turbine of the "Valmiera – Valka" wind farm is located at a distance of approximately 10 km from the "Valka" wind farm turbines, thereby ensuring that wind turbine accident scenarios and the calculated maximum consequence distances are respected.

No stationary high-risk installations were identified within the project area where, in the event of an accident, cumulative impacts with the wind turbines of the "Valka" wind farm could occur.

The project area is crossed by the railway line "Riga – Lugaži – state border", which is also used for freight transport. The nearest wind turbine is planned at a distance of 307 m from the railway track. According to the Belgian wind turbine risk assessment guidelines, the results indicate that the assessed turbine models should preferably be located at a minimum distance of 636 to 721 m (depending on the turbine model) from stationary high-risk installations. However, the railway line is not classified as a stationary high-risk installation, and the combined probability of a wind turbine accident affecting the railway line while a train is simultaneously passing is considered purely hypothetical. Nevertheless, in the event of an accident at turbines No. 1, No. 5, No. 6, or No. 7, the consequences could potentially also affect the adjacent railway line.

Transport of hazardous substances along the "Riga – Lugaži – state border" railway line is not typical; however, it may be assumed that substances such as petroleum products or liquefied petroleum gas may be transported along this route. Assuming that the intensity of such transport is low, the probability of accidents involving hazardous cargo in the immediate vicinity of the project area is considered to be only hypothetically possible. Nevertheless, in the event of an accident, the type and extent of consequences may be as follows[124]:

1) In the case of an accident involving petroleum products (gasoline, crude oil, diesel fuel), the most typical scenario is a release of hazardous substances into the ground, with or without ignition. In the case of ignition, thermal radiation effects may occur, which may pose a risk to humans and structures within approximately 100 m of the accident location.
2) In the case of an accident involving liquefied petroleum gas, the most severe consequences would be associated with a BLEVE (Boiling Liquid Expanding Vapour Explosion) of a rail tank wagon, which could pose a threat to human life within approximately a 250 m radius, while thermal radiation[125] of 8 kW/m² may extend up to 450 m. However, it should be noted that a BLEVE results in a short-duration exposure within the affected area; therefore, thermal radiation exposure considered hazardous for unprotected technological equipment is not expected to be prolonged, which allows the conclusion that such

[124] The modelling of the propagation of accident consequences was performed using the Effects (version 13.0.1) computer software developed by Gexcon for modelling the impact propagation of accident consequences (SIA "Estonian, Latvian & Lithuanian Environment" licence ID 66730890787096783)
[125] Thermal radiation hazardous to unprotected technological equipment

radiation would not directly compromise the safety of wind turbines. Another impact mechanism in the case of gas release is the possibility of a vapour cloud explosion and associated overpressure effects. Explosion overpressure may affect both human health and life as well as buildings and equipment. In the case of wind turbines, the direct impact of overpressure is reduced due to the turbine tower geometry and the limited surface area exposed to the explosion effects.

According to the Belgian wind turbine risk assessment guideline referred to in this assessment, the distance at which interaction between wind turbines and high-voltage transmission infrastructure must be considered is 3.5 times the rotor diameter. For the largest turbine model planned in the "Valka" wind farm (rotor diameter 175 m), this distance is 612.5 m. Turbine No. 1 is planned at a distance of 575 m from the 110 kV high-voltage power line, which is slightly below the indicated threshold.

A BESS is planned in close proximity to the "Riga – Lugaži – state border" railway line. In the case of location alternatives (A/1 and B/1), an accident involving hazardous chemicals on the railway may pose a risk to BESS safety, as one of the causes of lithium-ion battery thermal runaway is external influence, which may include external thermal radiation or explosion-induced overpressure. However, considering that the occurrence of a railway accident developing in the immediate vicinity of the BESS is purely hypothetical, it may be concluded that such coexistence does not significantly increase the BESS accident risk. Nevertheless, the planned location would justify the development of joint emergency response and cooperation measures with the railway infrastructure operator.

In the case of BESS location alternative A/1, it should be noted that the project will be implemented within the railway operational protection zone, while in the case of BESS location alternative B/1, the project is planned within the protection zone of a 110 kV high-voltage transmission line.

BESS alternative C/1 is located at the greatest distance from the Riga–Lugaži–State Border railway line and the nearby 110 kV high-voltage overhead power line.

3.5.6. Mitigation measures

The performed risk matrix assessment indicates that the highest significance has been identified for accident scenarios associated with ice throw from wind turbines in the event of ice formation. This forms the basis for the implementation of additional mitigation measures to reduce this hazard, where persons or objects exposed to risk may be present within the hazard zone. In such cases, the level of hazard significance can be reduced both by decreasing the probability of occurrence and by reducing the number of exposed persons and receptors.

The furthest dispersion of accident consequences may be caused by scenarios such as mechanical impacts resulting from rotor blade detachment, or the release of toxic gases in the event of a BESS container accident. The hazard significance of such scenarios is assessed as low; however, the associated consequence distances must be taken into account when planning wind turbine placement and determining separation distances to adjacent sensitive objects and areas.

Recommendations for Safety Distances

A conservative but effective measure for reducing the expected hazard impact is the spatial separation of objects through the establishment of safety distances.

Summarising the information provided in the assessment and the calculated direct impact distances of accident consequences, the recommended safety distances around wind turbines are defined based on the turbine model with the largest consequence dispersion potential – Nordex N175 – 6.8 MW – and are as follows:

1) 87.5 m – operational restriction zone, within which the establishment of permanent workplaces is not recommended (based on rotor diameter and direct impact potential within the rotor operating area).
2) 252 m – recommended distance to national main roads (based on calculations performed in accordance with Belgian risk assessment guidelines). This distance is also applicable to main railway lines.
3) 317 m – recommended distance to all types of national and municipal roads, provided that no technical risk mitigation measures are implemented (based on maximum ice throw distance).
4) Where technical mitigation measures are implemented, the distance may be reduced to:
   a) national main roads – 252 m;
   b) municipal roads – 87.5 m.
5) 721 m – restriction zone for locating high-risk installations (based on calculations performed in accordance with Belgian risk assessment guidelines).
6) 800 m – distance to residential and public buildings (based on Cabinet Regulation No. 240).

Safety distances around the wind turbine locations planned within the "Valka" wind farm are shown in Figure 3.5.5.

