



Cross-Border Sustainable Renewable Energy Acceleration in Ukraine - Mapping Synergy Renewable Energy Acceleration Areas between Ukraine, EU Member States, and Moldova

Task 5. Technical Analysis Report for Development of RAA

Environmental Criteria and Constrains

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INTRODUCTION

At the XXII Ministerial Council meeting of the Energy Community in December 2024, the Ministerial Council adopted Recommendation 2014/1/MC-EnC on accelerating the deployment of renewable energy projects and implementing the energy efficiency principle first. This Recommendation calls on the Contracting Parties of the Energy Community to establish the necessary legal and institutional preconditions for the implementation of provisions related to Renewable Acceleration Areas and the streamlining of permitting procedures for renewable energy projects under Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652 (Revised RED). Furthermore, the Recommendation mandates the Secretariat to assist Contracting Parties in these efforts and to report annually on the progress achieved.

In support of this mandate, the Energy Community Secretariat, with assistance from the European Climate Foundation (ECF) under its Ukraine Programme, is implementing a project aimed at establishing Cross-Border Renewable Energy Acceleration Areas (RAAs) in Ukraine.

This initiative targets five critical regions – Lvivska, Zakarpatska, Ivano-Frankivska, Chernivetska and Vinnytska Oblasts, chosen for their strategic positioning along Ukraine's borders with the EU and Moldova and their environmental significance. These oblasts encompass protected natural areas and substantial renewable energy potential, serving as a focal point for advancing Ukraine's green recovery, energy transition, and integration into the EU energy market.

This Report represents the results of the implementation by the Environmental and Spatial Planning Specialists of the Task 5, which was to compile a technical report on environmental and social constraints, assessing impacts on land use, ecosystems, and local communities, and identifying potential mitigation measures.

The assessment has been conducted in accordance with the tailored RAA environmental criteria, elaborated in the framework of the Project considering the requirements and provisions set forth by the Revised RED as well as Ukrainian legislation, regulations, conditions, and the results of consultations with stakeholders.

The Report is structured in three chapters: Chapter 1 of the Report describes the specifics of criteria mapping, in particular criteria assessment indicators, data sources, data processing methods, spatial patterns of criteria assessment results; Chapter 2 explains the algorithm of integration of criteria layers and gives spatial analysis of the environmental criteria assessment results; Chapter 3 contains recommendations for further application of the results of environmental criteria assessment.

1. SPECIFICS OF CRITERIA MAPPING

Considering the requirements and provisions set forth by the Revised RED and adopting them to Ukrainian context with regard to Ukrainian legislation, regulations, and natural conditions, as well as the proposals received through consultations with stakeholders, the set of environmental criteria in the designating RAAs has been elaborated.

The environmental criteria have been designed to ensure the requirement of the Revised RED that RAAs have to be designated where the deployment of renewable energy sources is not expected to have a significant environmental impact, in view of the particularities of the selected area. This will contribute to the introduction of a simplified permit procedure in the relevant areas, as provided for by the Revised RED.

Within the framework of the Project the criteria have been elaborated to support designation of RAAs both for solar and wind renewable energy technologies. While defining only one of these technologies as a target for a specific RAA requires refining the proposed criteria.

The areas that will be identified as meeting the defined environmental criteria are completely excluded from further analysis for the purposes of RAAs designation.

The defined environmental criteria are grouped to 5 groups, each of which has its own specifics of mapping, including data sources and data processing methods as well as impact on the final result of environmental criteria assessment.

For the purposes of the environmental criteria assessment in the framework of the current Project the publicly available in online sources data have been used. That ensures possibility to present transparently all results of the Project implementation as well as the background input data and the algorithms of data processing. Used datasets are sufficient for the purposes of high-level assessment and methodology approbation conducted within the Project, but for the purposes of official planning and establishing RAAs at the national level the official data have to be used (more details are given below in the Chapter 3).

1.1. Criteria Group 1. Wildlife Protection Constraints.

The criteria of this group are mostly dictated by the Revised RED and ensure considering priority areas for biodiversity protection within which the other types of using are limited to varying degrees. This group includes four criteria.

Considering the negative impact on the environment that have energy facilities, including also those using renewable sources, it was proposed to consider 700 m sanitary protected zones to ensure excluding environmental impact of renewable energy facilities to wildlife in protected and other sensitive areas. Taking into account the highest levels of sensitivity of wildlife comparing to human the size of the proposed zones to be used is taken as the maximum possible size of such sanitary protection zones determined by acting state building regulations that is 700 m for

wind power plants with a capacity of over 20 MW¹. The proposed 700 m buffer zones are applied to each indicator of criteria of Wildlife Protection Constraints Group.

Criterion 1.1: Areas protected under international legislation.

Taking into account the provisions of the Revised RED as well as the obligations taken by Ukraine under international agreements the three indicators are defined to assess this criterion.

Indicator 1.1.1: Areas of Emerald Network Sites with 700 m buffer zones.

The Revised RED requires the exclusion of Natura 2000 sites while designating RAAs, which are created in EU countries to meet the requirements of the Birds² and Habitats³ Directives. These two directives provide a legislative framework for all EU Member States to ensure implementation of the requirements of the Convention on the Conservation of European Wildlife and Natural Habitats (1979), Bern Convention⁴. Non-EU countries which are Parties to the Bern Convention by analogy with the Natura 2000 Network in EU countries set-up the Emerald Network of Areas of Special Conservation Interest to protect the species, as well as their habitats, listed in the Appendices of the Bern Convention providing the lists of wild species that are protected by the Convention. Also according to the Bern Convention if an area has candidate status for inclusion in the Emerald Network list, it also a subject to the protection regime under the Convention.

Since Ukraine is a Party to the Bern Convention the Emerald Network sites both established and candidate have been considered in the RAAs assessment.

The Emerald Network dataset represents both adopted and proposed Emerald Network Sites with an additional 700-meter buffer zone calculated around them. To obtain The Emerald Network objects in the focus areas, official spatial data from the European Environment Agency (EEA) was used⁵.

A file in GeoPackage format was downloaded from the resource, which contains the complete database of The Emerald Network objects. The last changes to the file were made on 27.05.2025. The data is fully relevant to the studied areas. In the QGIS software, the data was cut outside the corresponding areas and saved as a separate layer for further use in the mapping process. A buffer of 700 m was built from the outer edge of the polygons.

The Emerald Network sites are the most widely represented areas protected by international law within the study area, including both established and nominated

¹ State Standard of Ukraine 8339:2015 "Wind energy. Wind power plants. Assessment of the impact of a wind power plant on the environment"

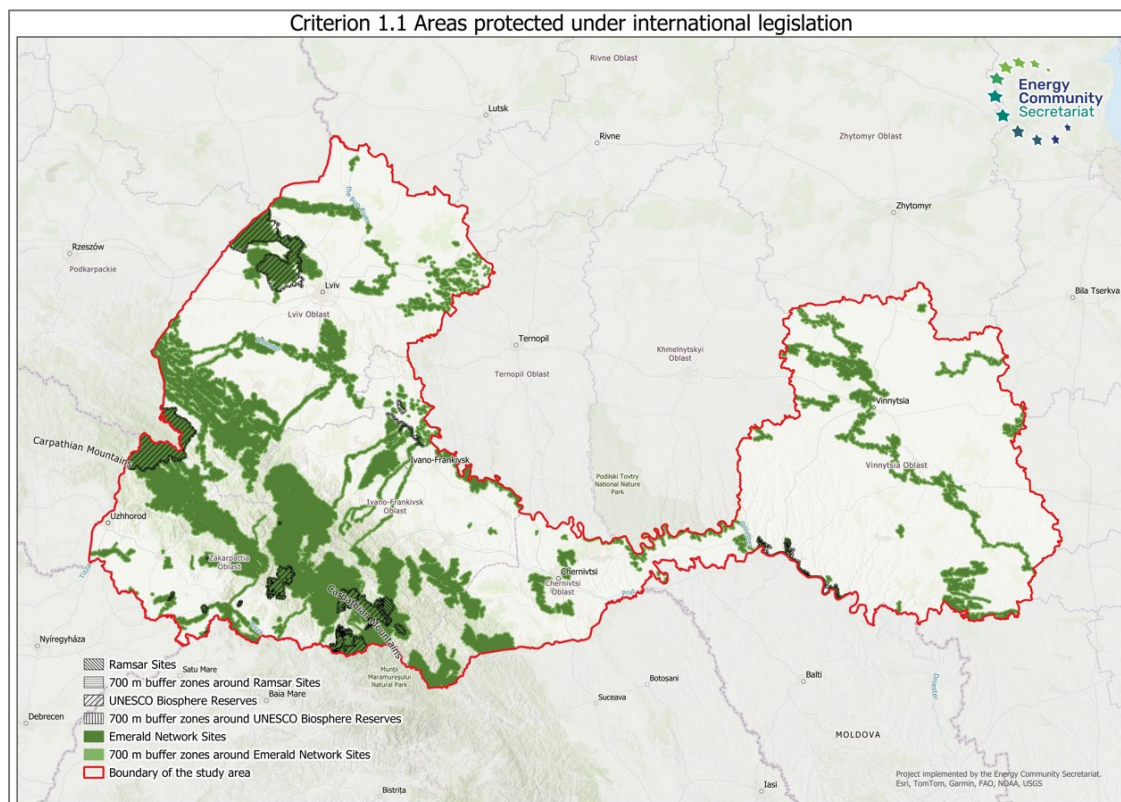
² The Directive on the conservation of wild birds, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147>

³ The Directive on the conservation of natural habitats and of wild fauna and flora, available at <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701>

⁴ Convention on the Conservation of European Wildlife and Natural Habitats, available at <https://rm.coe.int/1680078aff>

⁵ <https://www.eea.europa.eu/en/datahub/datahubitem-view/4c4c8086-c940-400b-9064-29063143b2de>

sites, which together form the ecological framework of the region, in a certain way ensuring the functional connectivity of valuable natural complexes. At the same time, three main spatial clusters can be distinguished among the approved Emerald Network sites: Carpathian (covering mountainous areas within Zakapatska, Ivano-Frankivska and partly Lvivska Oblasts), Pre-Carpathian (foothill areas of Lvivska and Ivano-Frankivska Oblasts), and Podilsk (a network of territories along the Southern Bug river valley). In addition, there is a certain concentration of relevant territories in the north of Lvivska Oblast, and fragmentary centres in Zakapatska and Chernivetska Oblasts. In general, within the framework of the study, the territories of established Emerald Network sites cover about 12.3% of the territory.



Pic. 1.1. Map of areas meeting Criterion 1.1: Areas protected under international legislation.

At the same time, the distribution of nominated sites of the Emerald Network in the region was also analysed within the framework of the study. These territories are located mainly in the western part of the study region (mountainous areas of Lvivska and Zakapatska Oblasts), mostly representing areas of potential expansion of established Emerald Network sites. In spatial terms, they constitute about 4.5% of the study territory.

In general, taking into account the area of buffer zones, which is approximately equal to the total area of the Emerald Network of the region, these territories cover a third part of the study territory (about 32.0%), which indicates the need to take into account the environmental priorities of management of the Carpathian region with the spread of relevant functional concepts for the use of the territories in the Podillia direction.

Indicator 1.1.2: Areas of Ramsar Sites with 700 m buffer zones.

The Ramsar sites have been considered as one of the types of areas protected under international legislation since Ukraine is a party of the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat⁶ and took obligations on defining wetlands of international importance, elaborating regulations, and creating protected areas for protecting such wetlands, increasing the number of waterfowl in suitable wetlands, as well as supporting research and the exchange of data and publications relating to wetlands and their flora and fauna.

The Ramsar Sites dataset contains the delineation of Ramsar wetland sites and their corresponding 700-meter buffer zones. Data on Ramsar sites in the focus areas were obtained from the official Ramsar Sites Information Service portal⁷. The file contains current data on Ramsar sites in the study areas for 2025 and was additionally verified using open sources, in particular from the wownature.in.ua resource⁸. The RSIS source is official, as it is the Ramsar Convention database, which is supported by the international secretariat of this convention. The data was imported into QGIS and trimmed to the boundaries of the respective areas. The attribute tables contain the official names and codes of the sites. A buffer of 700 m was built from the outer edge of the polygons.

Ramsar sites occupy a rather small area within the study region – about 0.2% (together with the established buffer zones – up to 0.5%). For the most part, these areas are concentrated within Zakapatska and Ivano-Frankivska Oblasts (mountain zone – high-mountain lakes and swamps, foothill zone – lakes and reservoirs, river floodplains, swamp massifs). These sites, although small in area, are of critical importance for the habitat of endemics, as well as during seasonal bird migrations. Within Chernivetska and Vinnytska Oblasts, these areas are mainly extended floodplain complexes, important as "leading paths" for waterfowl and regulation of the water regime of the region. There are no wetland areas protected by the Ramsar Convention in Lvivska Oblast.

Despite their fragmentation within the region, Ramsar sites are part of a Pan-European network of wetlands, the spatial continuity of which is extremely important for the functioning of international ecological networks (in particular, the Pan-European Ecological Network – PEEN).

Indicator 1.1.3: Areas of UNESCO Biosphere Reserves with 700 m buffer zones.

While Ukraine, as a member of UNESCO, actively participates in the work of the MAB Program⁹, the areas of Biosphere Reserves protected areas under the UNESCO the Man and the Biosphere Programme also have been considered.

The UNESCO Biosphere Reserves dataset covers the areas of UNESCO Biosphere Reserves and 700-meter buffer zones surrounding them. The list of objects was

⁶ Official UNESCO data about the Ramsar Convention available at: <https://www.unesco.org/en/biodiversity/wetlands>

⁷ The official Ramsar Sites Information Service portal: <https://rsis.ramsar.org>

⁸ <https://wownature.in.ua/oberihaymo/ramsarski-uhiddia>

⁹ The official web-site of the UNESCO the Man and the Biosphere Programme - <https://www.unesco.org/en/mab>

obtained from UNESCO's Man and the Biosphere (MAB) Programme website⁹ and compared with the geometry of the objects of the nature reserve fund from the dataset The Nature Reserve Fund dataset. Using the Join data joining method, the data from the table was combined with the data of the geospatial dataset and stored in the geodatabase in the GeoPackage format. A buffer of 700 m was built from the outer edge of the polygons.

Within the study area, UNESCO biosphere reserve sites are represented by three objects: Roztochya, East Carpathians and Carpathian Biosphere Reserves. The total area within the study area does not exceed 1.5% (together with the established buffer of up to 2.0%).

The Carpathian Biosphere Reserve is located completely within the borders of Zakarpatska Oblast. The Reserve includes massifs located at an altitude of 180 to 2061 m above sea level representing the landscape and biogeographic diversity of the Eastern Carpathians.

The East Carpathians Biosphere Reserve within Ukraine is represented by the territories of the Uzhansky National Nature Park and the Nadsyansky Regional Landscape Park (in the Zakarpatska and Lvivska Oblasts, respectively), which are centres of beech and fir-beech forests that are unique in terms of nature conservation.

The Roztochya Biosphere Reserve is located within the northwestern part of the Lvivska Oblast (the Roztochya Nature Reserve, Yavorivskiyi National Nature Park, the Ravske Roztochya Regional Landscape Park with adjacent territories). The Roztochya region is an ecological corridor connecting the Polish Highlands with Podillia, and which ensures the migration of plants and animals.

There are no UNESCO biosphere reserves within Ivano-Frankivska, Chernivetska and Vinnytska Oblasts.

