



## **Integrated Renewable Energy Planning in Southeast Europe**

**Pilot project: Integrated Wind and Solar Planning in  
Zadar County**

**Renewable Energy Siting Framework**

**Contract number:**

**Service provider:**

Energy Institute Hrvoje Požar

Savska cesta 163, Zagreb

**Client: The Nature Conservancy (TNC)**

**Title:**

**Integrated Renewable Energy Planning in Southeast Europe**

**Pilot project: Integrated Wind and Solar Planning in Zadar County**

**Authors:**

Veljko Vorkapić

Željka Fištrek

Ana Kojaković

Siniša Knežević

**Associated expert:**

MSc Vesnica Koščak Miočić Stošić

Zagreb, April 2021

## **Copyright**

*Any information and documents provided by the Client are the property of the Client and the Service Provider cannot use them outside the scope of the Contract, without the prior written consent of the Client.*

*The Service Provider will keep as a business secret all the information it receives from the Client or third parties under the order of the Client in connection with the Contract. Any business data prepared by the Service Provider or its subcontractors for the purpose of executing the Contract shall also be regarded as a business secret.*

## **Responsibility**

*The Service Provider is under no circumstances responsible for the implementation of the Study's results. This responsibility lies exclusively with the Client.*

## **Confidentiality**

*02 – available only for the Service provider and Client*

## **Acknowledgments**

The authors would like to express their gratitude to Zadar County for endorsing the project. They also extend their gratitude for the valuable inputs, critical comments and suggestions from experts from the following institutions:

Institute for Environment and Nature Conservation, Ministry of Economy and Sustainable Development

Institute for Spatial Development, Ministry of Physical Planning, Construction and State Assets

Physical Planning Institute of Zadar County

Faculty of Agriculture, University of Zagreb

Biom Association

Association for Bat Conservation Tragus

The Nature Conservancy

Prof. dr. sc. Josip Kusak

Emily Gray (editing)

**Table of contents**

---

- Executive Summary ..... 7**
- 1 Introduction ..... 9**
- 2 Sensitivity maps .....11**
  - 2.1 Approach and methodology ..... 11
  - 2.2 Exclusion and Very High Sensitivity areas..... 13
  - 2.3 Indicators ..... 17
  - 2.4 Stakeholder engagement..... 20
  - 2.5 Sensitivity maps ..... 21
- 3 Suitability for RES.....26**
  - 3.1 Suitability for solar power plants..... 26
  - 3.2 Suitability for wind power plants..... 30
- 4 Conclusions .....33**
- 5 References .....35**
- 6 Annexes .....36**
  - Annex 1 – List of exclusion zones and very high sensitivity areas ..... 36
  - Annex 2 – List of indicators ..... 43
  - Annex 3 - Datasets used for sensitivity analysis..... 55
  - Annex 4 – Weighting factors used for sensitivity analysis ..... 57
  - Annex 5 – Stakeholder engagement ..... 59

## List of figures and tables

---

|  |    |
|--|----|
| Figure 2-1. Sensitivity map of Zadar County for solar power plants.....  | 22 |
| Figure 2-2. Sensitivity map of Zadar County for wind power plants.....   | 24 |
| Figure 3-1. Suitability map for SPP .....  | 28 |
| Figure 3-2. Area suitable for SPP within low sensitivity areas .....   | 29 |
| Figure 3-3. Suitability map for WPP .....  | 31 |
| Figure 3-4. Area suitable for WPP within low sensitivity areas.....  | 32 |
| <br>   |    |
| Table 2.1. Potential negative effects of wind and solar power plants.....  | 11 |
| Table 2.2. Areas and features where construction of wind and solar power plants is either legally prohibited or restricted ..... | 12 |
| Table 2.3. The colour ramp for presentation of sensitivity maps .....  | 13 |
| Table 2.4. Legal restrictions on the siting of wind power plants and solar power plants .....                                    | 13 |
| Table 2.5. Areas of very high sensitivity for the siting of wind power plants and solar power plants .                           | 15 |
| Table 2.6. Indicators used in the sensitivity analysis of WPP.....   | 17 |
| Table 2.7. Indicators used in the sensitivity analysis of SPP .....  | 19 |
| Table 2.8. Area of each sensitivity level for SPP .....  | 23 |
| Table 2.9 Area of each sensitivity level for WPP .....   | 25 |
| Table 3.1. Suitability criteria for SPP .....  | 26 |
| Table 3.2. Area suitable for SPP development within each sensitivity level.....  | 26 |
| Table 3.3. Suitability criteria for WPP .....  | 30 |
| Table 3.4. Area suitable for WPP development within each sensitivity level.....  | 30 |