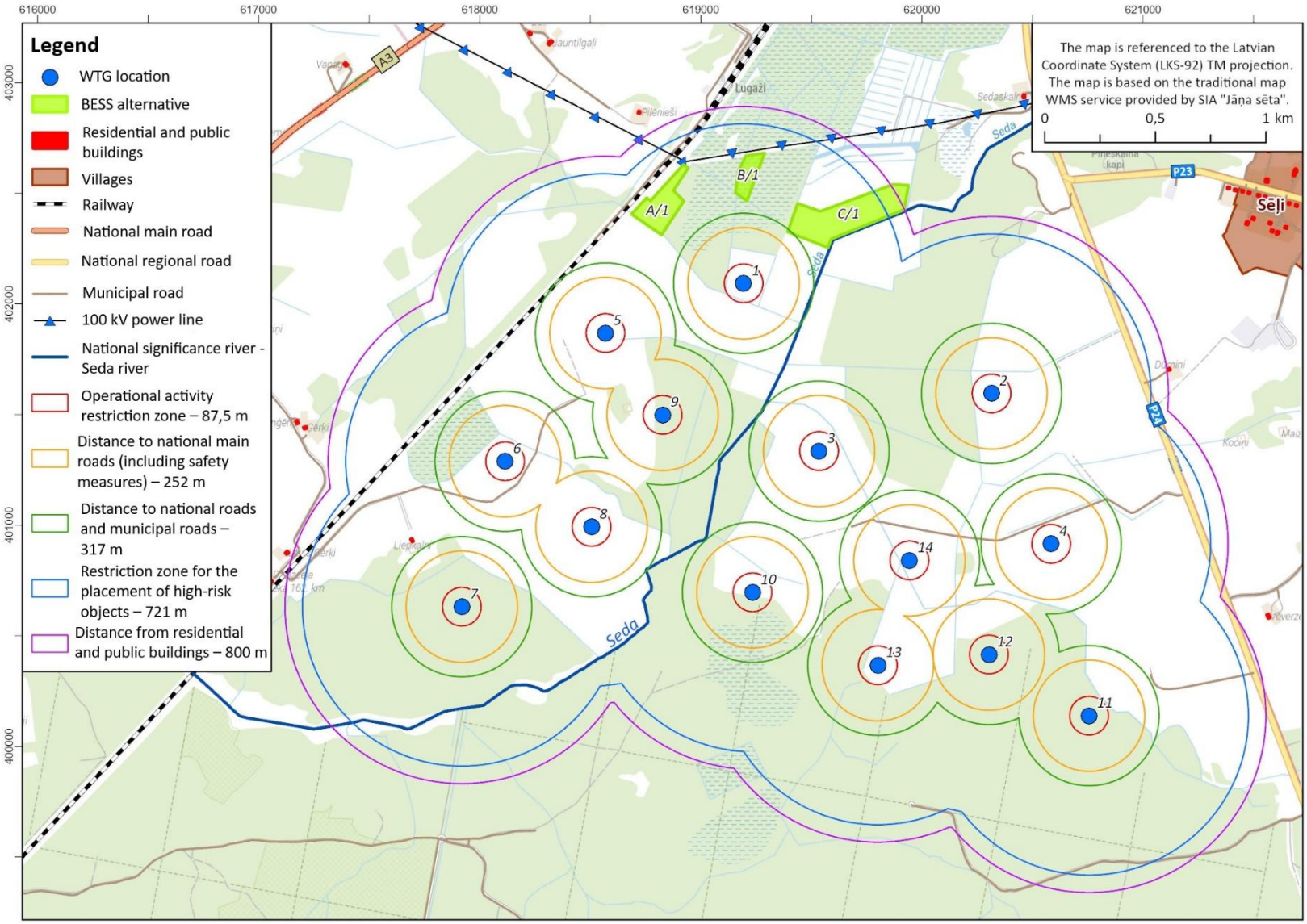


Figure 3.5.5. Safety distances for wind turbines in wind park "Valka"

Ensuring Safety Distances at the "Valka" Wind Farm or Additional Requirements for Hazard Mitigation

The wind turbine models assessed in the EIA process, as well as equivalent products from other manufacturers, are equipped with automatic vibration sensors and safety systems that shut down the turbine when a defined vibration threshold is exceeded. This system can detect both mechanical damage to the installation and ice formation on the rotor. In addition, automatic shutdown of the turbine is also triggered when other operational parameters exceed defined threshold values, for example in the case of rotor overspeed.

Wind turbines are also equipped with smoke detection systems, which activate an automatic safety response leading to shutdown of the installation in the event of detection. Wind turbines are further equipped with lightning protection systems. The assessed turbine models are equipped with ice detection systems, and, where necessary, anti-icing systems can also be installed.

A key factor in maintaining the wind turbine risk level is ensuring proper operation and maintenance, including compliance with operational regimes, execution of manufacturer-recommended periodic maintenance, and performance of necessary repair works.

Based on the information on defined safety distances for the assessed wind turbine models and the analysis of affected areas of safety zones, the authors of the Report consider that there is a basis for establishing the following conditions for implementation of the proposed activity:

1) The total installed capacity of the assessed wind farm, in the case of full build-out using the evaluated wind turbine models and installation of Vestas V172 turbines, may exceed 100 MW or be lower than 100 MW depending on reduction of turbine numbers or selection of one of the four remaining turbine models. If the installed capacity exceeds 100 MW, a civil protection plan must be prepared in accordance with Regulation No. 563 of the Cabinet of Ministers of 19 September 2017 "Procedures for Identifying and Determining Objects of Increased Danger, as well as for the Planning and Implementation of Civil Protection and Disaster Management". If the total installed capacity is below 100 MW, national legislation does not require the preparation of a civil protection plan. However, **considering the location of the wind farm in proximity to sensitive receptors and the relatively high population density in the surrounding area, a civil protection plan or an environmental risk and emergency response management plan equivalent to a civil protection plan must be developed for the "Valka" wind farm. The plan must include procedures for emergency response in accident situations. During the preparation of the plan, consultations shall be carried out with institutions potentially involved in emergency response, property owners (taking into account land use and management conditions), and the municipality. The plan development process must ensure public access and the possibility for the public to submit comments and proposals for improvement. The operation of the wind farm may not commence prior to completion of the plan.**