Criterion 1.2: Areas designated under national protection schemes for nature and biodiversity conservation.

According to the Law of Ukraine "On Nature Environment Protection"¹⁰ land and water areas, natural complexes and objects that have special ecological, scientific, aesthetic and economic value and are intended to preserve natural diversity, the gene pool of animal and plant species, maintain the general ecological balance and background monitoring of the environment, are withdrawn from economic use in whole or in part and are declared a territory or object of the Nature Reserve Fund of Ukraine. Thus the criterion on areas designated under national protection schemes for nature and biodiversity conservation is assessed by the following indicator.

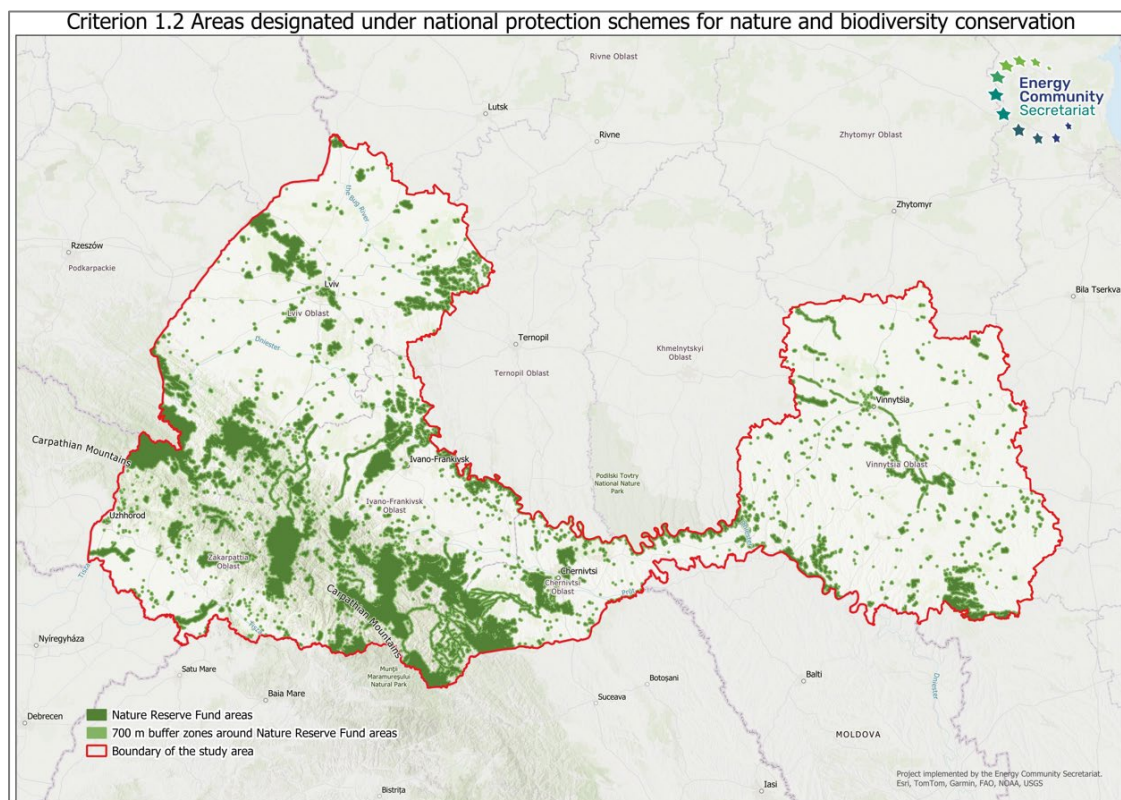
Indicator 1.2.: Nature Reserve Fund of Ukraine areas with 700 m buffer zones.

For the purposes of high-level assessment in the framework of the Project the areas of Nature Reserve Fund have been considered equally, regardless of the category

¹⁰ The official text of the Law of Ukraine "On Nature Environment Protection" available at: <https://zakon.rada.gov.ua/laws/show/1264-12#Text>

defined according the Law of Ukraine “On the Nature Reserve Fund of Ukraine”¹¹. The Law establishes 11 categories of protected areas of varying degrees of strictness of the protected regime from a strict excluding any economic activity (e.g. Strict Nature Reserves and Reserved Sites) to a flexible one that allows a certain degree of economic use (e.g. National Nature Parks or Regional Landscape Parks). Also there are 4 categories representing man-made objects such as zoological parks, botanical gardens, dendrological parks and parks-monuments of landscape art. Such objects have important role in biodiversity preservation, but designing RAAs might consider them in different way than areas of other categories. The same for such big by area and zoned to differentiated usage regime objects as National Nature Parks or Regional Landscape Parks – the specific criteria might be developed within more detailed assessment.

The Nature Reserve Fund dataset represents the official areas of the Nature Reserve Fund of Ukraine with 700-meter buffer zones. The data was obtained from the National Data Portal¹² in the Nature Reserve Fund section. The data was uploaded in shapefile format. The data is valid as of 2024. In QGIS, the data was converted to GeoPackage format and the coordinate system was changed to WGS-84. The attribute composition of the objects was edited and translated into English. A 700 m buffer was built from the outer edge of the polygons.



Pic. 1.2. Map of areas meeting Criterion 1.2: Areas designated under national protection schemes for nature and biodiversity conservation.

¹¹ The official text of the Law of Ukraine " On the Nature Reserve Fund of Ukraine" available at: <https://zakon.rada.gov.ua/laws/show/2456-12#Text>

¹² The National Data Portal <https://data.gov.ua>

Analysis of the distribution of nature reserve fund territories within the study area demonstrates a certain spatial heterogeneity, due to both physical and geographical conditions and the level of anthropogenic development of the territory. The greatest concentration of protected areas is observed in the mountainous and foothill parts of the Carpathians, covering the Zakarpatska, Ivano-Frankivska and partly Lvivska Oblasts. Numerous national natural parks, strict nature reserves, regional landscape parks and protected landscapes are located here, which form a holistic ecological network aimed at preserving unique mountain ecosystems, forest and meadow biocoenoses. Chernivetska Oblast is characterized by an average level of protected areas. The main protected areas are concentrated in the south-western part (foothills and mountainous areas), where regional landscape parks and strict nature reserves operate. Vinnytska Oblast has the lowest share of protected areas among the regions considered. The spatial distribution of the protected areas here is mosaic: most of the objects are confined to river valleys (in particular the Southern Bug River) and separated forest areas.

So, in the comparative aspect, a clear pattern is observed: from west to east, the level of protected areas gradually decreases. If in the Carpathian region (Zakarpatska, Ivano-Frankivska and partly Lvivska Oblasts) protected areas form a systemic nature protection framework, then in Chernivetska and Vinnytska Oblasts they are mainly local and separated. The total percentage of protected areas within the study region is about 8.5%. At the same time, given the significant number of objects, the areas of buffer zones identified during the assessment are about 12.0%.

Some protected areas of the Nature Reserve Fund are partly or fully covered by areas protected under international legislation – UNESCO Biosphere Reserves, Ramsar Sites as well as Emerald Network sites. Such layering does not affect the assessment result, thus they can be ignored in further assessments.

Criterion 1.3: Major bird migratory routes.

The criterion on major bird migratory routes is assessed by the key indicator – migratory routes, but also supplemented with additional indicator – Important Bird and Biodiversity Areas. A buffer of 700 m is applied to both indicators, as to other indicators in the Wildlife Protection Constraints Criteria Group.

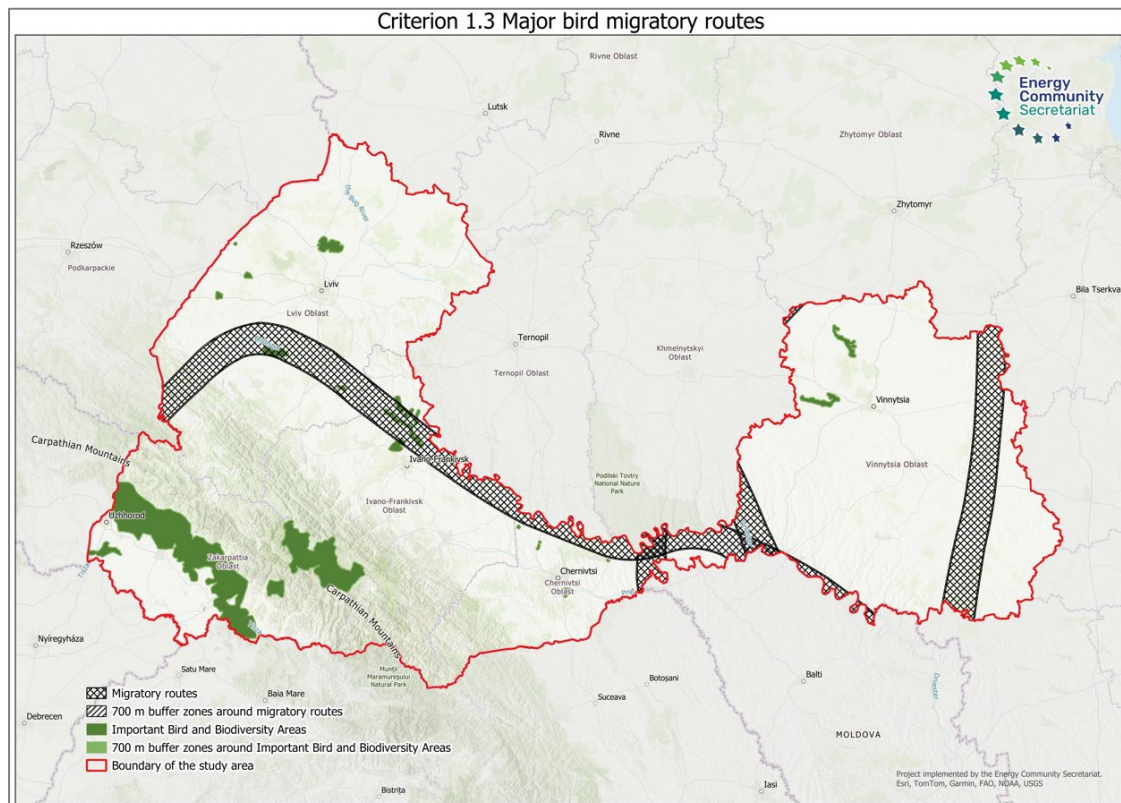
Indicator 1.3.1: Migratory routes with 700 m buffer zones.

Being a party to the Bonn Convention on Migratory Species of Wild Animals¹³ as well as of the African-Eurasian Waterbird Agreement (AEWA)¹⁴ Ukraine have undertaken to conserve and, where necessary and feasible, restore habitats important for ensuring the favourable conservation status of migratory species. Besides creation of protected areas of different types along migratory routes on migratory birds stops locations the Revised RED demands considering the major migratory routes along

¹³ Convention on the Conservation of Migratory Species of Wild Animals (1979), available at: <https://www.cms.int/en/convention-text>

¹⁴ African-Eurasian Waterbird Agreement (1995), available at: <https://www.unep-awea.org/en/documents/agreement-text>

their entire length. A migratory corridor is a conditional path along which birds travel during seasonal flights, the width of it is not fixed, as it depends on many factors reaching the width of the nesting area. The boundaries of such corridors are not clearly defined on the territory, which makes it impossible to take them efficiently into account in spatial analysis for the purposes of planning the development of the territory. Appropriate consideration of this criteria demands conducting additional research to determine exact areas necessary for supporting birds' migration to be included to the spatial analysis for the purposes of RAAs designation.



Pic. 1.3. Map of areas meeting Criterion 1.3: Major bird migratory routes.

For the purposes of current assessment, the major migratory routes have been considered based on scientific research conducted by order of the Environmental Ministry.

The Migratory Routes dataset describes areas and paths of major bird migratory routes, together with 700-meter buffer zones calculated around them. The data was obtained from the National Report of Ukraine on the State of the Environment¹⁵, in the format of a raster image, which was vectorised to determine the main Migratory Routes. The data was saved in GeoPackage format and the coordinate system was changed to WGS-84. A buffer of 700 m was built from the outer edge of the polygons.

The study area is crossed by migration corridors of significant international importance due to their role as routes of intercontinental seasonal migration of

¹⁵ The National Report of Ukraine on the State of the Environment, available at: http://nature.org.ua/nr98/ukrvers/indicators/map_18.htm

migratory birds. In particular, in the latitudinal direction along the Dniester River valley, the region crosses a branch of the Dnieper Migration Corridor. In addition, the routes of the Broad-Frontal and Polissia North-Latitudinal Meridian Corridors of Seasonal Migration of Birds pass through the territories of Chernivetska and Vinnytska Oblasts. According to approximate estimates, the territories included in the migration routes occupy about 11-12% of the total area within the region. These territories are a key element of the ecological network, contribute to the maintenance of biodiversity and genetic exchange between populations, which indicates the need to preserve the territories within the routes in their natural state and minimize the impact of economic activity. At the same time, special attention is required for areas where routes intersect with transport infrastructure facilities or densely populated areas, as this increases the risk of disruption of migration processes.

Indicator 1.3.2: Important Bird and Biodiversity Areas with 700 m buffer zones.

The Important Bird and Biodiversity Areas (IBAs)¹⁶ concept has been launched by BirdLife and covers internationally significant for the conservation of birds and other biodiversity identified based on a set of standardised, data-driven criteria.

The dataset on Important Bird and Biodiversity Areas includes sites identified under the BirdLife International concept and corresponding 700-meter buffer zones. The data on digital boundaries of Important Bird and Biodiversity Areas from the World Database of Key Biodiversity Areas were obtained from BirdLife International (March 2025 Version)¹⁷. The Terms of Use for IBA data¹⁸ and the Terms of Use for KBA data¹⁹ are considered.

Global Dataset containing the current polygons, of which 11,817 are Important Bird and Biodiversity Areas (IBA) and 2,194 are bird triggered Key Biodiversity Areas (KBA). This file contains the March 2025 edition of the BirdLife International Global IBA Spatial Dataset. The data was obtained in shapefile format for the study area and saved in GeoPackage format. A buffer of 700 m was constructed from the outer edge of the polygons.

The distribution of IBA territories has a rather expressed regional contrast: the greatest concentration is observed in the western part of the studied territory (in Zakarpatska Oblast), while in the eastern (Vinnytska Oblast) IBA territories occur singly. In general, the weight of these territories in spatial terms is approximately 4.0%. At the same time, the largest number and area of important ornithological territories are within Zakarpatska Oblast. Here, a continuous system of ornithological territories is traced, covering mountainous and foothill areas. These areas form a single ecologically coherent cluster, corresponding to the boundaries of the Carpathian Biosphere Reserve and adjacent forest massifs. The territories are characterized by high forest cover, a variety of altitudinal zones and are key centres of nesting and migration of mountain bird species. IBA territories of Lvivska Oblast are located in the southern and central parts of the Oblast. They are confined to forest and foothill landscapes, providing favourable conditions for forest and rare bird

¹⁶ <https://datazone.birdlife.org/about-our-science/ibas>

¹⁷ <https://datazone.birdlife.org/contact-us/request-our-data>

¹⁸ <https://datazone.birdlife.org/info/dataterms>

¹⁹ <https://www.keybiodiversityareas.org/terms-of-service>

species. In the territory of Chernivetska Oblast, IBAs have a limited distribution, concentrating mainly in the central and eastern parts – in river valleys and on the border of foothill and plain landscapes. The territories have a small area, but play an important role as connecting links between the Carpathian and Podolsk bird complexes. IBAs within the Vinnytska region are represented by single compact areas in the northern part of the region. These territories have a plain-floodplain type, which is typical of stopping and feeding places for migratory birds. The area of such territories is insignificant compared to the Carpathian region.