## Abbreviations and Acronyms

---

AHP – Analytic Hierarchy Process

CLC – CORINE Land Cover

CR – Critically endangered

DEM – Digital elevation model

EIA – Environmental Impact Assessment

EN – Endangered

GHG – Greenhouse gasses

MCA – Multi-Criteria Analysis

MZOE – Ministry of Environment and Energy

MINGOR – Ministry of Economy and Sustainable Development (eng. MESD)

MGIPU – Ministry of Construction and Physical Planning

MPGI – Ministry of Physical Planning, Construction and State Assets

MPS – Ministry of Agriculture

NECP – National Energy and Climate Plan

PV – Photovoltaic

RES – Renewable energy sources

SCI – Site of Community Importance

SEA – Strategic Environmental Assessment

SPA – Special Protection Area

SPP – Solar power plants

VU – Vulnerable

WF – Weighting factor

WPP – Wind power plants

## EXECUTIVE SUMMARY

---

According to Croatia's Energy Development Strategy (OG 25/20) and integrated National Energy and Climate Plan (NECP), the country plans to increase the capacity of wind power plants (WPP) and solar power plants (SPP) to 1,364 MW and 768 MW respectively by 2030. This equals 20.8% and 11.7%, respectively, of Croatia's total planned power generation capacity in 2030. These capacities are expected to increase further by 2050.

However, increasing the installation of renewable energy sources (RES) creates significant demand for land and resources. This creates a potential conflict between the climate policies and the preservation of natural capital. If this installation is not carefully planned, it can also lead to delays that increase the costs of RES projects for governments and investors.

The objective of the *Pilot project: Integrated Wind and Solar Planning in Zadar County* is to contribute to climate change mitigation through the increased deployment of RES and sustainable use of natural resources and to facilitate administrative procedures for the development of RES projects. The project develops an approach and methodology for the evaluation of space sensitivity to wind and solar power plants that considers potential negative effects on nature, land use and landscape.

Zadar County was selected as a pilot area for the development of sensitivity maps. The county is located in the central Adriatic part of Croatia and it encompasses northern Dalmatia and south-eastern Lika. Zadar County is characterised by a high natural potential for RES, with around 2,600 hours of sunshine annually and favourable wind conditions, both of which make it attractive for SPP and WPP developers. On the other hand, the county is also rich in biodiversity and cultural sites. Within the county, there are 20 protected sites covering 10.5% of the county's territory, and 50.3% of its land territory is included in the Natura 2000 ecological network. At the moment, there are eight operating wind farms with a total installed capacity of around 215 MW. There is high interest in new developments, both in SPP and WPP, which will be considered in the course of the development of the county's new spatial plan. Due to its spatial sensitivity and RES potential, the county seemed appropriate for the application of this novel approach.

The methodology developed serves as a tool for spatial planning as it provides guidelines based on defined criteria and thresholds important for the sustainable utilisation of RES. The project does not intend to provide technical guidelines for the impact assessment of individual wind and solar projects or to replace existing Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures but rather to speed up development and avoid potential conflicts in the initial project phase. Finally, the project informs potential project developers about site sensitivity levels and potential risks associated with different locations in order to facilitate the implementation of RES projects.

The development of sensitivity maps is based on a three-step approach. In the first two steps, areas which cannot be used for wind and solar siting due to legal constraints (exclusion zones) and areas which are potentially highly vulnerable to the establishment of wind and solar plants (very highly sensitive) are identified. In the third step, evaluation of the remaining areas against a set of indicators and determination of their sensitivity level using a multi-criteria analysis (MCA) is performed. Indicators are divided into three categories: nature and biodiversity; natural resources important for economic activities; and social and cultural features. Based on the results of the MCA, areas are categorised as low, medium or high sensitivity areas. The sensitivity areas were also compared to

suitability areas for the resources, based on natural potential and technical requirements, to identify areas within Zadar County that are both low sensitivity and potentially suitable for RES development.

The analysis shows that there are 31,833 hectares (ha) of potentially suitable land (good to excellent suitability) for SPP within very high sensitivity areas and 1,302 ha within high, 12,734 ha within medium, and 22,188 ha within low sensitivity areas in Zadar County. Assuming that 2 ha of land are required for 1 MW SPP capacity, Zadar County's potential capacity amounts to 15,917 MW in very high sensitivity areas and 651 MW within high, 6,367 MW within medium, and 11,094 MW within low sensitivity areas.