2) As previously indicated in the Report, the proposed location of wind turbines No. 6 and 7 in relation to the residential building "Liepkalni" is not permissible under applicable regulatory requirements, namely that the wind turbines are planned at a distance of less than 800 m from a residential building registered in portal of State Land Service of Immovable Property. Construction of both wind turbines is only permissible if the residential building "Liepkalni" is no longer used for residential purposes and is removed from portal of State Land Service.
3) In accordance with the recommendations of the Belgian risk assessment guidelines, no above-ground high-risk installations are located within the defined 721 m safety distance from the planned wind turbine locations. Assessment of the applicable municipal spatial plan indicates that the development of high-risk installations in the vicinity of the wind farm may be possible in the future. Although this condition is not directly applicable to the "Valka" wind farm, the authors of the Report consider that, in further territorial development and planning of high-risk installations in the future, the hazard potential generated by the turbines should be taken into account.
4) It has been determined that the operation of the planned wind farm will not pose a risk to national roads; however, municipal roads are located within the ice throw zone. Therefore, for WTGs No. 4, 6, and 14, when located in their planned positions, there is a basis to require implementation of technical measures for environmental risk mitigation. **Wind turbines No. 4, 6, and 14 must be equipped with ice detection or anti-icing systems, as well as turbine shutdown systems in the event of icing conditions.**
5) The railway line Riga – Lugaži – state border is considered an infrastructure element equivalent in significance to national main roads. The planned location of wind turbine No. 5 is 307 m from the railway line, which means that in the case of use of the Nordex N175-6.8 MW turbine model, there is a risk of ice throw affecting railway infrastructure. For risk mitigation, if the Nordex N175 model is selected, it is recommended to increase the distance of the turbine location from the railway line by at least 7 m. **Regardless of the selected turbine model, wind turbine No. 5 must also be equipped with ice detection or anti-icing systems and turbine shutdown systems in icing conditions.**
6) The maximum horizontal distance from the tower to the tip of the rotor blade (for the Nordex N175-6.8 MW model) is 87.5 m, and this distance is recommended to be defined as a zone with restricted economic activity. Although human movement and economic activities within this zone do not pose a direct and continuous risk to human health or life, the establishment of permanent workplaces within this area is not recommended. At the same time, it is essential to ensure appropriate information regarding operational risks, particularly in cases where icing conditions may occur, and in such circumstances restricted access to the wind turbine must be ensured. Personnel responsible for wind turbine maintenance must be trained in accordance with occupational health and safety requirements, and based on workplace risk assessment results, appropriate personal protective equipment must be provided to ensure worker safety and health protection during operational and maintenance activities.
7) Drainage ditches and watercourses are located in the immediate vicinity of the wind turbines; therefore, in the event of an accident, contamination of surface waters is possible. The tallest turbine tower among the assessed models is 166 m. The nearest

national watercourse – the Seda River – is located at a distance greater than 166 m from the planned turbine locations. **However, a system of drainage ditches exists within the project area, which justifies the requirement that wind turbine operation and maintenance documentation must include procedures for emergency response in the event of oil leakage or turbine failure. These procedures shall define measures for limiting the spread of oil leakage and for the collection of spilled oil. The project developer must ensure the availability of human resources capable of responding to such incidents during the operational phase, as well as appropriate equipment and technical means enabling access to the accident site and implementation of spill containment and recovery measures.**

8) The probability of accidents in the BESS system is not characterised as high; however, in location of A/1 and B/1 alternatives, in the event of a BESS container accident, under unfavourable atmospheric conditions, the hazard zone may affect Lugaži railway station and the residential building "Pilēnieši". The modelling undertaken indicates that the separation distance is sufficient to ensure that, in the event of a BESS accident under Alternative C/1, the direct consequences would not affect buildings with residential or public functions. Nevertheless, all three location alternatives are situated within the direct impact zone of potential wind turbine accident scenarios. In the case of Alternative A/1, the safety of the BESS could also be compromised by a railway accident occurring on the Riga–Lugaži–State Border railway line. For all three assessed location alternatives, **the civil protection plan of the facility must include measures for warning the affected area in the event of a BESS accident and appropriate measures for rescue of affected persons, as well as suitable solutions for protecting the BESS from external impacts. The number of people exposed to BESS accident risk, as well as external impact risk, may be reduced by considering alternative BESS locations.**
9) Considering that the wind farm is planned to be constructed on forest land and in its immediate vicinity, **during the detailed design stage of the wind farm, in consultation with the State Forest Service, the State Fire and Rescue Service, Latvia's State Forests, and other forest owners, a fire safety plan must be developed, including the design and construction of necessary infrastructure. For areas where the required infrastructure is planned, approval from the Nature Conservation Agency must be obtained.**
10) Physical security of wind turbines must ensure controlled access to the installation and implement measures preventing unauthorised access to the turbine interior.

3.5.7. Assessment of alternatives

EIA Report evaluates alternative wind turbine technologies. Taking into account the information provided by wind turbine manufacturers regarding technical solutions and available technologies for accident risk and consequence mitigation, all assessed technological alternatives are considered equivalent. At the same time, it should be noted that potential impact zones – i.e., high-risk areas – are directly dependent on the size of the wind turbine. In the context of environmental risk, the construction of wind turbines with lower tower heights and smaller rotor diameters would be considered a more favourable solution.

In the EIA Report each turbine location has also been assessed as an alternative. A more detailed overview of the assessed location alternatives is provided in Chapter 6 of the Report.

4. PARTICIPATION OF THE PUBLIC

The initial public consultation of the proposed activity took place from 27 August 2024 to 16 September 2024. Notices regarding the initial public consultation were published on 27 August 2024 in the newspapers "Ziemeļlatvija" and "Valkas Novada Vēstis", as well as on the websites of the Valka Municipality, SIA "Estonian, Latvian & Lithuanian Environment", and the Energy and Environment Agency. Individual notification regarding the proposed activity was provided to those landowners whose properties are located within or adjacent to the wind farm study area.

The initial public consultation meeting was held on 5 September 2024 at the Valka City Cultural Centre (Emīla Dārziņa street 8, Valka, Valka Municipality, LV-4701). A summary of the initial public consultation is provided in original EIA Report (Appendix 14).

Project developer organised three informational working group meetings during the preparation of the Report at the Valka City Cultural Centre (Emīla Dārziņa street 8, Valka, Valka Municipality, LV-4701). The first working group meeting took place on 21 August 2025, where residents were informed about the justification for the selection of the "Valka" wind farm study area and the technical parameters of the wind turbines, including their height, rotor dimensions, and potential manufacturers. The second working group meeting, held on 18 September 2025, provided information on natural values, including results of bird, bat, and habitat surveys carried out within the EIA process. The third working group meeting, held on 26 September 2025, was conducted by specialists from SIA "Estonian, Latvian & Lithuanian Environment", who presented information to residents on the shadow flicker effect, noise emissions, and environmental risks.