Criterion 1.4: Other sensitive areas identified through sensitivity maps and relevant tools.

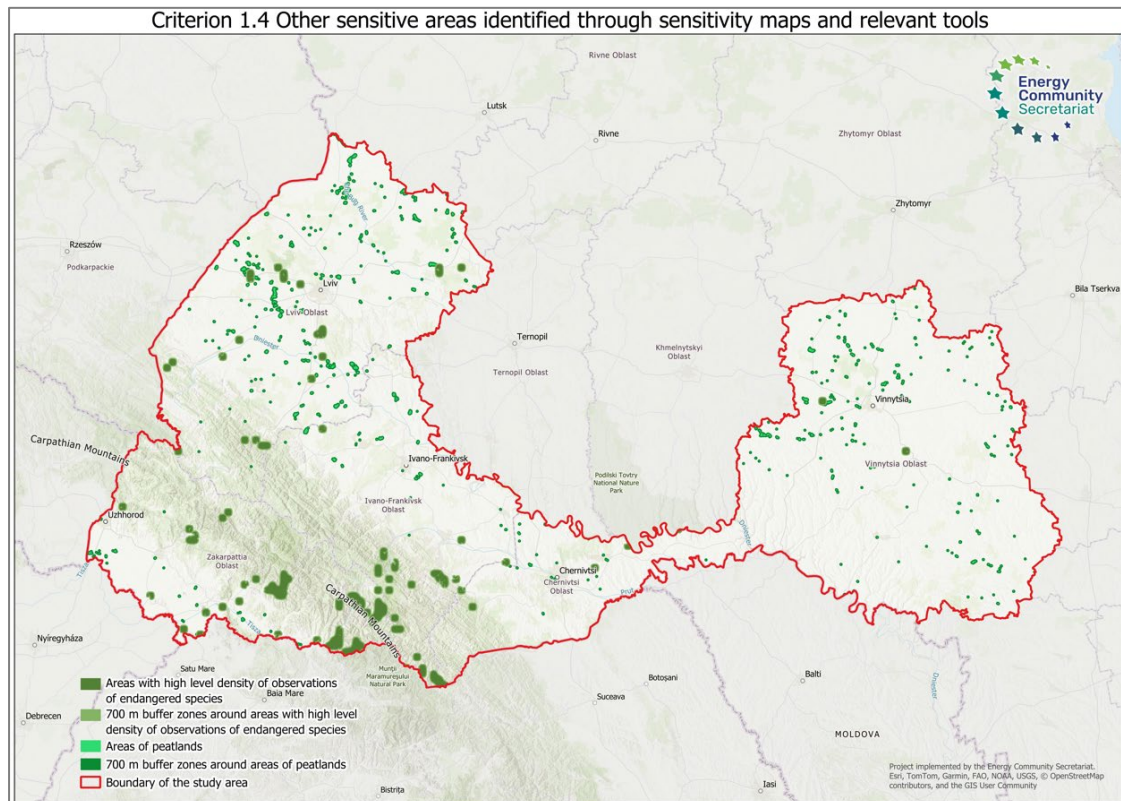
Considering the recommendations of the Revised RED regarding taking into account in addition to protected under international and national legislation areas, and migratory routes, other vulnerable areas that can be identified by applying various cartographic and analytical tools, the indicators of areas with high level density of observations of endangered species and of peatlands have been included to the assessment. These indicators have been taken into account as there are some general international or national obligations on protection of such objects, but no areas with specific regime are designed for this purpose in Ukraine.

Indicator 1.4.1: Areas with high level density of observations of endangered species including 700 m buffer zones.

Rare and endangered species of fauna and flora that permanently or temporarily reside (grow) in natural conditions within the territory of Ukraine, its continental shelf and exclusive (marine) economic zone are subject to special protection according to the Law of Ukraine "On Nature Environment Protection" and are listed in the Red Book of Ukraine²⁰. The endangered species of fauna and flora of international and European importance are also marked in the IUCN Red List and lists of endangered species attached to international agreements, conventions and EU Directives. Protection of such species not always ensured by established protected areas and might require considering on the base of scientific observation.

While there is still no state system of biodiversity monitoring in Ukraine, the corresponding task is being implemented, within the limits of its capabilities, but still very effectively, by a team of enthusiastic biologists, who have united in the non-profit non-governmental organization "Ukrainian Nature Conservation Group". Members of this organization work in different regions of Ukraine, mainly in scientific and educational institutions and, on their own initiative, fill the database on the location of rare species of flora and fauna in the territory of Ukraine, which can be used to consider the endangered species locations while designating RAAs.

²⁰ The official text of the Law of Ukraine "About the Red Book of Ukraine" available at: <https://zakon.rada.gov.ua/laws/show/3055-14#Text>



Pic. 1.4. Map of areas meeting Criterion 1.4: Other sensitive areas identified through sensitivity maps and relevant tools.

The dataset on Areas with high level density of observations of endangered species observations presents sites with a high density of endangered species records and 700-meter buffer zones calculated around them. Data were obtained from Global Biodiversity Information Facility (Publication date September 3, 2024)²¹. The dataset consists of records of protected species published in a series of publications specially prepared by the Institute of Zoology: Materials for the 4th edition of the Red Book of Ukraine.

The data are available in the form of tabular records with coordinates of places of encounter with protected species. For data analysis, zones with density of encounter with species above average were identified. For this purpose, the tabular data were converted into a vector point layer, the density of points in squares and the average value were calculated. The result of the calculation was saved in a polygonal layer in GeoPackage format. A buffer of 700 m was built from the outer edge of the polygons.

The spatial distribution of areas with high level density of observations of endangered species demonstrates a clear differentiation within the study area, highlighting two main, but different in nature, concentration zones. Thus, the main hotbed of endangered biodiversity is the Carpathian region. Here, the highest density and continuity of observation of areas with the corresponding characteristics are observed. This zone covers mainly mountainous and foothill territories of Lvivska, significant territories of Ivano-Frankivska, Zakarpatska and Chernivetska Oblasts. In

²¹ <https://www.gbif.org/dataset/2b00ca94-c839-4a28-8c58-1412523958f1#description>

contrast to this zone, another focus of observations is located much further east, within the borders of Vinnytska Oblast. This zone is more isolated and associated with the features of the relief and ecosystems of Podillia. In general, within the study area, the areas with a high density of observations of species under threat of extinction occupy 2.0-2.5% (taking into account the territories of buffer zones around them).

Indicator 1.4.2: Peatlands with 700 m buffer zones.

Since natural peatlands play an important role in regulating the hydrological regime of rivers and are one of the most effective natural reservoirs of greenhouse gases they are defined as being of particular value by the Land Code of Ukraine²² as well as part of wetlands of international importance. Because there is no state data on peatlands areas and borders, their location can be taken into account for analysis purposes only through GIS analysis instruments based on satellite data.

The dataset on peatlands includes areas with a peat depth greater than one meter and 700-meter buffer zones generated around them. The data source is Microsoft Planetary Computer²³. This layer displays a global map of land use/land cover (LULC) derived from ESA Sentinel-2 imagery at 10 m resolution in 2024. Each year is generated with Impact Observatory's deep learning AI land classification model²⁴, trained using billions of human-labelled image pixels from the National Geographic Society. The global maps are produced by applying this model to the Sentinel-2 Level-2A image collection on Microsoft's Planetary Computer, processing over 400,000 Earth observations per year.

The data was loaded in GeoTIFF format, pixels corresponding to peatlands were selected using the selection method. In the next step, the data was transformed into vector format and saved in GeoPackage format. A buffer of 700 m was constructed from the outer edge of the polygons.

The spatial distribution of peatlands within the study area clearly correlates with the natural conditions of relief and hydrology, demonstrating a bimodal character, reflecting the presence of two main natural areas favourable for their formation. At the same time, the areas of peatlands occupy within the study region only 1.5% (taking into account the territories of the buffer zones around them).

The largest cluster of peatlands is located in the northern part of the studied area and covers significant areas of Lvivska Oblast and extends to the border of Rivne and Volyn regions. This territory belongs to the zone of the southern edge of Polissia, which is characterized by flat relief and high groundwater levels. This combination of geological and climatic factors is ideal for the formation of numerous small and medium-sized peat areas. The second significant cluster is located in the eastern part, mainly in Vinnytsia region. Although this zone is located on the Podilskyi plateau, peatlands here are concentrated in local relief depressions and along river systems that provide the necessary moisture. This cluster is more compact, but also dense, confirming that the key factor is precisely hydrological accessibility, regardless of

²² The official text of the Land Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/2768-14>

²³ <https://planetarycomputer.microsoft.com/dataset/group/io-land-cover>

²⁴ https://www.impactobservatory.com/global_maps

belonging to the largest lowlands. The main spatial feature is the almost complete absence of peatlands in the south-western part of the region. The mountainous terrain with steep slopes and rapid natural drainage make conditions extremely unfavourable for the accumulation of organic residues and the formation of peat.

1.2. Criteria Group 2. Natural Conditions.

Defining environmental criteria for the purposes of RAAs designation the Wildlife Protection Constraints criteria group has been supplemented with group of criteria of Natural Conditions that limit development of renewable energy sites regardless of human activity, including elevation, steep slopes and areas prone to flooding as one of natural hazards. Spreading of natural hazards of other types hasn't been considered in the framework of current study because of lack of complete data for the study region as for the whole territory of Ukraine in general. Considering of spreading of other types of natural hazards might be conducted for selected areas on further lower levels of assessment. At the same time by applying the criteria of steep slopes and areas prone to flooding might mostly excluded the areas of spread of other natural hazards unfavourable to RAAs (like landslides, avalanches, mudflows).

Criterion 2.1: Elevation.

The elevation criterion is assessed by the indicator of areas with elevation higher than 800 m.

Indicator 2.1: Areas with elevation higher than 800 m.

This indicator is established at the international level within the methodology elaborated by the International Renewable Energy Agency (IRENA, 2016). Adapting the indicator to Ukrainian context the height has been reduced from value of 2000 m (proposed by IRENA methodology, which has a rather arbitrary criterion for the territory of Ukraine as there are only six peaks in the Ukrainian Carpathians whose height exceeds 2,000 meters) to 800 m taking into account the national legislation²⁵ and experts' recommendations.

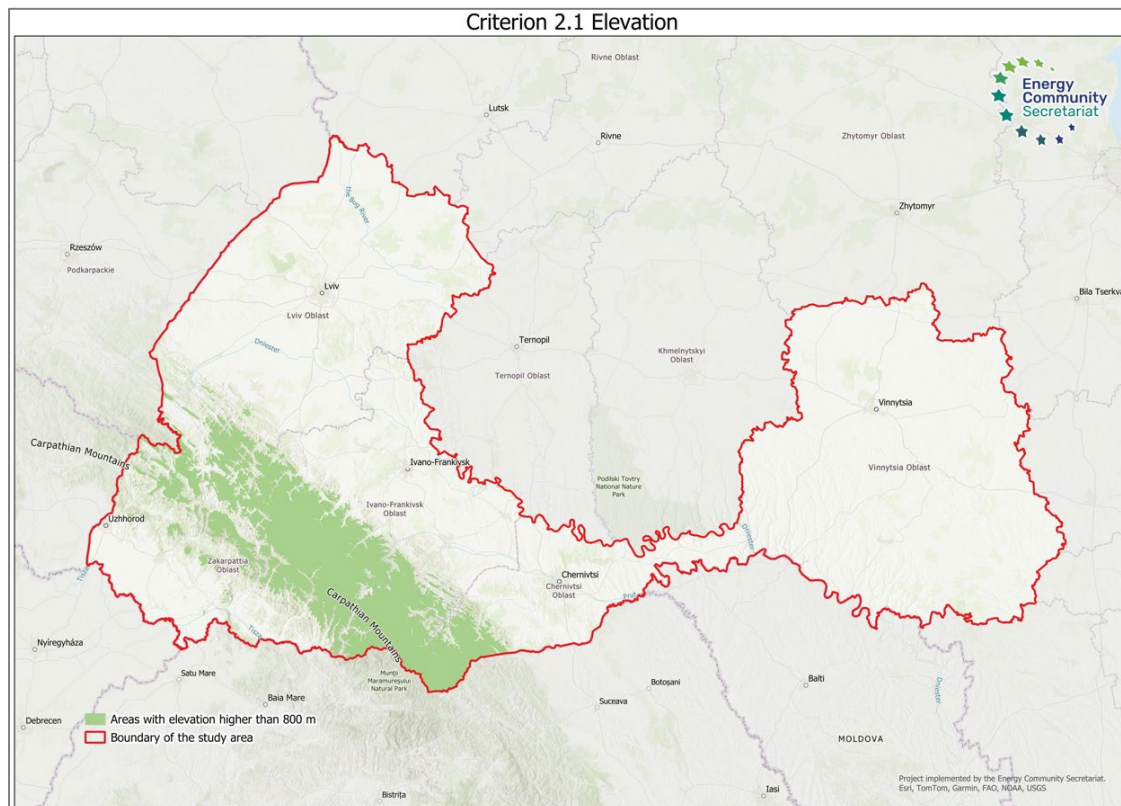
The dataset of areas with elevation higher than 800 meters is built based on the digital terrain model which was obtained by merging several adjacent tiles obtained using the SRTM 1 Arc-Second Global option, provided by the US Geological Survey (USGS) resource²⁶. This option provides a spatial resolution of about 30 meters and is a reliable source of radar elevation data.

During the processing of the digital terrain models, the resolution of 30 m was fully preserved at all stages. Based on the digital terrain model, all pixels above an altitude

²⁵ The Law of Ukraine of August 21, 2025 No. 4577-IX "On Amendments to the Tax Code of Ukraine and Other Laws of Ukraine Regarding Support for Enterprises of the Defense Industrial Complex", available at: <https://zakon.rada.gov.ua/laws/show/4577-20#Text>

²⁶ <https://dwtkns.com/srtm30m>

of 800 m were selected. In the next step, the data was transformed into a vector format and saved in GeoPackage format.



Pic. 1.5. Map of areas meeting Criterion 2.1: Elevation.

Territories with a height of over 800 m form one virtually continuous massif, which in a certain way repeats the contours of the Carpathian mountain system and occupies about 10% of the study area. This zone is the only one within the studied region that has such altitudinal characteristics. The massif covers the southern part of Lvivska Oblast, significant territories of Ivano-Frankivska and Zakarpatska Oblasts, as well as the south-western areas of Chernivetska Oblast.

Criterion 2.2: Steep slopes.