In the case of WPP, there are 40,910 ha of potentially suitable land (good to excellent suitability) for WPP within very high sensitivity areas and 117 ha within high, 5,655 ha within medium, and 8,451 ha within low sensitivity areas in Zadar County. Assuming that 15 ha of land are required for 1 MW of wind energy capacity (based on a more recent WPP build in Croatia, although this number varies significantly), Zadar County's potential capacity amounts to 2,727 MW in very high sensitivity areas and 8 MW within high, 377 MW within medium, and 563 MW within low sensitivity areas.

The SPP and to a lesser degree WPP potentials estimated for low sensitivity areas within Zadar County can contribute significantly to Croatia's efforts to reach the national RES targets defined for 2030.

# 1 INTRODUCTION

---

The Nature Conservancy (TNC) and Energy Institute Hrvoje Požar (EIHP) signed a Memorandum of Understanding (MOU) in December 2019 with the objective of formalising a mutual collaboration for the purpose of jointly launching and implementing an *Initiative for Integrated Renewable Energy (RE) Planning in Southeast Europe*. The purpose of the initiative is to accelerate the deployment of renewable energy in Croatia and across Southeast Europe, namely by incorporating environmental and social values in the planning phase to reduce conflicts and facilitate RES development.

With its climate and energy framework, the EU aims to reduce its greenhouse gas (GHG) emissions by at least 40% from 1990 levels and to increase the share of RES in its energy mix to at least 32% by 2030. Moreover, in 2020, the European Commission proposed a new target to cut GHG emissions to at least 55% by 2030 in order to reach carbon neutrality by 2050. In line with the EU climate and energy policy and these legislative developments, Croatia developed the Energy Development Strategy (OG 25/20), which covers the period up to 2030 and has an outlook to 2050. According to this Energy Development Strategy and the integrated National Energy and Climate Plan (NECP) for the period 2021-2030, Croatia plans to increase the capacities of wind power plants (WPP) and solar power plants (SPP) to around 1,364 MW and 768 MW (two-thirds of the planned SPPs would be non-integrated systems) respectively by 2030. These capacities are expected to increase further by 2050.

However, increasing the installation of renewable energy sources (RES) creates significant demand for land, potentially creating a conflict between the RES targets and the preservation of natural capital. This could lead to delays or even cancellations that increase the costs of RES projects for governments and investors. Since investors are often guided by the locations for RES developments indicated in spatial plans, when incorrect positioning based purely on wind potential is included in these plans, it can result in long and costly procedures for investors and even project cancellation. The application of a sensitivity approach can potentially reduce this risk.

The objective of the *Pilot project: Integrated Wind and Solar Planning in Zadar County* is to contribute to climate change mitigation through increased deployment of RES and sustainable use of natural resources, and to facilitate administrative procedures for the development of RES projects. The project developed an approach and methodology for the evaluation of space sensitivity for wind and solar power plants considering potential negative effects on nature, land use and landscape.

The methodology for the development of sensitivity maps was developed through a participatory approach that included various experts, based on the currently available data and information about the status of natural resources, flora and fauna, cultural heritage and landscape value, taking into consideration the existing and planned land use patterns. The aim was to identify sites with high sensitivity where RES should not be implemented, but also sites with lower sensitivity in order to stimulate the deployment of renewable energy there.

Zadar County was selected as a pilot area for the development of sensitivity maps. The county has rich biodiversity, and around 50% of its area is part of the NATURA 2000 ecological network. The county, as most of coastal Croatia, is also rich in solar and wind resources. The county represents a good case to analyse potential conflicts and expected trade-offs related to RES developments in Croatia (especially for the coastal areas, where most of the RES developments are expected). Nevertheless, the aim was to develop a methodology that can be scaled up to the national level or used in any other county.

The methodology developed serves as a tool for spatial planning as it provides guidelines based on defined criteria and thresholds important for the sustainable utilisation of RES. The project does not intend to provide technical guidelines for the impact assessment of individual wind and solar projects or to replace existing Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures. The development of the sensitivity maps did not encompass targeted field research and evaluation of potential impacts arising from specific projects. However, the methodology can serve as a baseline and provide support for future SEAs. Finally, the project informs potential project developers about site sensitivity levels and the potential risks associated with a location in order to facilitate the implementation of RES projects.

## 2 SENSITIVITY MAPS

To support the spatial planning process and identification of suitable sites for solar and wind power plants which would not jeopardise the natural and social values of the area, sensitivity maps that would guide spatial planners in sustainable solar and wind siting were developed.