In addition to the previously organised working group meetings, an additional meeting was held with residents of the Piparciems area of Valka on 25 November 2025 at the premises of the Valka Regional Museum. During the three working group meetings and the additional Piparciems meeting, residents actively participated in discussions and submitted proposals, which are summarised in original EIA Report (Appendix 15).

The public consultation of the EIA Report took place from 19 May 2026 to 19 June 2026. The public consultation meeting was held on 26 May at 17:00 at the Valka City Cultural Centre (Emīla Dārziņa street 8, Valka, Valka Municipality, LV-4701). The EIA Report is also transmitted to the cross-border consultation process.

5. LIMITING FACTORS FOR THE INTENDED ACTIVITIES AND SOLUTIONS TO MITIGATE ENVIRONMENTAL IMPACTS

5.1. FACTORS LIMITNG THE INTENDED ACTIVITY

During the preparation of the EIA Report, limiting factors for the intended activity have been identified, which affect the feasibility of implementing the intended activity at the specifically selected locations.

Residential buildings

According to Regulation No. 240 of the Cabinet of Ministers of 30 April 2013 "General Regulations for the Planning, Use and Building of the Territory", construction of wind turbines is not permitted

closer than 800 m from residential and public buildings. According to the information available in portal of State Land Service regarding the main use type of buildings, construction of wind turbines No. 6 and 7 is restricted, as they are located less than 800 m from the residential building "Liepkalni" (cadastral designation of residential building 94880090010001). Construction of the above-mentioned wind turbines is permissible if an agreement is reached regarding demolition of the uninhabited building and deletion of the relevant records from the cadastre and the Land Register.

Low-frequency noise

Compliance with the low-frequency noise limit value for residential areas cannot be ensured by selecting the technological alternative Vestas V172 – 7.2 MW with standard blades.

Environmental risks and emergency situations

The location of wind turbine No. 5 is planned at a distance of 307 m from the railway line "Rīga – Lugaži – State Border". Therefore, if the technological alternative Nordex N175 – 6.8 MW is selected, there is a risk of hazard to railway infrastructure caused by falling ice. In the case of selecting this model, the wind turbine location must be moved further away, or a model must be selected for which the maximum ice throw distance is less than 307 m.

Wind turbine blade overhang restrictions

In its letter submitted during the public consultation process, JSC Latvian State Forests states that Wind Turbines No. 11, 12, 13 and 14 have blade overhang extending over land parcels under the ownership of the Ministry of Agriculture and managed by Latvian State Forests (cadastral designation 94880130056 and 94880130012). Where such blade overhang occurs, an easement agreement with Latvian State Forests must be concluded for the area affected by the blade overhang. In addition, technical specifications must be requested from Latvian State Forests through the Building Information System. At present, Latvian State Forests reserves the right not to issue the required technical specifications and does not consent to the proposed blade overhang.

5.2. POTENTIAL SUBSTANTIAL IMPACTS AND MITIGATION SOLUTIONS

This section of the Report summarises information on potential substantial or significant impacts and impact mitigation measures that need to be implemented or are recommended during implementation of the intended activity. Environmental impact mitigation measures are classified into three groups:

1) Measures required to comply with requirements set out in legislation, guidelines or by institutions, measures for public safety, as well as measures to prevent, reduce or compensate for substantial or significant impacts. These measures should be considered as measures without which implementation of the intended activity would not be permissible.
2) Recommendations for impact mitigation based on expert assessment, but not established in legislation or guidelines.
3) Proposals submitted by residents during the EIA process, including during the initial public consultation and information meetings.

Information on potential substantial impacts and associated mitigation measures is summarised in Table 5.2.2 of the Report, distinguishing between measures applicable during the construction period and measures applicable during the operational period of the wind turbines. The table also provides an assessment of the significance of residual impacts, using the criteria included in Table 5.2.1.

Table 5.2.1. Impact significance assessment scale

Impact	Description
Insignificant impact	No qualitatively or quantitatively measurable changes in the state of the environment are expected, or the potential event has a low level of risk. Such impacts are identified in the text of the Report but are not assessed in this section.
Minor unfavourable impact	Qualitatively or quantitatively measurable small and/or temporary changes are expected in the level of resource consumption, in the state of the environment or in the context of certain socioeconomic factors, which do not overall prevent the achievement of the target values or threshold values for environmental quality set out in legislation.
Minor favourable impact	Qualitatively or quantitatively measurable small and/or temporary changes are expected in the level of resource consumption, in the state of the environment or in the context of certain socio-economic factors, which have an overall favourable effect on the environment and/or society.
Significant unfavourable impact	Qualitatively or quantitatively measurable changes of significant magnitude or scale are expected in the level of resource consumption, in the state of the environment or in the context of certain socio-economic factors, which may result in the non-achievement of the target values or guidelines for environmental quality set out in legislation or guidelines.
Significant favourable impact	The intended activity will result in significant quantitatively or qualitatively measurable improvements in the level of resource consumption, in the quality of the environment or in the context of certain socio-economic factors compared to the baseline situation.
Substantial unfavourable impact	Environmental quality limit values set out in legislation in the field of the environment will be violated. Such an impact should be considered as an exclusionary factor.
Substantial favourable impact	The intended activity will result in substantial quantitatively or qualitatively measurable improvements in the level of resource consumption, in the quality of the environment or in the context of certain socio-economic factors. The environmental quality target values set out in legislation and guidelines will be met.

The initiator of the intended activity has familiarised itself with the mandatory impact mitigation measures identified by experts and institutions, as well as measures arising from legislative requirements or institutional conditions. The initiator intends to fully implement the mandatory measures and assess the feasibility of implementing recommended measures during implementation of the intended activity. With the implementation of environmental impact mitigation measures, it is not expected that construction or operation of the planned wind farm will result in significant or substantial impacts.