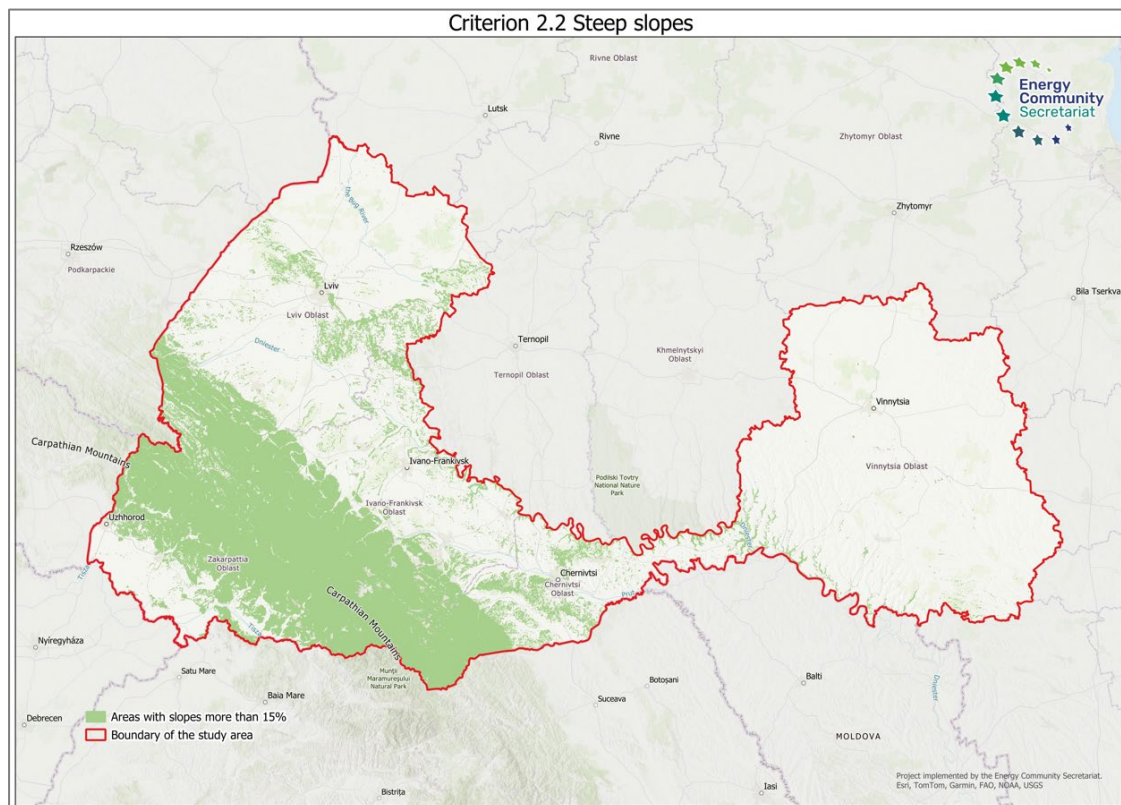
The steep slopes criterion is assessed by the indicator of areas with slopes more than 15%.

Indicator 2.2: Areas with slopes more than 15%.

Areas with slopes more than 15% are defined as areas with difficult engineering and geological conditions for development needs according to national building regulations²⁷.

²⁷ The official text of the State Building Regulations B.2.2-12:2019 "Planning and Development of Territories" available at: https://e-construction.gov.ua/laws_detail/3260441209981634046

The dataset on areas with slopes greater than 15% is also based on USGS data²⁸ from the same source and represents raster modelling results identifying territories with steep slopes. The slope calculation was performed in QGIS software using digital elevation models, which were obtained as a result of previous work by merging Earth Explorer tiles with a resolution of 1 arc-second, covering the territories of the regions. To correctly calculate the slope, the rasters were reprojected into the metric coordinate system EPSG:32636 (UTM zone 36N). The slope calculation was performed using the GDAL tool - raster analysis - Slope, while maintaining the ratio of vertical units to horizontal, which is equal to 1. All slope values are given in degrees.



Pic. 1.6. Map of areas meeting Criterion 2.2: Steep slopes.

The distribution of areas with slopes over 15% is similar to the distribution of areas with a height of over 800 m, confirming that steep slopes are a direct characteristic and dominant feature of the mountainous and foothill terrain within the studied region. The area of distribution of steep slopes covers Zakarpatska, Ivano-Frankivska and the south-western parts of Lvivska and Chernivetska Oblasts and accounts for about 12.5% of the total area of the region.

It is worth noting that areas with slopes over 15% are classified as unsuitable or limitedly suitable for agricultural use, infrastructure construction and urban development due to the high risk of erosion, landslides and significant complexity of engineering works. Consequently, their presence determines a low potential for intensive economic development and, conversely, a high potential for environmental

²⁸ <https://dwtkns.com/srtm30m>

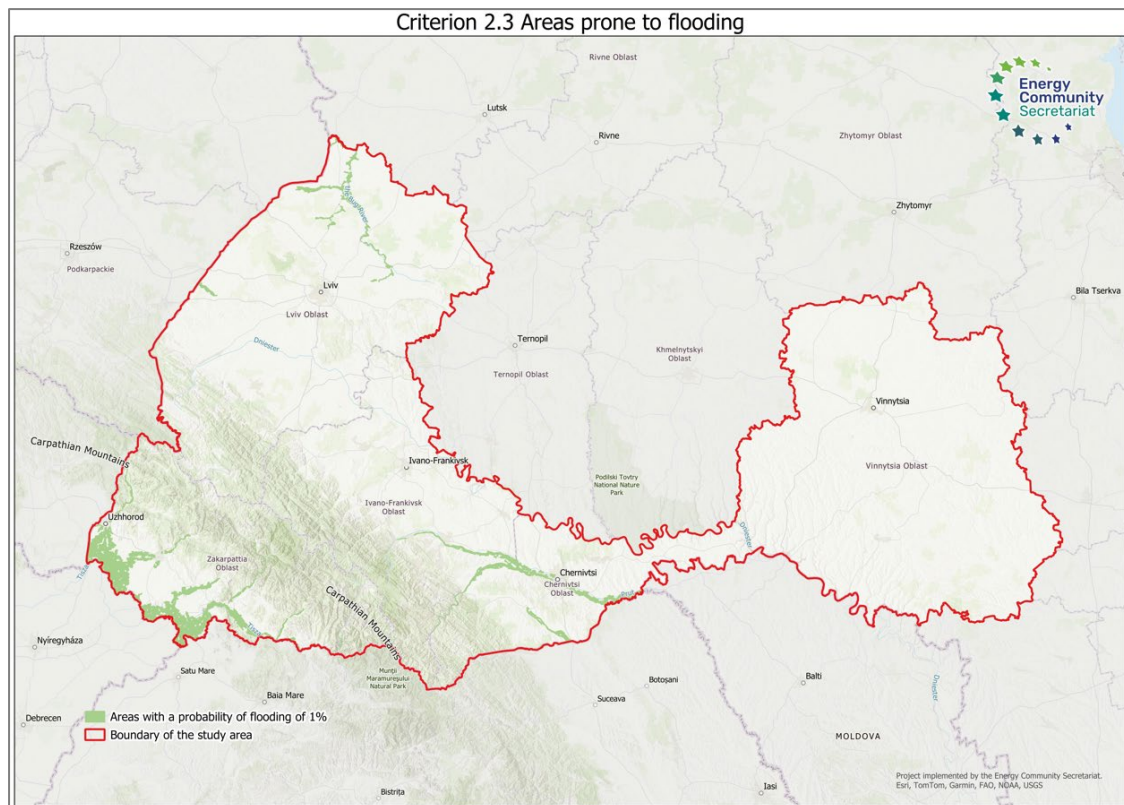
protection activities and the development of ecotourism, thus contributing to the preservation of the integrity of ecosystems.

Criterion 2.3: Areas prone to flooding.

The areas prone to flooding criterion is assessed by the indicator of areas with a probability of flooding of 1%.

Indicator 2.3: Areas with a probability of flooding of 1%.

Areas with a probability of flooding of 1% are defined as areas with difficult engineering and geological conditions for development needs according to national building regulations²⁹.



Pic. 1.7. Map of areas meeting Criterion 2.3: Areas prone to flooding.

The dataset on flood-prone areas defines zones with annual probability of flooding of 1%. The data were extracted from the flooding model based on data from Joint Research Centre Data Catalogue³⁰. The data was obtained in Geotiff format. In the next step, the data was transformed into a vector format of polygonal objects and saved in GeoPackage format.

²⁹ The official text of the State Building Regulations B.2.2-12:2019 "Planning and Development of Territories" available at: https://e-construction.gov.ua/laws_detail/3260441209981634046

³⁰ <http://data.europa.eu/89h/8e49997c-ba99-4ed1-9aec-059bb440001b>

Analysis of the distribution of areas within the studied region with a probability of flooding of 1% demonstrates its clear spatial connection to the hydrological network.

Flood zones are almost completely correlated with river beds and their floodplains. Thus, in Lvivska Oblast, flood zones are concentrated mainly along the Western Bug River and its tributaries. The largest flooded areas are observed in low-lying areas, where the relief is flat and the river valleys are wide. In Zakarpatska Oblast, flooding hazard is typical for the valleys of the Tysa, Latorytsia, Uzh rivers and their tributaries. Floods here are characterized by rapid water rises, local flooding of settlements. In Chernivetska Oblast flooding is typical for the Prut, Cheremosh rivers and their tributaries. The largest flood zones are located in wide river valleys and low-lying areas, where water can flood significant areas of agricultural land. In total, within the study area, potentially flooded areas account for 1.5-2.0%.

1.3. Criteria Group 3. Land Use Regulations.

Since Ukrainian legislation contains some protection demands regarding specific types of lands aiming in preserving the natural potential of such lands for necessary using of them the third criteria group has been defined to be excluded from further RAAs designation analysis. Protecting lands of water fund, forest, agricultural and recreational lands has a dual nature, combining economic and environmental components.

Criterion 3.1: Areas of forest fund.

Indicator 3.1: Forest areas with 100 m buffer zones.

Forest lands protection is regulated by the Forest Code of Ukraine³¹ as well as by other laws of Ukraine since they perform protective, sanitary and hygienic, health, water protection, recreational, aesthetic, educational, and other functions and are a source for meeting society's needs in forest resources. A buffer zone of 100 m also considered to meet requirements of the national building regulations on fire protection indent to the built-up areas with a maximum size of 100 m.

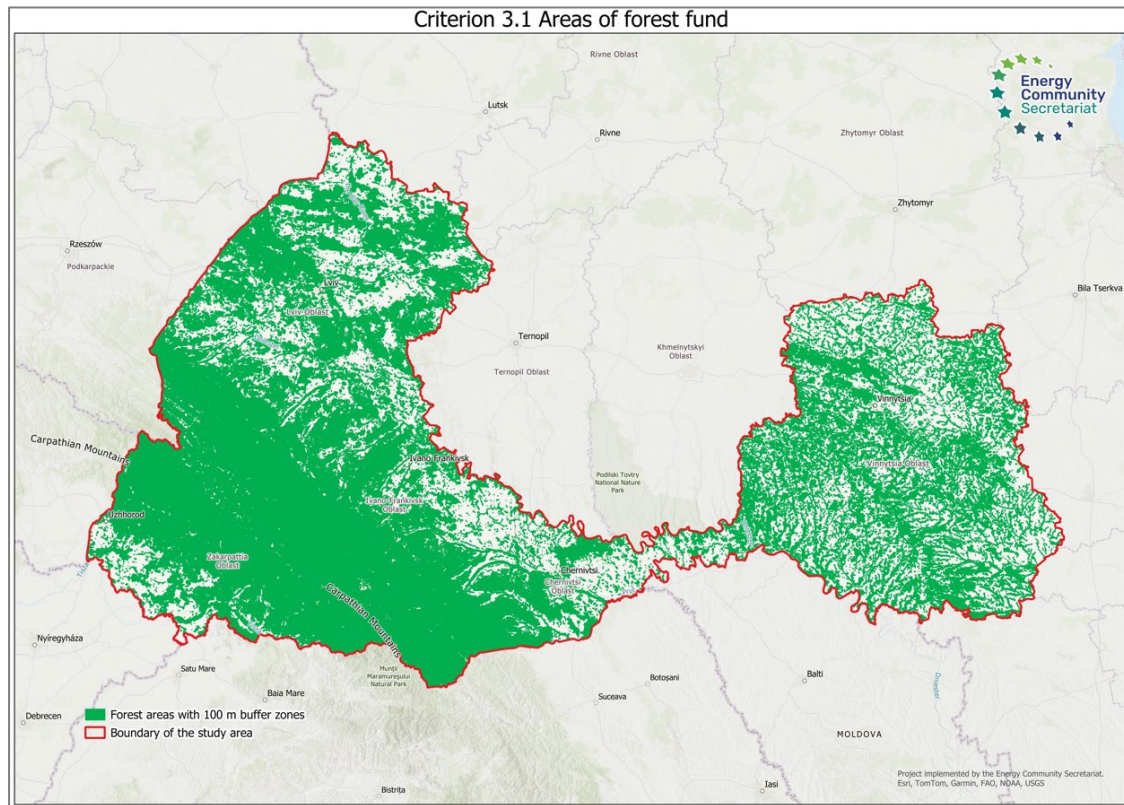
The dataset on forest areas includes territories classified as forests according to the Forest Code of Ukraine and corresponding 100-meter buffer zones. Data were obtained from Microsoft Planetary Computer³². This layer displays a global map of land use/land cover (LULC) derived from ESA Sentinel-2 imagery at 10m resolution in 2024. Each year is generated with Impact Observatory's deep learning AI land classification model³³, trained using billions of human-labelled image pixels from the National Geographic Society. The global maps are produced by applying this model to the Sentinel-2 Level-2A image collection on Microsoft's Planetary Computer, processing over 400,000 Earth observations per year.

³¹ The official text of the Forest Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/3852-12#Text>

³² <https://planetarycomputer.microsoft.com/dataset/group/io-land-cover>

³³ https://www.impactobservatory.com/global_maps

The data was loaded in Geotiff format, pixels corresponding to the forest were selected using the selection method. In the next step, the data was transformed into vector format and saved in GeoPackage format. A 100 m buffer was constructed from the outer edge of the polygons.



Pic. 1.8. Map of areas meeting Criterion 3.1: Areas of forest fund.