Table 5.2.2. Measures for mitigation or prevention of environmental impacts and assessment of residual impacts

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
Noise	3.1.	Before commissioning of the wind farm, environmental noise measurements shall be carried out in the residential areas located closest to the wind farm and substation.	M	Construction stage, including repeated impact assessment if necessary	All	Minor unfavourable impact
		During preparation of the substation construction design, noise calculations for the substation and BESS shall be performed and solutions shall be provided where necessary.	M	Construction stage, including repeated impact assessment if necessary	All	Minor unfavourable impact
		The quietest possible wind turbine model shall be constructed, without exceeding the WHO recommended daily average noise limit value.	R	Construction stage, including repeated impact assessment if necessary	All	Minor unfavourable impact
Low-frequency noise		The total low-frequency noise level generated by wind turbines inside residential buildings shall not exceed 20 dB at wind speeds of 6 m/s and 8 m/s at a height of 10 m above ground level.	M	Construction stage, including repeated impact assessment if necessary	All	Minor unfavourable impact
Flicker	3.2.	Operation of turbines causing shadow flicker shall be stopped during periods when the respective turbine may cause shadow flicker in residential areas, ensuring compliance with the impact target values specified in the Report.	M	Construction stage – repeated shadow flicker impact duration calculation shall be performed Operation stage – implemented continuously	All	Minor unfavourable impact
		During operation of the wind farm, it is recommended to reduce shadow flicker at residential buildings below the specified limit values	R	Construction stage – repeated shadow flicker impact duration calculation shall be	All	Minor unfavourable impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		or eliminate it completely by providing for turbine shutdown during periods when shadow flicker formation is possible.		performed Operation stage – implemented continuously		
Impact on plants and habitats	3.3.3.	If during preparation of the construction design it becomes necessary to redesign the location of infrastructure objects related to the wind farm, an expert opinion shall be obtained and coordinated with the Nature Conservation Agency.	M	Construction stage	All	Minor unfavourable impact
		If it is determined that implementation of the designed solutions will destroy habitats of European importance or that construction will create a risk of deterioration of their quality, a compensation measures plan shall be prepared and coordinated with the Nature Conservation Agency.	M	Construction stage	All	Minor unfavourable impact
		At the Seda River crossing, free water flow shall be maintained within the existing watercourse width, barriers or steps shall not be created, and bank vegetation shall be restored after completion of works.	M	Construction stage	Access roads	Insignificant impact
		By implementing mitigation measures, negative impacts on changes in the hydrological regime and microclimate of habitats can be avoided.	M	Construction stage	Wind turbine No. 11, substation alternative B, BESS alternative B/1	Insignificant impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		Construction closer than 10 m from the tree crown projection shall be coordinated with the Nature Conservation Agency, including implementation of measures preventing potential negative impacts.	M	Construction stage	Wind turbines No. 6, 11	Insignificant impact
Impact on bat populations	3.3.4.	Ensure shutdown or prevention of operation of wind turbines in accordance with the conditions specified in Section 3.3.4.4 of the Report.	M	Operation stage	All	Minor unfavourable impact
		Bat monitoring shall be ensured during the first, second and third years after commencement of wind turbine operation.	M	Operation stage	All	Minor unfavourable impact
Impact on ornithofauna	3.3.5.	The lower part of wind turbine towers at the height of 1–2 tower sections shall be painted with a gradual transition from a dark shade to a light shade, if such a solution is not opposed by Valka Municipality in the context of landscape protection. The selected colouring solution shall be coordinated with Valka Municipality and the Nature Conservation Agency.	R	Construction stage	All	Minor unfavourable impact
		Deforestation works at wind turbine construction sites and associated infrastructure locations shall be carried out outside the breeding season of protected bird species.	M	Construction stage	All	Minor unfavourable impact
		Equipment/systems for automatic bird flight detection, recognition of flying birds and automatic wind turbine shutdown or significant reduction of rotor speed shall be installed at the wind farm when	M	Operation stage	All	Minor unfavourable impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		a collision with sensitive bird species is predicted (species list provided in Section 3.3.5).				
		The use of equipment/systems that deter birds from wind turbines is prohibited within the wind farm.	M	Operation stage	All	Minor unfavourable impact
		The maximum noise emission level of installed wind turbines shall not exceed 107.8 dB(A).	M	Operation stage	All	Minor unfavourable impact
		If the number of planned wind turbines is reduced, from the perspective of bird protection priority should be given to removing those wind turbines that cause the highest impact on areas important for birds according to the total impact level specified in Table 3.3.5.1.	M	Construction stage	All	Minor unfavourable impact
		The project proponent, in cooperation with sector experts and the Nature Conservation Agency, shall carry out monitoring to assess the actual impact on ornithofauna.	M	Construction and operation stages	All	Minor unfavourable impact
Landscape and visual impact	3.4.	To reduce visual impacts, steel tower structures are recommended as the preferred solution. If prefabricated concrete towers are selected, they should be painted in a tone matching steel towers	R	Construction stage	All	Minor unfavourable impact
		If the turbine layout is changed or construction of certain turbines is abandoned, a landscape expert assessment shall be obtained regarding the equivalence of the modified proposal with the	M	Construction stage	All	Minor unfavourable impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		landscape design principles and mitigation solutions defined in this assessment.				
Cultural heritage values	3.5.	Before commencement of construction works, wind turbine and associated infrastructure construction sites shall be surveyed by a qualified specialist – an archaeologist. A procedure defining measures and conditions for actions in cases where historical evidence (including burials) is discovered during construction works, including necessary reconstruction and strengthening of access roads, shall be developed and included in the construction design.	M	Construction stage	All	Minor unfavourable impact
		If explosive objects or human remains are discovered, works shall be immediately stopped and the police shall be contacted.	M	Construction stage	All	Minor unfavourable impact
		If remains of fallen soldiers are discovered during earthworks, in accordance with the principles of the intergovernmental agreements between Latvia – Germany (1997) and Latvia – Russia (2007) regarding the status of war victim burials in the territory of Latvia, earthworks at the respective location shall be suspended. The discovery of human remains shall be immediately reported to the police and the organisation "Brothers' Cemetery Committee" (bkkomiteja@apollo.lv). The contractor shall ensure the exhumation of soldiers' remains under expert supervision. Exhumation of soldiers'	M	Construction stage	All	Minor unfavourable impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		remains shall be carried out in accordance with instructions provided by the "Brothers' Cemetery Committee".				
		Transport routes for wind turbine components shall be developed taking into account the requirements for transportation of heavy and oversized cargo.	M	Construction stage	All	Minor unfavourable impact
Air quality	3.6.	Register all received complaints regarding dust generation and/or air quality, identify their causes and implement corrective actions. Register all emergency situations causing increased dust generation and/or air pollution and the actions taken to prevent impacts. Carry out regular construction site inspections and assess implementation of dust suppression measures. Identify and ensure sufficient water volumes for wetting construction sites and transport routes. Avoid engine idling – switch off engines when activities are not being performed. Ensure road surface wetting or treatment with dust suppression material if complaints regarding dust disturbance are received from residents. Prioritise the use of paved roads for transport purposes; use gravel road sections only where justified, including cases where alternative transport routes are unavailable.	R	Construction stage	All wind turbines, transport routes	Insignificant impact
Environmental risks and emergency	3.10.	Develop an environmental risk and accident consequence management plan equivalent to a civil protection plan. The plan shall include BESS system	M	Construction and operation stages	All	Insignificant impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
situations		safety requirements and measures for emergency situations.				
		Inform the operator of the procedures and actions required to reduce occupational environment risks.	M	Construction and operation stages	All	Insignificant impact
		Automatic process control and monitoring.	M	Operation stage	All	Insignificant impact
		When planning emergency response measures, appropriate actions and resources shall be provided to limit the spread of chemical substances and collect them from the water surface.	M	Construction and operation stages	All	Insignificant impact
		Wind turbine fire safety documentation shall include procedures for action in the event of fire, defining measures for operational response after fire detection.	M	Construction and operation stages	All	Insignificant impact
		Wind turbines shall be equipped with anti-icing systems or ice detection systems ensuring shutdown of the wind turbine operation if icing is detected.	M	Construction and operation stages	Wind turbines No. 4, 5, 6, 14	Minor unfavourable impact
		Warning signs regarding the possibility of falling ice fragments shall be installed, or warning light signals connected to the ice detection system and combined with warning signs shall be installed.	R	Construction stage	Internal wind farm roads	Minor unfavourable impact
		Access roads shall be closed using physical barriers during icing conditions.	R	Construction stage	Internal wind farm roads	Minor unfavourable impact
		Manual restart of wind turbine operation after	R	Construction stage	Internal wind	Insignificant

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		accidents or high-risk situations shall be performed in the presence of an equipment operator.			farm roads	impact
		Access to wind turbines shall be controlled and measures shall be ensured to prevent unauthorised persons from entering wind turbine facilities.	M	Construction and operation stages	All	Insignificant impact
Soil and groundwater contamination	3.8.	Assessment of soil contamination level shall be carried out before dismantling construction areas and making a decision regarding further use of removed soil.	R	Construction stage	All	Insignificant impact
Impact on drainage systems	2.3.	Develop a drainage system reconstruction project.	M	Construction stage	All	Insignificant impact
Communication systems	3.11.	Obtain approvals from the Ministry of Defence, Civil Aviation Agency and SJSC "Latvijas gaisa satiksme".	M	Construction stage	All	Insignificant impact
		Before implementation of the activities planned in the project, measurements of the electromagnetic field intensity of broadcasting signals shall be carried out.	M	Construction stage	All	Insignificant impact
		After implementation of the activities planned in the project, repeated measurements of the electromagnetic field intensity of broadcasting signals shall be carried out.	M	Construction stage	All	Insignificant impact
		Solutions shall be provided to ensure restoration of broadcasting volume, coverage and service provision capacity to the required extent and quality if these are reduced due to project	M	Construction stage	All	Insignificant impact

Aspect	Reference	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	Wind turbine number to which the measure applies	Residual impacts after implementation
		implementation.				
		The project developer shall obtain Latvia State Radio and Television Centre technical requirements for preparation of the wind farm construction design and performance of construction works.	M	Construction stage	All	Insignificant impact

6. COMPARISON OF ALTERNATIVES OF THE PROPOSED ACTIVITY

During the EIA process, one wind turbine layout solution was analysed in detail; however, in the subsequent assessment, each wind turbine included in this solution is also considered as an individual alternative, thus comparing and prioritising certain wind turbines within the same layout. Five technological alternatives were assessed in detail.

This chapter provides a detailed analysis of the main aspects and impact factors used for the comparison of layout and technological alternatives. The chapter summarises conclusions that allow a justified assessment of the environmental impact of each alternative and provides a basis for selecting a specific alternative.

6.1. ASSESSMENT OF SITE ALTERNATIVES

The EIA was initiated based on the initially proposed layout solution with the maximum capacity of the wind farm study area, assuming the construction of 15 wind turbines. During the refinement and determination of the initial layout, priority was given to assessments provided by nature experts, as expert opinions may significantly influence wind turbine layout solutions. The most important factors affecting the layout were the assessments provided by ornithofauna, species and habitat experts, which were actively provided from the beginning of the EIA process, resulting in the development of up to 23 wind turbine layout alternatives. As a result, 14 wind turbines have been assessed in detail within the EIA Report.

Although EIA Reports usually analyse several wind turbine layout alternatives, within this Report one basic wind turbine layout solution has been assessed in detail, where each wind turbine included in this layout is considered as a separate alternative, thereby allowing certain wind turbines to be prioritised over others within the same layout. This approach was selected considering that not all wind turbines assessed in the Report may be implemented. Therefore, mutual comparison of wind turbines serves as a basis for identifying the "best" and "worst" solutions and for making decisions regarding their construction feasibility and environmental impact.

Several criteria have been established for mutual comparison of wind turbines (see Table 6.1), which are divided into the following categories: technical parameters; impact on society; impact on natural values; visual impact and cultural heritage. Considering that these categories are not directly comparable by their nature and that the number of criteria differs between categories, a separate wind turbine priority list has been developed for each category, reflecting the most favourable solutions within the respective category.