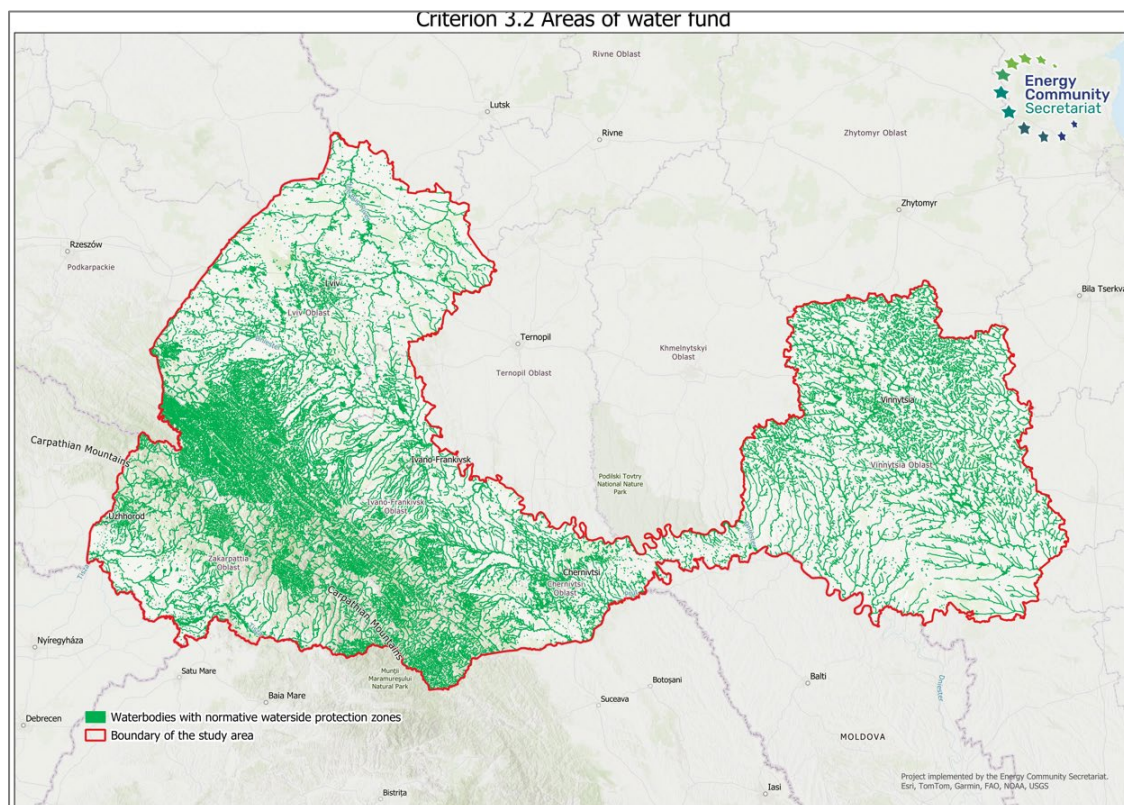
The highest forest cover is in Zakarpatska and Ivano-Frankivska Oblasts, where forests form continuous massifs in the mountainous zone of the Carpathians and perform important water protection and soil protection functions. Chernivetska and Lvivska Oblasts are characterized by an average level of forest cover, with forests concentrated mainly in the foothills and southern areas. Vinnytska Oblast has the lowest share of forest cover among the analysed territories, which is explained by the predominantly flat relief and high level of land development for agriculture. In general, the region is characterized by a gradual change in forest cover from the southwest to the northeast – from dense mountain forests of the Carpathians to fragmented forest areas of Podillia. In general, the level of forest cover in the studied region of Ukraine is about 40.0%, which exceeds the average for the country, since here is concentrated a significant part of the natural and artificial forests of the Carpathian mountain belt, which form the main forest fund of Ukraine.

Criterion 3.2: Areas of water fund.

Indicator 3.2: Waterbodies with normative waterside protection zones.

To ensure protection of water resources the Water Code of Ukraine³⁴ establishes the waterside protection zones along/around all water bodies in which mostly all types of building-up are restricted.

The dataset on waterbodies with normative waterside protection zones includes polygons and lines of rivers, lakes, and reservoirs as well as calculated protection zones according to the Water Code of Ukraine. Data sources are Microsoft Planetary Computer³⁵. This layer displays a global map of land use/land cover (LULC) derived from ESA Sentinel-2 imagery at 10m resolution. Each year is generated with Impact Observatory's deep learning AI land classification model³⁶, trained using billions of human-labelled image pixels from the National Geographic Society. The global maps are produced by applying this model to the Sentinel-2 Level-2A image collection on Microsoft's Planetary Computer, processing over 400,000 Earth observations per year.



Pic. 1.9. Map of areas meeting Criterion 3.2: Areas of water fund.

³⁴ The official text of the Water Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text>

³⁵ <https://planetarycomputer.microsoft.com/dataset/group/io-land-cover>

³⁶ https://www.impactobservatory.com/global_maps

The data was loaded in GeoTIFF format, pixels corresponding to waterbodies were selected using the selection method. In the next step, the data was transformed into vector format and saved in GeoPackage format.

The analysis of the spatial structure of water resources in the study region demonstrates a gradual transition from mountainous-natural to plain-developed types of water landscape. Zakarpatska Oblast has a dense network of mountain rivers (Tisa, Latorytsia) and natural lakes, similar to Ivano-Frankivska with the Prut and Dniester rivers and numerous ponds. In Chernivetska Oblast, the main rivers are the Prut and Seret, reservoirs and ponds are used for irrigation. Lvivska Oblast has an average density of rivers (Western Bug, Dniester), but more artificial reservoirs. Vinnytska Oblast is plain, with the Southern Bug River and mainly artificial ponds. In general, from west to east, the density of water bodies and the share of natural water bodies decreases, and the role of artificial water bodies increases. In general, the percentage of the area of water bodies, taking into account the territories of water protection restrictions, is slightly more than 4.0%.

While the Project area doesn't cover the regions with sea coasts, the possibility of designation of RAAs along sea coasts and on shelf areas has to be analysed additionally and special criteria regarding waterside protection zones has to be elaborated for such areas.

Criterion 3.3: Agricultural lands.

Indicator 3.3: Areas categorised as agriculture land.

While the Land Code of Ukraine³⁷ establishes the priority of using suitable land for agricultural needs, providing for the use of such lands for agriculture, forestry or nature protection, the agricultural lands have been defined as one of the criteria of exclusion of areas from further RAAs designation. At the same time for the next more detailed assessments for RAAs designation purposes it is recommended to consider the data on degraded lands since according to numerous investigation there are extensive areas of degraded lands among the agricultural lands which can't be used appropriately for agricultural purposes.

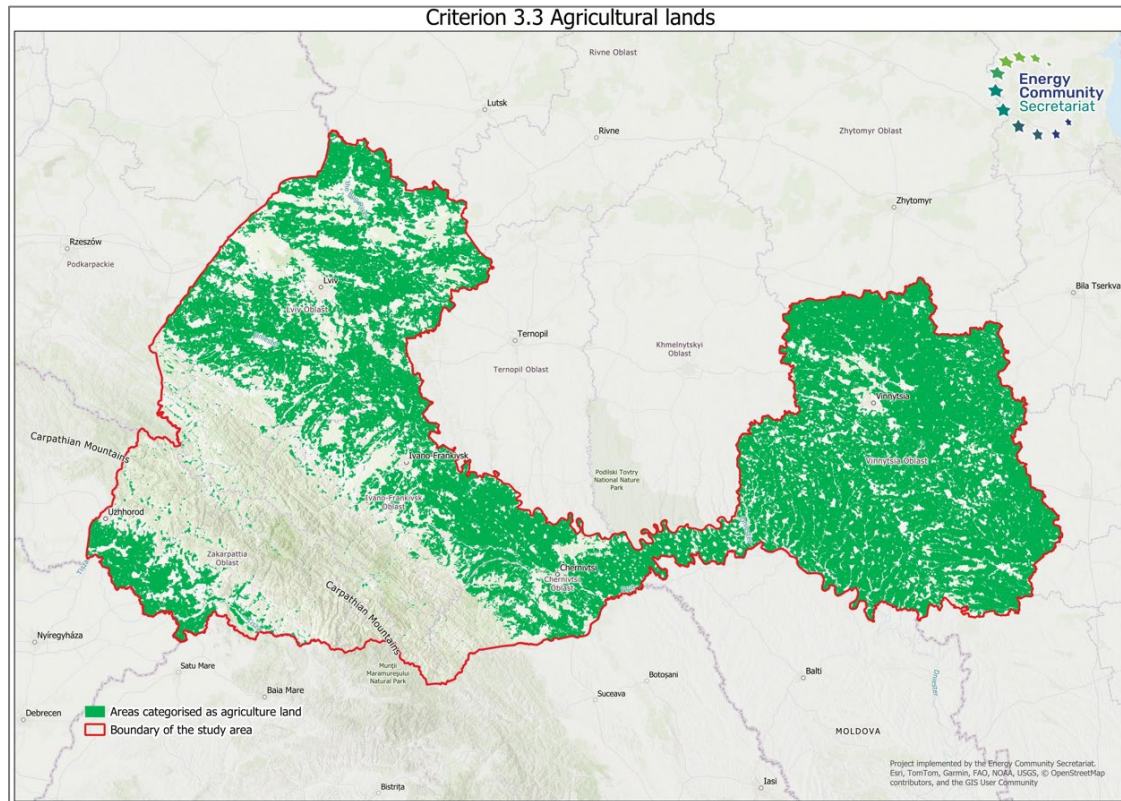
The dataset on agricultural areas represents territories used for agriculture, derived from Microsoft Planetary Computer³⁸. This layer displays a global map of land use/land cover (LULC) derived from ESA Sentinel-2 imagery at 10m resolution. Each year is generated with Impact Observatory's deep learning AI land classification model³⁹, trained using billions of human-labelled image pixels from the National Geographic Society. The global maps are produced by applying this model to the Sentinel-2 Level-2A image collection on Microsoft's Planetary Computer, processing over 400,000 Earth observations per year.

³⁷ The official text of the Land Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/2768-14>

³⁸ <https://planetarycomputer.microsoft.com/dataset/group/io-land-cover>

³⁹ https://www.impactobservatory.com/global_maps

The data was loaded in GeoTIFF format, pixels corresponding to agricultural areas were selected using the selection method. In the next step, the data was transformed into vector format and saved in GeoPackage format.



Pic. 1.10. Map of areas meeting Criterion 3.3: Agricultural lands.

Agricultural lands within Lvivska, Ivano-Frankivska, Chernivetska, Vinnytska, and Zakarpatska Oblasts are distributed unevenly, which is due to the relief and natural conditions.

They are most widespread in Vinnytska Oblast, where the plain relief and fertile black soil contribute to intensive agriculture – arable land and industrial crops prevail here. In Lvivska Oblast, agricultural development is somewhat less: the north and centre areas are actively used for grain crops, while the south areas turn into meadows and pastures. In Ivano-Frankivska and Zakarpatska Oblasts, due to the mountainous relief and high forest cover, arable land occupies a much smaller area; natural fodder lands, orchards and vineyards prevail. Chernivetska Oblast has an intermediate character – it combines plain agriculture with foothill gardening.

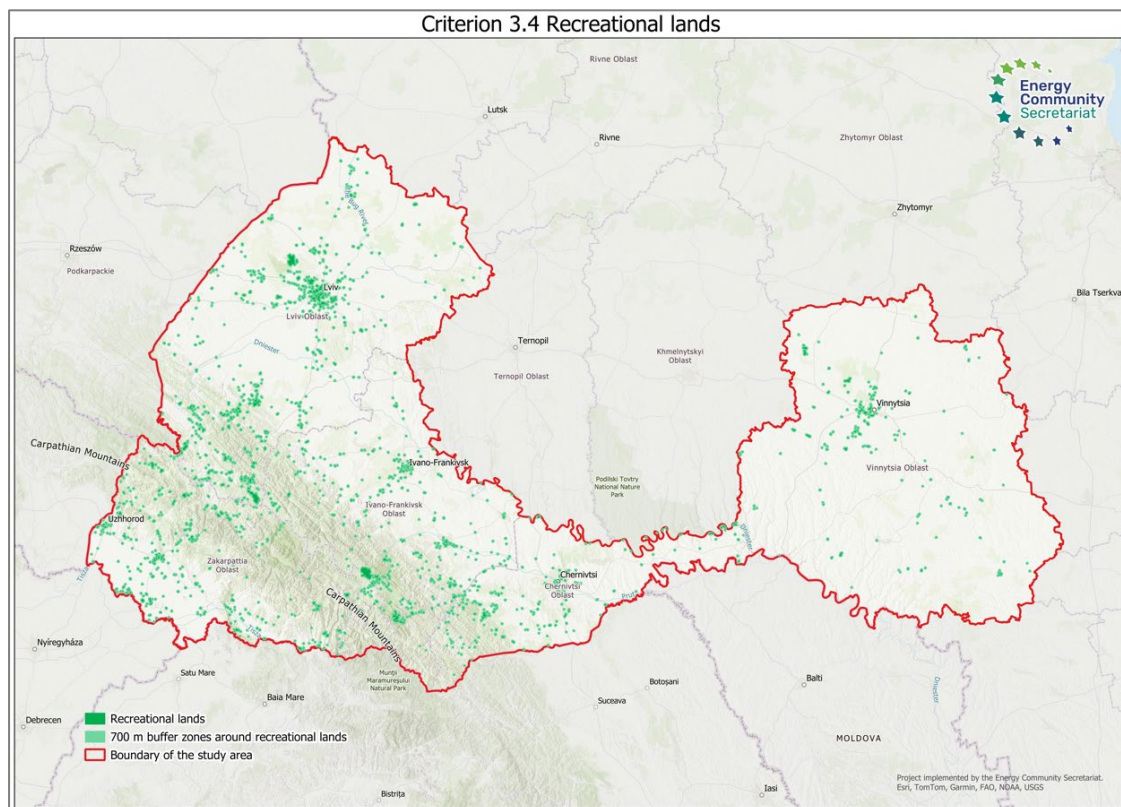
The area of agricultural land is decreasing from the largest in Vinnytska Oblasts to the smallest in Zakarpatska, which reflects a natural pattern: the plain regions of Podillia have the highest degree of agricultural development, while in the mountainous regions of the Carpathians, land use is limited by relief, forests and climatic conditions. The total area of agricultural land within the region is approximately 45.0%.

Criterion 3.4: Recreational lands.

Indicator 3.4: Recreational lands with 700 m buffer zones.

Since preserving the natural state of recreational lands is provided by the Land Code of Ukraine⁴⁰ and some state regulative documents including limiting the conditions for their transfer to other categories of land and the rules for their use such areas are considered as one of the environmental criteria within the RAAs designation assessment. Also a buffer zone of 700 m around such lands is considered since according to the national building regulations the recreational lands can't be covered by the sanitary protection zones.

The dataset on recreational lands includes areas designated for recreation and 700-meter buffer zones calculated around them. Data were obtained from open source data platform Kadastr.Live⁴¹. The data was downloaded from the resource in the form of vector tiles, which were converted to GeoPackage format. In the next step, land plots with the target designation "For recreational needs" were selected. The selected plots were saved in a separate layer. A buffer of 700 m was built from the outer edge of the polygons.



Pic. 1.11. Map of areas meeting Criterion 3.4: Recreational lands.

Recreational lands within the study region are characterized by different levels of territorial distribution and functional significance. The greatest concentration of such lands is observed in the Carpathian region – Lvivska, Ivano-Frankivska, and

⁴⁰ The official text of the Land Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/2768-14>

⁴¹ <https://kadastr.live>

Zakarpatska Oblasts, where high forest cover and the presence of mountainous landscapes create favourable conditions for the development of recreational activities. Most resort and tourist complexes, nature conservation and health areas are concentrated here, forming a powerful recreational framework of the region.

Chernivetska Oblast has similar conditions, but the scale of recreational use of its territory is smaller, and infrastructure development is local in nature. Recreational lands are concentrated mainly in river valleys, foothills and around natural objects of local importance. In Vinnytska Oblast, recreational lands occupy a small share in the structure of the land fund. They are represented mainly by recreation areas around water bodies and territories of sanatoriums and health resorts. Thus, recreational lands play a key role in the spatial organization of the Carpathian region, while in the central part of Ukraine their importance remains secondary and limited to local recreation centres. In general, in the structure of the region's land fund, the share of recreational lands is less than 1.0% (together with the territories of buffer zones – about 4.0%).

1.4. Criteria Group 4. Reverse Inclusion Criterion.

This criteria group consists of just one criterion, but is separated since has a very specific role in the assessment, namely reversely includes to the further assessment for the purposes of RAAs designation areas which meet the criteria of the second and third groups of environmental criteria.

Criterion 4.1: Artificial and built surfaces.

Indicator 4.1: Areas of high concentration of artificial and built surfaces.

The Revised RED defines artificial and built-up surfaces as one of the priority types of areas for RAAs designation. In this regard it is recommended to exclude artificial and built-up surfaces from the areas meeting environmental criteria of the second (Natural Conditions) and third (Land Use Regulations) groups.

Placement of alternative energy facilities on artificial surfaces within international and national protected areas, as well as migratory routes and sensitive areas requires a targeted analysis in each specific case as it might also have a negative impact on biodiversity. Thus, it isn't relevant to consider them in evaluating the criteria of the first group (Wildlife protection constraints).

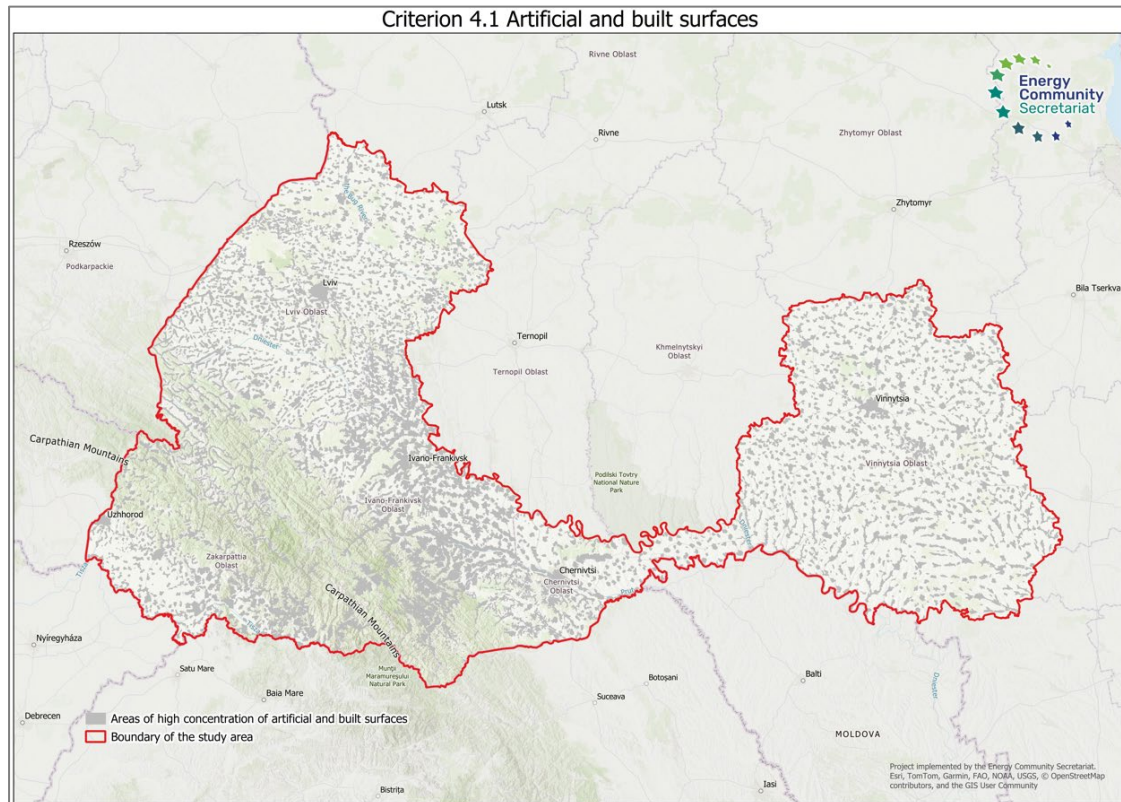
The dataset on built-up areas represents territories covered by artificial and built surfaces, derived from Microsoft Planetary Computer⁴². This layer displays a global map of land use/land cover (LULC) derived from ESA Sentinel-2 imagery at 10 m resolution. Each year is generated with Impact Observatory's deep learning AI land classification model⁴³, trained using billions of human-labelled image pixels from the National Geographic Society. The global maps are produced by applying this model

⁴² <https://planetarycomputer.microsoft.com/dataset/group/io-land-cover>

⁴³ https://www.impactobservatory.com/global_maps

to the Sentinel-2 Level-2A image collection on Microsoft's Planetary Computer, processing over 400,000 Earth observations per year.

The data was loaded in GeoTIFF format, pixels were selected using the selection method, which corresponded to built-up areas. In the next step, the data was transformed into vector format and saved in GeoPackage format.



Pic. 1.12. Map of areas meeting Criterion 4.1: Artificial and built surfaces.

Areas of high concentration of artificial and built-up surfaces in the study region have an expressed spatial differentiation, reflecting the level of urbanization and economic activity of the regions. The highest degree of development is observed in Lvivska Oblast, where the agglomeration type of settlement dominates with the centre in the city of Lviv. It is here that the largest area of artificial surfaces is concentrated - industrial, transport and residential. In addition to Lviv, significant centres of development are Drohobych, Stryi, Sheptytskyi and other cities, which form a dense network of urbanized territories.

In Ivano-Frankivska Oblast, built-up land is concentrated mainly in the urban agglomerations of Ivano-Frankivsk, Kalush and Kolomyia, as well as along the main transport corridors. Territorially urbanized areas occupy a smaller part of the region, but tend to expand towards the foothills.

Zakarpatska Oblast is distinguished by a variegated nature of development: high density is observed in valley areas, in particular around Uzhhorod, Mukachevo and Berehove, while mountainous areas remain sparsely developed.

In Chernivetska Oblast, the area of concentration of artificial surfaces is limited to the territory of the city of Chernivtsi and its suburban belt, as well as several industrial centres in the river valleys. In general, the share of built-up land here is low.

In Vinnytska Oblast, the most urbanized areas remain the territories around the regional centre – Vinnytsia. The level of concentration of artificial surfaces here is average, residential and industrial buildings along transport axes prevail.

In general, the highest share of artificial and built-up areas is in Lvivska and Ivano-Frankivska Oblasts, the average level is in Vinnytska and Zakarpatska, while Chernivetska Oblast is characterized by the lowest degree of urbanization. The spatial distribution of such lands clearly correlates with the level of economic development, population density, and transport accessibility of the territories.

1.5. Criteria Group 5. Planning Constraints.

The Planning Constraints Criteria Group includes criteria on development regulations, as well as sanitary, aviation, security, historical and cultural restrictions. Also when applying the criteria of this group an assessment of the loss of ecosystem services might be conducted in cases it is possible to be done, as well as a socio-ecological approach, analysing alternatives for the use of the territory, might be applied to assessment.

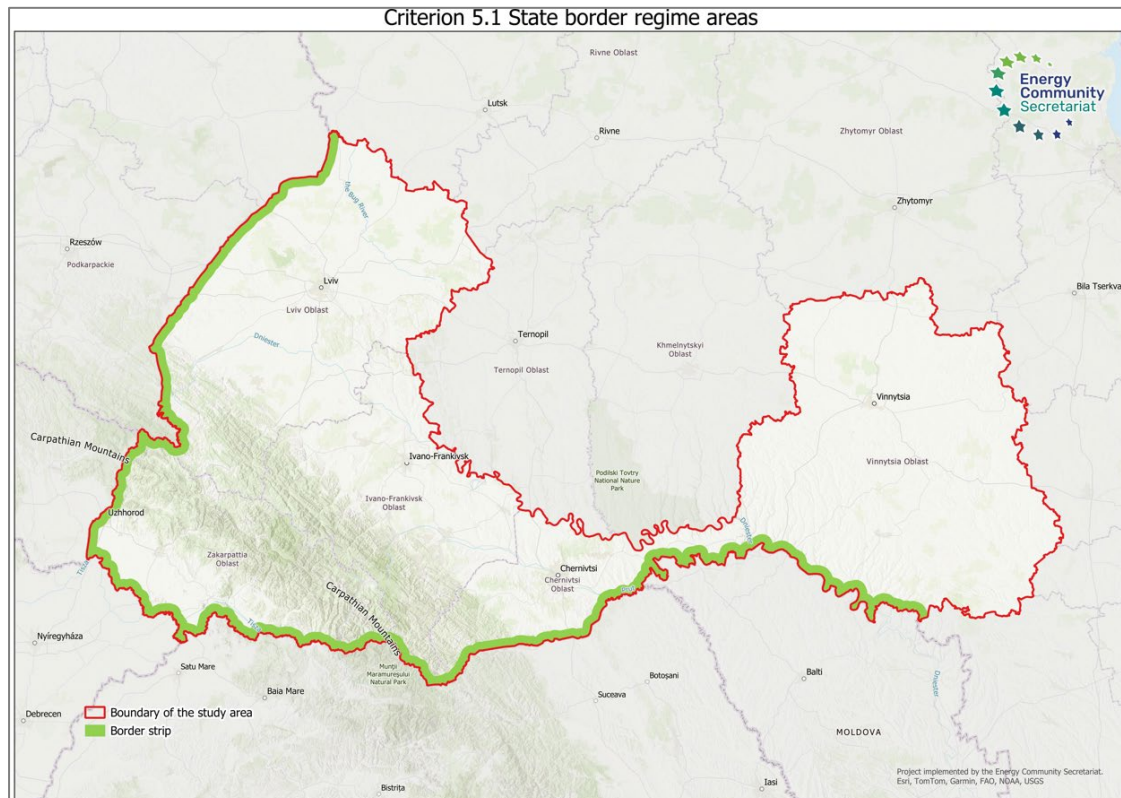
In the framework of the Project high-level assessment the only one criterion has been considered as the security restriction on areas of state border regime has legislative established size and can be taken into account while conducting planning on high level. Other criteria can be considered only with detailed planning at the local level since data on such restrictions are not systematized and structured, collecting which for large areas might take incredible time and expert resources. More detailed description of necessary assessments of planning constraints in the framework of specific local studies for the purposes of RAAs designation is given below in the Chapter 3.

Criterion 5.1: State border regime areas.

Indicator 5.1: Border strip.

A border strip regime is established in accordance with the requirements of the Law of Ukraine "On the State Border of Ukraine"⁴⁴ at a width of 5 km from the state border, along the entire length of it, which provides for getting permissions of the State Border Guard Service for any activity, including construction, in the border strip. This doesn't allow to introduce a simplified procedure on these areas and therefore it is impossible to meet requirements of the Revised RED to RAAs at such areas.

⁴⁴ The official text of the Law of Ukraine "On the State Border of Ukraine" available at: <https://zakon.rada.gov.ua/laws/show/1777-12#Text>



Pic. 1.13. Map of areas meeting Criterion 5.1: Border strip.

The dataset on the border strip includes the polyline of the State Border of Ukraine and a calculated 5-kilometer buffer zone around it. The data were obtained from the Ministry for Development of Communities and Territories of Ukraine⁴⁵. The data was loaded in GeoJSON format and converted to WGS-84 coordinate system and GeoPackage format. A 5 km buffer was constructed from the inner edge of the border.

The width of the border strip is regulated by national legislation and is constant along the entire length of the state border. Therefore, the differentiation of the areas of these territories in terms of regions within the study area is determined solely by the length of the state border within their borders. The largest area of the border strip is in Zakarpatska and Chernivetska Oblasts, and the smallest is in Ivano-Frankivska Oblast. At the same time, the total percentage of the territory within this restriction is about 6.6% of the total area of the study region.

⁴⁵ <https://mtu.gov.ua/content/kodifikator-administrativnoteritorialnih-odinic-ta-teritoriy-teritorialnih-gromad.html>

2. INTEGRATIVE RESULT OF ENVIRONMENTAL CRITERIA ASSESSMENT

2.1. Algorithm of integration of criteria layers.

Algorithms for integrating environmental criteria layers are based on methods of overlap analysis and Boolean algebra.

Overlay analysis in GIS is the process of superimposing multiple spatial layers to determine where certain conditions coexist. Modern GIS overlay operations not only merge map layers visually, but also integrate their attribute data: when layers are overlaid, new output features carry the combined attributes of overlapping input features. Overlay embodies the geographic principle of areal integration and relies on the mathematics of set theory and topology – in effect treating geographic regions as sets that can be intersected or united. The vector approach uses geometric spatial operations on features (points, lines, polygons).

Vector overlay takes two or more layers of vector features (often polygons) and outputs a new layer with geometries derived from the spatial relationships between inputs. In a typical polygon-on-polygon overlay, the boundaries of input polygons are essentially cut where they intersect each other, producing smaller polygon pieces in the overlap and non-overlap areas. Each piece is a “least common geographic unit” (LCGU) – a region where a particular combination of input polygons overlaps. The overlay algorithm assembles these pieces into new polygons and constructs an output attribute table by copying attributes from each input layer’s polygon that contributed to each piece (if a piece has no overlap from one layer, that layer’s attributes may be left null).

Boolean logic and set theory underpin these vector operations. Classic overlay tools correspond to logical set operations. For example, an *Intersect* operation outputs only the areas common to all input layers – equivalent to a logical AND (and to set intersection). A *Union* includes all areas from both layers – equivalent to OR (set union), combining features and retaining even those that don’t overlap. A *Difference* (sometimes called Erase) takes one layer and subtracts any part that overlaps the other – effectively A AND NOT B. A *Symmetrical Difference* (XOR) keeps areas that are in either one layer or the other but not in both. Another common tool, *Clip*, uses one layer (often a polygon boundary) to “cookie-cut” another layer, trimming the input features to the clip layer’s extent (this is like an intersect where only the clipped layer’s attributes are kept). These overlay operations are summarized as follows:

- Intersect – retains only overlapping features/areas from the input layers ($A \wedge B$, logical AND);
- Union – combines features from all input layers, overlapping or not ($A \vee B$, logical OR);
- Difference (Erase) – removes areas of one layer that overlap with the other ($A - B$, i.e. A and NOT B);

- Symmetric Difference – retains areas that belong to either layer but exclude any overlaps (XOR);
- Clip – cuts one layer's features to the boundary of another layer, keeping only parts inside the clipping polygon (The clip result is essentially the intersection of the features with the clip polygon, but only the input layer's attributes are preserved).

These vector overlay tools allow analysts to pose a variety of spatial queries. For instance, finding all land parcels that lie *within* a flood zone is a clip or intersect operation (parcels \cap flood zone), whereas combining two land-use maps into one requires a union. Notably, an *Intersect* is one of the most frequently used overlays, since many analyses boil down to finding areas that satisfy multiple criteria simultaneously.

Implementation in QGIS: QGIS provides all the standard vector overlay operations through its Geoprocessing Tools (accessible via the menu *Vector* ► *Geoprocessing Tools* or the *Processing Toolbox*). To perform a vector overlay in QGIS, you typically load the input layers and then run the desired tool. For example, to intersect two layers in QGIS, you would open the *Intersection* tool, choose the two input vector layers (e.g. Layer A and Layer B), and specify an output. QGIS will then generate a new layer where the features correspond to the overlapping parts of A and B, with an attribute table that merges attributes from both sources. Similarly, the *Union* tool in QGIS takes two polygon layers and produces a layer containing all areas from both inputs; where polygons overlap, they are split and the output contains attributes from both layers, and where one layer had no feature, the attributes from that layer may be null in the output. The *Clip* tool (found under Geoprocessing) prompts for an Input layer and a Clip layer – for instance, clipping a roads line layer by a country boundary polygon will output only the road segments within that country's polygon. All these tools are straightforward to use via QGIS's GUI: the user selects the operation, chooses the input and overlay layers, and QGIS handles the geometric processing (using its built-in libraries like GEOS for accurate polygon intersection). The resulting layer is added to the map, ready for further analysis or map display.

Applied implementation. The conditions for the overlap analysis of environmental criteria were:

- unified layer format;
- unified coordinate system;
- polygonal layer type;
- lack of output attributes.