Table 6.1. Criteria for comparison of wind turbine alternatives

No.	Criteria
TECHNICAL PARAMETERS	
1	Distance of the wind turbine to the newly constructed substation, km (substation alternative A)
2	Distance of the wind turbine to the newly constructed substation, km (substation alternative B)

No.	Criteria
3	Distance of the wind turbine to the newly constructed substation, km (substation alternative A, infrastructure alternative A)
4	Distance of the wind turbine to the newly constructed substation, km (substation alternative B, infrastructure alternative B)
5	Length of newly constructed access roads to the wind turbine, km (infrastructure alternative A)
6	Length of newly constructed access roads to the wind turbine, km (infrastructure alternative B)
7	Approximate deforestation area (wind turbine and construction area), ha (infrastructure alternative A)
8	Approximate deforestation area (wind turbine and construction area), ha (infrastructure alternative B)
9	Predicted electricity production of the wind turbine (wake loss) for technological alternative Vestas V172, %
10	Wind turbine shutdown time required to ensure compliance with shadow flicker impact duration limit values, min
IMPACT ON SOCIETY	
11	Distance of the wind turbine to the nearest residential or public building (excluding buildings located within 800 m), m
12	Number of residential and public buildings located within a 2 km zone around the wind turbine
13	Number of residential areas where the noise indicator LAeq,T level is between 30 and 40 dB(A) (excluding Liepkalni)
15	Number of residential buildings where, using the wind turbine model with the highest low-frequency noise emissions, the noise level reaches 10–20 dB(A) at wind speed of 8 m/s (excluding Liepkalni)
16	Total shadow flicker impact duration for each wind turbine (without mitigation measures), worst technological alternative for Siemens Gamesa model, worst-case scenario, h
17	Impact duration after implementation of shadow flicker mitigation measures, min
18	Number of residential buildings affected by shadow flicker from the respective wind turbine (worst technological alternative for Siemens Gamesa model), total
19	Distance of the wind turbine to roads, km
20	Distance of the wind turbine to railway lines, km
21	Number of cadastral units within 800 m of the wind turbine
22	Whether the wind turbine is located in a forest area (wind turbine risk regarding fire spread)
IMPACT ON NATURAL VALUES	
23	Negative impact on specially protected species, habitats and species locations
24	Collision and mortality risk for bats
25	Impact of the wind turbine on habitats suitable for birds
26	Distance of the wind turbine to micro-reserves and Natura 2000 sites
27	Location of the wind turbine and construction area within arable land, forest or grassland areas

No.	Criteria
28	Approximate deforestation area (wind turbine and construction area), ha (infrastructure alternative A)
29	Approximate deforestation area (wind turbine and construction area), ha (infrastructure alternative B)
IMPACT ON LANDSCAPE AND CULTURAL HERITAGE	
30	Distance of the wind turbine to Valka city, km
31	Distance of the wind turbine to the nearest village Sēļi, km
32	Distance of the wind turbine to the PLA "Ziemeļgauja", km
33	Theoretical visibility of wind turbines from four cultural heritage monuments in the surrounding area

When analysing each criterion category separately, significant differences between wind turbines can be observed (see Table 6.2.). From the perspective of technical parameters, the most favourable solutions are those located relatively closer to the planned substation, as their construction requires fewer resources, including shorter access roads and infrastructure. In this context, the lowest impact value is demonstrated by wind turbine No. 5, while the highest impact was identified for wind turbine No. 4.

From the perspective of impact on society, better results are demonstrated by wind turbines located further away from roads and forest areas (considering environmental risk aspects), as well as at a sufficient distance from residential buildings and populated areas. Examples include wind turbines No. 13 and 10, which received the lowest impact assessments, whereas wind turbines No. 2 and No. 4, located closer to populated areas, including Sēļi village, demonstrate a higher impact on society.

From the perspective of natural values, a trend can be observed – lower impacts are associated with wind turbines planned on agricultural land and not significantly affecting important natural areas (wind turbines No. 4, 5 and 6). In contrast, wind turbines located within or near forest complexes cause greater impacts on natural values, which is reflected in higher assessment values (for example, wind turbines No. 7 and 11).

From the perspective of landscape and cultural heritage, more favourable solutions are those located further away from Valka city and Sēļi village, thereby reducing visual impacts on populated areas. The assessment also considers wind turbine visibility from cultural heritage monuments located in the surrounding area. In this category, the lowest impact is demonstrated by wind turbine No. 7, while a higher impact value was assigned to wind turbine No. 2.

Overall, it can be concluded that there is no single universally best wind turbine layout solution across all categories. Although each category identifies different wind turbines as the most suitable alternatives, the final decision-maker regarding acceptance of the intended activity must define priorities – for example, whether greater importance should be given to preservation of natural values or reduction of impacts on society. An illustrative example is the location of wind turbines within forest complexes – such a solution may cause greater impacts on natural values;

however, at the same time, these wind turbines are often located further away from populated areas, thereby reducing impacts on residents.

*Table 6.2. Summary of results of wind turbine alternative assessment**

Groups of criteria				
Wind turbine No.	**Technical parameters**	**Impact on society**	**Impact on natural values**	**Impact on landscape and cultural heritage**
1	18	37	13	16
2	19	42	13	18
3	17	24	12	16
4	31	41	10	17
5	14	37	10	13
6	18	36	10	13
7	27	37	15	10
8	16	26	11	13
9	24	30	12	14
10	29	19	14	13
11	29	27	15	15
12	28	25	14	16
13	22	15	14	15
14	24	30	12	16

**a lower numerical value indicates a more favourable (lower) impact, whereas a higher value indicates a higher impact*

6.2. ASSESSMENT OF CABLELINE AND BESS ALTERNATIVES

The comparison of the substation location alternatives carried out prior to the public consultation included two substation alternatives. However, following the public consultation and based on the recommendations of the habitat experts and the Municipality of Valka, a third substation alternative (alternative C) was additionally assessed.

With regard to environmental noise, the comparison of the two initial alternatives identified alternative B as the preferred option, as it is located approximately 200 metres further from residential properties than alternative A. Following the inclusion of the third substation alternative (alternative C) in the assessment, it was concluded that, from the environmental noise perspective, alternative C is more favourable than alternative B, as it is located at an even greater distance from residential buildings. At the same time, it should be noted that only the proposed land parcel for the substation has been identified at this stage, whereas the exact location of the substation within the land parcel has not yet been determined.

Following the public consultation of the EIA Report, the habitat experts recommended the assessment of an additional substation location alternative (alternative C). The assessment concluded that, from the perspective of conserving natural values, alternative C is the most favourable option, as its implementation would not result in adverse effects on protected

habitats, sites of specially protected species or other natural values. Consequently, unlike alternative B, for which there is a potential impact on the microclimate of the adjacent habitat due to drainage, alternative C does not require such mitigation measures.

The BESS location alternatives were assessed from the perspective of environmental risks and accident scenarios. Although the likelihood of an accident involving the BESS is not considered to be high, the proposed locations under alternatives A/1 and B/1 are such that, in the event of an accident involving a BESS container and under unfavourable meteorological conditions, the accident impact zone could extend to the Lugaži railway station and the residential property Pilēnieši. By contrast, alternative C/1 is located furthest from the Lugaži railway station and the nearest residential buildings, and the modelling undertaken indicates that, under this layout, the direct consequences of a BESS accident would not affect buildings with residential or public functions. Therefore, from the perspective of accident risk and civil protection, alternative C/1 is the preferred location alternative.