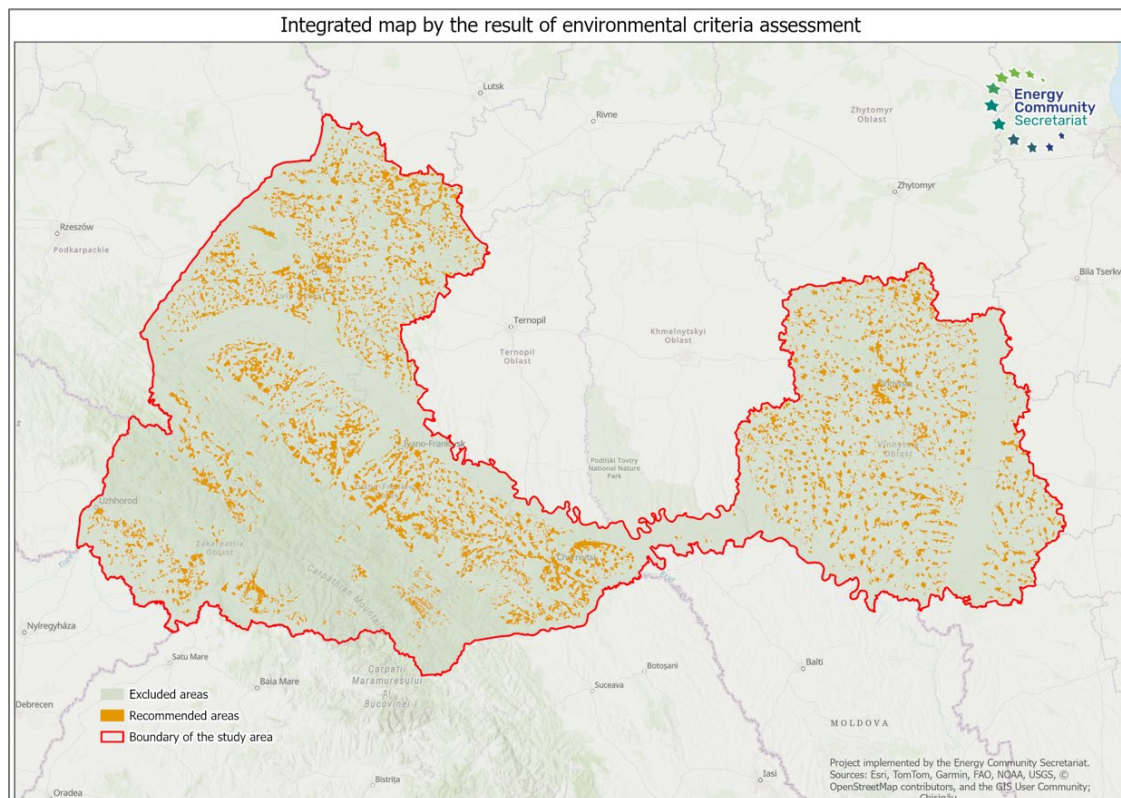
The overall integration process based on overlay analysis consisted of the following steps:

1. Formation of a separate layer in the geodatabase for each indicator.
2. Building buffers for relevant objects.

3. Performing iterative overlay operations using the layer merging method.
4. Obtaining the final integral constraint layer.

The Union tool was selected to perform operations in the GIS environment.

The result was saved in the geodatabase in the format GeoPackage as a separate layer and laid out in map presented below (see Pic. 1.14).



Pic. 1.14. Integrated map by the result of environmental criteria assessment.

2.2. Spatial analysis of the environmental criteria assessment results.

The spatial distribution of the territories identified as having the potential for RAAs designation within their borders is mosaic and fragmented.

Their greatest concentration is observed in the northern and eastern parts of Lvivska Oblast, in the foothills of Ivano-Frankivska Oblast, in the lowland part of Zakarpatska Oblast, within the Khotyn Upland and north-western territorial communities of Chernivetska Oblast, as well as in Vinnytska Oblast, where the density of potentially suitable sites is relatively uniform throughout the territory (with the exception of the migration corridor). The Carpathian mountain region, as well as the main river valleys of the Dniester, Prut and Tysa, are almost completely excluded due to a combination of environmental and ornithological restrictions.

By the nature of use and spatial structure, the identified areas are mainly of anthropogenic origin. These are the territories of industrial facilities, warehouses, building roofs, technical zones, areas of technogenically altered lands, as well as

individual sites along highways and railways. In the foothill areas of Ivano-Frankivska, northern Zakarpatska and Chernivetska Oblasts, suitable areas are local, insular character and usually adjacent to settlements. This distribution indicates the predominance of urbanized and post-industrial landscapes in the structure of potential zones for the RAAs designation.

In general, the results obtained demonstrate that the identified areas have low environmental value, favourable topographic parameters and sufficient accessibility to engineering infrastructure. The highest potential for the further development of renewable energy is observed in Vinnytska and northern parts of Lvivska Oblasts, as well as in local foothill zones of Ivano-Frankivska Oblast. Taking into account comprehensive ecological, biotic and spatial criteria ensured an ecologically balanced approach to the identification of areas and minimized the risks of impact on natural ecosystems and biodiversity. Thus, the results obtained can serve as a basis for strategic planning of RAAs distribution and further planning their locations at the local level.

3. RECOMMENDATIONS FOR FURTHER APPLICATION OF THE RESULTS OF ENVIRONMENTAL CRITERIA ASSESSMENT

3.1. The purpose of the generated integrative environmental constraints map.

The generated integrative environmental constraints map is a result of a preliminary high-level spatial analysis from the perspective of environmental vulnerability. It represents the division of the study territory into areas that are a subject to certain environmental restrictions and areas that have a reduced probability of environmental conflicts when placing RAAs.

Its main function is not only to show the current state of spatial distribution of environmental constraints, but mainly to provide the possibility of in-depth modelling and variant analysis. While the study has been conducted at a regional level to a considerable extent based on open source data, it is worth emphasizing that the results obtained are indicative in nature and cannot be considered as a direct guide to practical actions. The map is a demonstration of a methodological approach that requires further refinement at local levels with the involvement of current, planning and technical data, as well as taking into account the specifics of individual types of renewable energy facilities. The received result of the study can be considered as a dynamic spatial-analytical tool that integrates a set of thematic layers that reflect various aspects of territorial organization (from natural conditions and land use structure to environmental restrictions and other planning regulations).

A feature of the created map is its adaptability to changes in input parameters and assessment criteria. This allows to gradually expand the analytical base by integrating new criteria and indicators, for example, data on the sanitary or historical restrictions, the level of anthropogenic load or forecast climate parameters, as well as refine the applied indicators and analysis parameters, and update input data. Thanks to this, the map can be transformed from a basic spatial analysis tool into a comprehensive decision-making support system for energy planning.

In a geoinformation environment, the generated map can be used to conduct sequential spatial analysis, which allows:

- to combine layers of criteria in different combinations to identify areas where favourable conditions coincide;
- to impose restrictions to identify areas with a high level of environmental vulnerability, where the placement of objects is extremely impractical;
- to apply clipping to exclude from further consideration areas that are a subject to strict environmental or legal restrictions;
- to form different scenarios of suitability, for example, comparing options focused on minimizing environmental impact or, conversely, on maximum infrastructure accessibility;
- to conduct a quantitative assessment of the areas of territories by suitability categories, which allows forming a structured basis for making management and planning decisions.

Thanks to such applied approach to its formation, the map is a spatial modelling tool that allows not only to record the current distribution of indicators, but also to identify patterns and spatial relationships between natural and functional parameters. Analysis of the results of overlay combinations of criteria helps to trace the influence of certain factors on the overall structure of the suitability of territories – for example, to assess how the formation of buffer zones or the inclusion of additional planning restrictions changes the available area for the placement of renewable energy facilities. The map also demonstrates which territories require additional local detailing, which is important for pinpointing possible areas for the location of RAAs. It allows to identify spatial patterns and potential limitations that are not always obvious when using individual data layers, and also serves as a guideline for prioritizing the study of territories with greater infrastructure accessibility.

Therefore, the map can be used as a basis for constructing thematic analytical sections and, provided that it is used as a basic model for further analytical processing, creates the possibility of a flexible transition from the regional to the local level of analysis, gradual refinement of data and detailing of the boundaries of territories potentially suitable for the location of renewable energy facilities. At the regional level, it reflects the general structure of the suitability of territories, forming the context for a strategic vision for the development of RAAs. At the local level, it serves as a basis for conducting more detailed assessments and specifying the boundaries of potential sites for the accelerated deployment of renewable energy sources.

Thus, the created map is not a static result of analysis, but a tool for continuous modelling and data verification, which helps to increase the validity of spatial decisions.

3.2. Necessary clarifications for the assessment improvement.

In modern approaches to managing spatial planning and development, the quality of input data used to build geospatial models is of particular importance. Depending on the purpose of the study and the level of detail, various sources of geospatial information are used - from open to official state databases. These sources differ significantly in the degree of accuracy, completeness of attribute information, spatial resolution and level of reliability.

As noted above, the integrative map generated within the framework of the current Project is conceptual in nature and is intended for a preliminary spatial analysis of the environmental vulnerability of the study territory. At this stage of the study, there is quite enough to use open source data, the use of which allowed us to carry out the initial spatial interpretation of the territory, determine the general patterns of the placement of criteria and their relationships, and also form an analytical basis for subsequent detailing.

Further refinement of the geospatial model at the stage of planning locations for official designation of RAAs requires the use of reliable, updated and metrically accurate data. This is information from official sources, which is formed by state authorities (ministries, state and national services and agencies), local governments or owners of relevant databases. These data are the basis for the precise definition

of the boundaries of territorial objects, the analysis of land use parameters, the assessment of the state of natural resources and the verification of the results obtained at the previous stages.

Table 1.1. Recommended data sources for RAAs locations official planning.

Criteria	Required data	Recommended data sources
Criterion 1.1: Areas protected under international legislation	Areas of Emerald Network Sites.	<i>Is already used in the current study.</i> The official web-map of European Environment Agency on Emerald Network Sites: https://emerald.eea.europa.eu .
	Geospatial data in vector format on location of Wetlands of International Importance (protected under the Ramsar Convention).	<i>Is already used in the current study.</i> The official web-site of Ramsar Convention: https://www.ramsar.org
	Areas of UNESCO Biosphere Reserves.	<i>Is already used in the current study.</i> The official web-site of the UNESCO Man and the Biosphere Programme: https://www.unesco.org/en/mab .
Criterion 1.2: Areas designated under national protection schemes for nature and biodiversity conservation.	Registers and Geospatial data in vector format on location of Nature Reserve Fund of Ukraine.	The Ministry of Economy, Environment and Agriculture of Ukraine <i>and</i> Oblast Military-Civil Administrations.
Criterion 1.3: Major bird migratory routes.	Geospatial data in vector format on pathing major bird migratory routes along the territory of Ukraine.	The Ministry of Economy, Environment and Agriculture of Ukraine. <i>Additional research is required.</i>
	Geospatial data in vector format on locations of areas defined as Important Bird and Biodiversity Area.	<i>Is already used in the current study.</i> BirdLife International. (Data obtained through: https://datazone.birdlife.org/contact-us/request-our-data)
Criterion 1.4: Other sensitive areas identified through sensitivity maps and relevant tools.	Geospatial data in vector format on observations of endangered species of flora and fauna listed in the Red Book of Ukraine and international lists.	The Ministry of Economy, Environment and Agriculture of Ukraine. <i>Additional research is required, the collected data by NGOs might be used.</i>
	Geospatial data in vector format on	The Ministry of Economy, Environment and Agriculture of Ukraine.

Criteria	Required data	Recommended data sources
	location of peatlands to be protected.	<i>Additional research is required.</i>
Criterion 2.1: Elevation. Criterion 2.2: Steep slopes.	Elevation model.	The State Service of Geodesy, Cartography and Cadastre of Ukraine.
Criterion 2.3: Areas prone to flooding.	Geospatial data in vector format on areas with a probability of flooding of 1%.	The State Emergency Service of Ukraine.
Criterion 3.1: Areas of forest fund.	Geospatial data in vector format on location of the lands of forest fund.	The State Agency of Forest Resources of Ukraine.
Criterion 3.2: Areas of water fund.	Waterbodies areas and lines.	The State Agency of Water Resources of Ukraine.
Criterion 3.3: Agricultural lands.	Geospatial data in vector format on location of the lands of agricultural purpose.	The State Service of Geodesy, Cartography and Cadastre of Ukraine (data of the State Land Cadastre).
Criterion 3.4: Recreational lands.	Geospatial data in vector format on location of the lands of recreational purpose.	The State Service of Geodesy, Cartography and Cadastre of Ukraine (data of the State Land Cadastre).
Criterion 4.1: Artificial and built surfaces.	Areas covered artificial and built surfaces.	The State Service of Geodesy, Cartography and Cadastre of Ukraine.
Criterion 5.1: State border regime areas.	Geospatial data in vector format on location of the state border of Ukraine.	State Border Guard Service of Ukraine.

Without the involvement of official sources, spatial modelling risks losing analytical correctness, which can lead to distortions and critical errors in subsequent planning or management decisions.

The refinement of the spatial model has to be carried out pointwise, within a specific territory of interest, where maximum accuracy of coordinates, relevance of attribute data and confirmation of legal ownership of objects are required. This approach allows to avoid errors associated with incorrect interpretation of data, and also provides high analytical reliability of the results. The involvement of official sources at this stage ensures that spatial models not only reflect the real state of the territory, but are also suitable for scientifically sound planning, management decision-making and practical use in the processes of placing RAAs.

Thus, the integration of open and official data sources provides a balance between the efficiency of forming a conceptual map and the accuracy and reliability of the spatial model at the stage of its detailing.

In addition, regular changes in land use structure, the state of natural ecosystems, legislative requirements, as well as conducting new observations and research require systematic updating of spatial data for the date of RAAs designation assessment. Thus, even reliable data entered into a spatial model must be updated over time.

At the next steps of the assessment some of the criteria might be detailed and refined. Thus, the data on degraded lands might supplement the data on agricultural lands to exclude such areas from environmentally vulnerable and provide possibility for planning RAAs on such lands.

Considering the major bird migratory routes criteria demands conducting additional research to determine exact areas necessary for supporting birds' migration to be included to the spatial analysis for the purposes of RAAs designation. Also other species migratory routes (bats, insects etc.) might be also consider in case of availability of relevant and reliable data.

Indicators on sensitive areas, such as areas of high concentration of endangered species observations, and locations of peatlands to be protected require additional research to be conducted to ensure efficient consideration in RAAs planning.

Also it might be taken into account that currently in Ukraine there are no completed cadastre databases on protected areas and land resources to be taken for automated consideration in assessment. All available in the state authorities data needs to be completed and checked for ensuring the reliable result.

While the Project area doesn't cover the regions with sea coasts, the possibility of designation of RAAs along sea coasts and on shelf areas has to be analysed additionally and special criteria regarding waterside protection zones has to be elaborated for such areas.

Since the Law of Ukraine "On the Ecological Network of Ukraine"⁴⁶ lays down the regulatory and legal foundations for the formation of a holistic network of territories that are of special value for environmental protection and, in accordance with the laws and international obligations of Ukraine, are subject to special protection, it is recommended to consider ecological network schemes as an additional source of data on the territories that are of special value for environmental protection in case such schemes been elaborated for the relevant area.

Planning specific RAAs locations require data detailing to provide in-depth analysis, including clarification of geospatial parameters of any existed at the area constraints, their typification, degrees of environmental value, physical characteristics, etc.

The system of criteria and indicators used in the study covers the main natural, environmental and land management aspects that determine the feasibility of

⁴⁶ The official text of the Law of Ukraine "On the Ecological Network of Ukraine" available at: <https://zakon.rada.gov.ua/laws/show/1864-15#Text>

applying accelerated mechanisms for the placement of renewable energy facilities within the region. At the same time, the level of detail of the indicators and the degree of their spatial adaptation to the regional context require further improvement to ensure the effective use of data at the local level. At the lower level, it is worth ensuring greater accuracy of cartographic materials and supplementing the system with indicators that take into account existing planning restrictions and other spatial development conditions.

First of all, these are protective restrictions. This subgroup includes protection zones of engineering infrastructure facilities, namely: protection zones of transport, energy, hydrometeorological observations objects. The parameters of such restrictions are determined taking into account technical characteristics of an object in accordance with the provisions of regulatory documents. This category also includes zones of special land use regime – protective zones around military units, facilities and other military formations formed in accordance with the legislation of Ukraine.

A large group is made up of sanitary restrictions: sanitary protection zones, distances and gaps. Their parameters are determined in accordance with the sanitary classification, technological characteristics and capacity of the facilities from which they are installed, in accordance with the provisions of the State Sanitary Rules for Planning and Development of Settlements⁴⁷, State Construction Regulations B.2.2-12:2019 "Planning and Development of Territories"⁴⁸, as well as other state and departmental construction standards, sanitary rules and norms, industry regulatory documents.

Sanitary protection restrictions constitute a separate subgroup, as they are taken into account on the basis of specialized projects. These include sanitary protection zones of sources and water supply structures of centralized drinking water supply systems, which are established in accordance with the Water Code of Ukraine⁴⁹ and State Construction Regulations V.2.5-74:2013 "Water supply. External networks and structures"⁵⁰. The regimes of districts and zones of sanitary (mining and sanitary) protection of resorts are determined in accordance with the provisions of the Law of Ukraine "On Resorts"⁵¹.

Significant restrictions within the research areas are created by airfields and helipads. Decision-making on the location of new facilities, including renewable energy facilities, requires compliance with restrictions related to the characteristics of aircraft flight paths (building restriction surfaces, air approach strips). In part, the use regimes of territories in the zones of influence of airfields are determined by the

⁴⁷ The official text of the State Sanitary Rules for Planning and Development of Settlements⁴⁷, approved by Order of the Ministry of Health of Ukraine dated June 19, 1996 No. 173, available at:

<https://zakon.rada.gov.ua/laws/show/z0379-96#Text>

⁴⁸ The official text of the State Building Regulations B.2.2-12:2019 "Planning and Development of Territories", available at: https://e-construction.gov.ua/laws_detail/3260441209981634046

⁴⁹ The official text of the Water Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/213/95-tp#Text>

⁵⁰ The official text of the State Construction Regulations V.2.5-74:2013 "Water supply. External networks and structures" available at: https://e-construction.gov.ua/laws_detail/3307711387089765865?doc_type=2

⁵¹ The official text of the Law of Ukraine "On Resorts" available at: <https://zakon.rada.gov.ua/laws/show/2026-14#Text>

provisions of the Air Code of Ukraine⁵² and State Construction Regulations B.2.2-12:2019 "Planning and development of territories"⁵³. The parameters of the specified restrictions, established based on the materials of airfield noise maps, are also taken into account.

Historical and cultural restrictions form a subgroup of historical and cultural nature, covering a wide range of objects: cultural heritage monuments and/or their territories, world cultural heritage sites and their buffer zones, historical areas of settlements, protected archaeological territories, historical and cultural reserves, protected areas, cultural heritage monument protection zones, development regulation zones, protected landscape zones, archaeological cultural layer protection zones and other objects. Such restrictions are taken into account during territory planning if there are any documents on their establishment, since they are determined by the relevant scientific and design documentation – the historical and architectural reference plan.

Additional restrictions on the economic use of the territory, which complicate or completely exclude the possibility of building renewable energy facilities, may be established based on the results of the engineering and construction assessment of the territory at the local level. Among them: location in the zone of manifestations of dangerous geological processes (landslides, various types of erosion, abrasion, karst), areas of waterlogging and groundwater flooding (with groundwater levels ≤ 3 m from the surface).

In general, the complex of planning restrictions that must be taken into account during research at the local level aimed at identifying territories favourable for the RAAs designation depends primarily on the characteristics of the project facilities themselves and is a subject to mandatory consideration during the development of the relevant spatial/urban planning and construction documentation.

3.3. Established in Ukraine environmental impact mitigation measures.

According to the requirements of the Revised RED before their adoption, the plans designating renewables acceleration areas shall be subject to a Strategic Environmental Assessment pursuant to Directive 2001/42/EC of the European Parliament and of the Council (*16), and, if they are likely to have a significant impact on Natura 2000 sites, to the Appropriate Assessment pursuant to Article 6(3) of Directive 92/43/EEC.

In addition, the Revised RED introduces a distinct and mandatory obligation for Member States to establish a binding set of environmental mitigation measures specifically applicable within RAAs. This mitigation framework must ensure that renewable energy plants, co-located energy storage facilities, and associated grid-

⁵² The official text of the Air Code of Ukraine available at: <https://zakon.rada.gov.ua/laws/show/3393-17#Text>

⁵³ The official text of the State Building Regulations B.2.2-12:2019 "Planning and Development of Territories", available at: https://e-construction.gov.ua/laws_detail/3260441209981634046

connection infrastructure are designed and operated in a manner that avoids adverse environmental impacts or, where avoidance is not possible, significantly reduces them. The measures must be effective, proportionate, and applied in a timely manner, and must guarantee full compliance with the requirements of Article 6(2) and Article 12(1) of the Habitats Directive, Article 5 of the Birds Directive, and Article 4(1)(a)(i) of the Water Framework Directive.⁵⁴ To operationalise this requirement, Ukraine will need to:

- introduce a legal basis mandating the adoption of an RAA-specific mitigation rulebook,
- develop and approve the rulebook through secondary legislation, and
- integrate these mitigation measures directly into both RAA designation and the streamlined permitting procedure for projects located within RAAs.

At the same time in the renewables acceleration areas, renewable energy projects that comply with the environmental mitigation measures identified in the plans prepared by Member States, should be exempt from the obligation to carry out a specific environmental impact assessment at project level within the meaning of Directive 2011/92/EU, with the exception of projects where Member State has determined to require an environmental impact assessment in its national mandatory list of projects and of projects which are likely to have significant effects on the environment in another Member State or where a Member State that is likely to be significantly affected so requests. The obligations under the Convention on environmental impact assessment in a transboundary context (17), signed in Espoo on 25 February 1991, should remain applicable to Member States where the project is likely to cause a significant transboundary impact in a third country.

The procedures of strategic Environmental Assessment and Environmental Impact Assessment have been introduced into Ukrainian legislation. These procedures have to be considered while placing RES facilities in general and designating RAAs in particular like for example in the preparation of the National Renewable Action Plans. However, currently the full implementation of the both mechanism is limited due to the applicable martial law.

The procedure and responsibilities under the strategic environmental assessment are established by the Law of Ukraine "On Strategic Environmental Assessment"⁵⁵. This Law regulates relations in the field of environmental impact assessment, including for public health, implementation of state planning documents and applies to state planning documents that relate to agriculture, forestry, fisheries, energy, industry, transport, waste management, water resource use, environmental protection, telecommunications, tourism, urban planning or land management (schemes) and the implementation of which will involve the implementation of activities (or which contain activities and facilities) for which the legislation provides for the implementation of an environmental impact assessment procedure, or which

⁵⁴ For examples of mitigation measures tailored to wind and solar energy development, see the IUCN Guidelines on Mitigating Biodiversity Impacts Associated with Wind and Solar Energy Development.

⁵⁵ The official text of the Law of Ukraine "On Strategic Environmental Assessment" available at: <https://zakon.rada.gov.ua/laws/show/2354-19#Text>

require an assessment, taking into account the likely consequences for territories and facilities of the nature reserve fund and the ecological network, except for those related to the creation or expansion of territories and facilities of the nature reserve fund.

According to the Law, the parties to the implementation of the Strategic Environmental Assessment procedure are the customer of the relevant state planning document, the central executive bodies implementing the state policy in the field of environmental protection and health protection, relevant departments on environmental protection and health protection of state administrations on regional level of state government, other executive bodies, local self-government bodies, the public, and in case of potential cross border impacts – the state of origin and the affected state.

The strategic environmental assessment procedure is carried out through the following stages:

1. Determining the scope of the Strategic Environmental Assessment.
2. Drawing up a Strategic Environmental Assessment Report.
3. Conducting public discussions and consultations, as well as transboundary consultations in accordance with the procedure provided by the Law.
4. Taking into account the Strategic Environmental Assessment Report, the results of public discussions and consultations in improvement the state planning document.
5. Informing about the approval of the state planning document.
6. Monitoring the consequences of the implementation of the state planning document for the environment, including for public health.

The Law of Ukraine “On Environmental Impact Assessment”⁵⁶ establishes the legal and organizational principles of environmental impact assessment aimed at preventing environmental damage, ensuring ecological safety, environmental protection, rational use and reproduction of natural resources, in the process of making decisions on the implementation of economic activities that may have a significant impact on the environment, taking into account state, public and private interests.

Environmental Impact Assessment is carried out in compliance with the requirements of environmental protection legislation, taking into account the state of the environment in the place where the planned activity is planned to be carried out, environmental risks and forecasts, prospects for socio-economic development of the region, the capacity and types of cumulative impact (direct and indirect) on the environment, including taking into account the impact of existing facilities, planned activities and facilities for which a decision has been received to carry out the planned activity or the issue of making such decisions is being considered.

The parties of Environmental Impact Assessment are business entities, state authorities, local self-government bodies that are customers of the planned activity, the authorized central body, authorized territorial bodies, other executive bodies, the

⁵⁶ The official text of the Law of Ukraine “On Environmental Impact Assessment” available at: <https://zakon.rada.gov.ua/laws/show/2059-19#Text>

Supreme Rada of the Autonomous Republic of Crimea, the Council of Ministers of the Autonomous Republic of Crimea, local self-government bodies, the public, and in cases of potential cross border impacts – the state of origin and the affected state.

The Environmental Impact Assessment Procedure provides for:

- preparation by the economic entity of an environmental impact assessment report in accordance with the Law requirements;
- holding a public hearing;
- analysis by the authorized body of the information provided in the Environmental Impact Assessment Report, any additional information provided by the economic entity, as well as information received from the public during the public hearing, during the transboundary impact assessment procedure, and other information;
- provision by the authorized body of a reasoned conclusion on the Environmental Impact Assessment;
- consideration of the conclusion on the Environmental Impact Assessment in the decision on the implementation of the planned activity;

In Ukraine, electronic public registers of the Strategic Environmental Assessment⁵⁷ and the Environmental Impact Assessment⁵⁸ have been introduced that reflect all documents under both procedures.

In 2025, considering the limits provided by the martial law, the Ministry of Environmental Protection and Natural Resources has developed a Concept Note outlining potential deviations from standard EIA and SEA procedures during wartime and reconstruction efforts. The Concept Note was developed at the request of the European Commission as part of Reform 6 (Chapter 27 “Environment and Climate Change”) of the Ukraine Facility Plan, a 50-billion-euro financial support program for Ukraine from the European Union over 2024-2027 which also foresees renewable project deployment and development. The Concept Note stipulates Ukraine's obligation to ensure that, in each specific case, the introduction of forced temporary deviations complies with the following principles:

- Exceptionality. Decisions on derogations should only be taken in cases of urgent need, when the situation is compelling and requires rapid management decisions, and are determined by three criteria: defence capability, restoration of critical infrastructure and elimination of the consequences of an emergency.
- Controllability. When making a forced decision to apply derogations, the state exercises control to ensure that the activities to which the derogations apply are carried out exclusively within the framework that ensures the achievement of the objectives for which such derogations were applied (elimination of emergencies, restoration, defence capability).
- Reversibility. Decisions on the application of derogations shall cease to have effect if the planned activity has been implemented or shall be repealed upon

⁵⁷ Unified Register of Strategic Environmental Assessment available at: <https://eco.gov.ua/categories/e-seo>

⁵⁸ Unified Register of Environmental Impact Assessment available at: <https://eco.gov.ua/categories/e-ovd>

the expiry of the period of martial law or upon the completion of the recovery period within 90 calendar days after the termination or repeal of martial law. Ukraine confirms its commitment to make additional efforts in the future to create an improved process for granting derogations.

While these instruments require evaluation of potential impacts on biodiversity and protected areas, Ukraine does not have a dedicated legal mechanism equivalent to the EU's appropriate assessment (AA) in the manner required under the Habitats Directive or the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). This gap is particularly problematic in the context of the Revised RED, which mandates that plans designating RAAs to be subject to AA where applicable. To advance the development of RAAs in line with EU requirements, Ukraine will need to introduce a legal basis for AA-type assessments, define conservation objectives for protected sites, and establish clear procedures and methodological guidance for evaluating impacts on these objective, while also embedding requirements to assess reasonable alternatives and apply ecological compensation measures, at both planning and project levels.

In 2025, Ukraine continued its efforts to expand and manage its protected areas, despite the substantial challenges posed by the ongoing war. By early 2025, approximately 19% of the country's terrestrial land was designated as protected. However, a significant share of these areas remain under occupation or are located in active combat zones, facing direct environmental damage. According to the Ukrainian Nature Conservation Group, forests within war-affected zones, either temporarily controlled by Russian forces or inaccessible to Ukraine, cover more than 3 million hectares, representing roughly 22% of all forested areas in the country. Virgin steppes in these zones amount to 1,654,736 hectares, or approximately 59% of Ukraine's total steppes, while shrublands account for 4,514 hectares, over 10% of the national total. Among the highest protection category of the nature reserve fund, including national parks, natural and biosphere reserves, 44% of the total 1,236,366 hectares are located in war-affected zones, under temporary occupation, or otherwise inaccessible. These figures highlight the extensive pressures on Ukraine's most valuable natural areas and the significant risks to biodiversity and ecosystem integrity posed by the conflict.

If the Draft Law "On Territories of the Emerald Network" is adopted, Emerald Network sites would become a legally recognised category of nature protection areas in Ukraine, and the law would introduce a procedure comparable to the EU Appropriate Assessment (AA). The draft law foresees mandatory assessment of plans or projects that may significantly affect Emerald sites, including analysis of impacts on the habitats and species for which each site is designated. This would bring Ukraine closer to the EU Habitats and Birds Directives, where AA is required to determine whether a plan or project is likely to have adverse effects on the integrity or conservation objectives of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). Under such a system, activities must undergo a screening stage to determine whether significant effects are likely, and if so, a detailed assessment must follow—leading to conditions, alternatives, or prohibitions where

necessary to safeguard the site. Adoption of this draft law would therefore establish the legal basis for an AA-type mechanism in Ukraine, which is currently absent, and would be essential for ensuring that future spatial planning and renewable energy development, including Renewable Energy Acceleration Areas, comply with EU nature-protection standards.

Although the proposed methodology of RAAs identification foresees exclusion of all Emerald Network Sites from potential RAAs, still there is a possibility of remote influence of the RES facilities on Emerald Network Sites, thus a procedure comparable to the EU Appropriate Assessment might be also necessary on the stage of specific facilities designation within a specific RAA.