6.3. ASSESSMENT OF TECHNOLOGICAL ALTERNATIVES

The assessment of technological alternatives was carried out only with regard to physical impacts, namely noise generated by wind turbines and the shadow flicker effect, which are related to impacts on human health. From the perspective of natural values, technological alternatives are considered equivalent, with only insignificant differences. Therefore, in terms of biodiversity conservation, the decisive factor is the wind turbine layout rather than any specific technological alternative.

Environmental noise

The assessment compared nine technological alternatives, including both models with standard blades and models with aerodynamically improved blades. Based on the calculation results, it was concluded that the highest noise emissions would be generated by Vestas V172 – 7.2 MW with standard blades, while the lowest noise emissions would be generated by the Vestas V162 model with aerodynamically improved blades. When assessing the technological alternatives analysed within the EIA, it was concluded that all alternatives comply with the requirements of Latvian legislation. Compliance with the WHO recommended limit value could be ensured if the following wind turbine models are constructed:

- Nordex N163 – 7.0 MW with aerodynamically improved blades;
- Vestas V172 – 7.2 MW with aerodynamically improved blades;
- Siemens Gamesa SG170 – 7.0 MW with aerodynamically improved blades;
- Vestas V162 – 7.2 MW with both standard and aerodynamically improved blades.

Low-frequency noise

As a result of operation of the assessed wind turbine models, exceedance of the 20 dB(A) low-frequency noise limit value is not expected, except for one technological alternative – Vestas V172 – 7.2 MW with standard blades. Selection of this alternative could result in exceedance of the 20 dB(A) limit value at seven residential buildings at wind speeds of 6 and/or 8 m/s. The lowest low-

frequency noise level was calculated for the Siemens Gamesa SG170 – 7.0 MW model with standard blades.

Shadow flicker effect

The assessment compared five technological alternatives. When analysing the assessed technological alternatives, it was determined that both according to the worst-case scenario calculation method and the realistic scenario calculation method, the largest number of affected buildings and exceedances of limit values would result from the Siemens Gamesa SG170 model. In contrast, the lowest impact was calculated for the Nordex N163 model.

7. CONDITIONS FOR THE SUBSEQUENT MONITORING OF THE PROPOSED ACTIVITY IN THE CONTEXT OF THE ENVIRONMENTAL IMPACT

Since the planned activity may cause the most significant impacts on bird and bat species, monitoring of these species shall be carried out. A detailed monitoring programme shall be prepared for both bat and bird species monitoring and coordinated with the Nature Conservation Agency. Monitoring shall be carried out by certified experts. Based on the monitoring results, the Nature Conservation Agency may review the monitoring programme, including extending the monitoring period during the wind turbine operation phase.

Bats

Several studies indicate that bat activity near wind turbines may change after their installation[126]. The reasons for these changes are not fully understood; therefore, it is not possible to accurately assess potential risks before wind turbines become operational[127,128]. For the "Valka" wind farm area, it has been established that bat monitoring shall be carried out during the first, second and third years after commencement of wind turbine operation, including acoustic surveys and searches for dead bats near wind turbines.

Acoustic bat surveys shall be carried out using automatic ultrasound detectors installed in wind turbine nacelles and placed on the ground. The purpose of acoustic surveys using automatic ultrasound detectors installed on the ground is to determine whether bat activity within the survey area has changed as a result of wind turbine operation. Monitoring locations and methodology shall correspond to the number and frequency of survey points and the principles for assessing bat passes used in the assessment.

[126] Richardson, S.M., Lintott, P.R., Hosken, D.J., Economou, T. and Mathews, F., 2021. Peaks in bat activity at turbines and the implications for mitigating the impact of wind energy developments on bats. Scientific Reports, 11(1), p.3636.
[127] Solick, D., Pham, D., Nasman, K. and Bay, K., 2020. Bat activity rates do not predict bat fatality rates at wind energy facilities. Acta Chiropterologica, 22(1), pp.135-146.
[128] Bach, P., Bach, L. and Kesel, R., 2020. Acoustic activity and fatalities of Nathusius' pipistrelles (Pipistrellus nathusii) at wind turbines at coastal areas in Northwestern Germany. Evidenzbasierter Fledermausschutz in Windkraftvorhaben, pp.77-100.

Searches for dead bats shall be carried out by trained personnel, and the results shall be evaluated using search efficiency and scavenger removal correction coefficients. The minimum search frequency shall be: three times in May, June, July and September; six times in August.

After the first year of operation, wind turbine operational restrictions may be reviewed and accordingly relaxed or strengthened based on dead bat search results and acoustic monitoring data. If necessary, based on monitoring results, restrictions on wind farm operation may be revised again after the second year of operation.

Ornithofauna

Monitoring shall be carried out one year before commencement of construction works, during construction and during wind turbine operation. During construction, monitoring shall be carried out annually until commissioning of the wind turbines, while during the operational period monitoring shall be carried out for at least five years.

The need to continue operational monitoring shall be decided by the Nature Conservation Agency based on the monitoring data obtained. To reduce bird mortality caused by collisions with wind turbines, equipment/systems shall be installed at the wind farm for: automatic detection of bird flights; recognition of flying birds; automatic shutdown of wind turbines or significant reduction of rotor speed when a collision with sensitive bird species is predicted. The list of detectable species shall be determined during pre-construction monitoring by performing collision risk modelling and including diurnal birds of prey and other threatened species with a high collision risk. This list shall be coordinated with the Nature Conservation Agency. Based on operational monitoring results and bird mortality surveys, the Nature Conservation Agency shall have the right to modify the list. If mortality cannot be reduced using detection systems, other impact mitigation or compensation measures shall be determined in cooperation with experts.

Environmental noise

Before commissioning of the wind farm, environmental noise measurements shall be carried out in the residential areas located closest to the wind farm, substation and BESS in order to verify compliance of the predicted environmental noise levels. If environmental noise measurements demonstrate exceedance of noise limit values established the Regulations No. 16 of the Cabinet of Ministers of January 7, 2014 "Procedures for Environmental Noise Assessment and Management", noise mitigation measures shall be implemented. The measurement locations and methodology shall be coordinated with the Health Inspectorate before commencement of measurements.