A **sensitivity map for wind power plants (WPP)** gives an indication of the sensitivity of the analysed area to the establishment and operation of wind power plants. The sensitivity level is evaluated based on the most important potential impacts of wind technology on biodiversity, natural resources and society. The impacts may include potential direct and indirect negative effects arising from land occupation, turbine rotation and noise generated during wind power plant operation.

A **sensitivity map for solar power plants (SPP)** provides an indication of the sensitivity of the analysed area to the establishment and operation of solar power plants. The sensitivity level is evaluated considering the potential impacts of ground-mounted solar photovoltaic (PV) technology on biodiversity, natural resources and society. The identified potential impacts derive from the land occupation due to the installation of PV plants on the ground, which, on the one hand, prevents the use of that land for other purposes, and on the other hand, represents a new element in the landscape and thus changes the landscape's characteristics.

The potential negative impacts of wind and solar power plants which were considered during the development of the sensitivity maps are summarised in Table 2.1.

**Table 2.1. Potential negative effects of wind and solar power plants**

| Recipient                                     | Potential negative effects  |
|---|---|
| <b>Biodiversity:<br/>Habitats and species</b> | <ul style="list-style-type: none"> <li>- Change of vegetation cover because of vegetation removal and changed microclimatic conditions (valid for SPP)</li> <li>- Direct impacts on bird and bat populations due to collision with wind turbine blades (valid for WPP)</li> <li>- Habitat fragmentation</li> <li>- Loss of endangered and rare habitats and plant species</li> <li>- Indirect effects on animal species (e.g. large carnivores) due to habitat loss and/or fragmentation and noise</li> </ul> |
| <b>Natural resources</b>                      | <ul style="list-style-type: none"> <li>- Diminished potential of land allocation, and/or land quality, for other purposes (e.g. economic activities such as agriculture and forestry)</li> <li>- Risk of degradation of water resources – quality and/or quantity</li> </ul>  |
| <b>Society</b>                                | <ul style="list-style-type: none"> <li>- Effects on the quality and attractiveness of area/landscapes that are currently used for living, recreation and/or other human activities, such as cultural and historic sites and/or religious worshiping</li> <li>- Noise and flickering (valid for WPP)</li> </ul>  |

### 2.1 Approach and methodology<sup>1</sup>

The purpose of **sensitivity maps** is to provide an indication of the sensitivity of the analysed area to the establishment and operation of wind and solar power plants. The sensitivity is evaluated based on the prevailing state of the environment, biodiversity characteristics, land use patterns, and social and cultural features of Zadar County.

<sup>1</sup> Detailed information on the methodology used is provided in the document *Pilot project: Integrated Wind and Solar Planning in Zadar county - Methodology description*.

The development of sensitivity maps was based on a three-step approach:

- Step 1: Identification of areas which cannot be used for wind and solar siting due to legal constraints. These areas are labelled as **exclusion zones**.
- Step 2: Identification of areas which are potentially highly vulnerable to the establishment of wind and solar plants. These areas are labelled as **very highly sensitive**.
- Step 3: Evaluation of the remaining areas against a set of indicators, and determination of their sensitivity level using a multi-criteria analysis (MCA).

### **Step 1**

The areas where the establishment of wind and solar power plants is either legally prohibited or restricted are identified in line with the national legislation which regulates nature protection, infrastructure development, spatial planning and other relevant sectors. For example, such areas include national parks, strict reserves and other categories of protected areas where economic activities and any other activities which do not contribute to biodiversity conservation are prohibited. Another example is the prescribed corridors along and/or around infrastructure such as roads and airports. The list of the features included in this group is given in Table 2.2 and Annex 1.

**Table 2.2. Areas and features where construction of wind and solar power plants is either legally prohibited or restricted**

| <b>Category</b>            | <b>Examples</b>   |
|----------------------------|---|
| Protected natural areas    | Protected areas within the following categories: strict reserves, special reserves, national parks, Ramsar areas, nature monuments, monuments of park architecture, park forests, significant landscapes, Ramsar sites, UNESCO sites. |
| Cultural heritage          | Areas designated as cultural heritage areas and archaeological sites.   |
| Natural resources          | Protected coastal area (areas on islands and the mainland extending 1,000 m inland from the coast), water springs and water sanitation zone I.  |
| Infrastructure corridors   | Airports, highways and roads, railways, gas pipelines, transmission lines, antennas, and the respective legally prescribed corridors (see Annex 1 for the size of respective corridors).  |
| Specially designated areas | Military zones, tourist and recreational zones (hotels, touristic settlements, camps, open air sport facilities).   |
| Settlements                | Settlements and their immediate surroundings.   |

### **Step 2**

Certain areas and features are highly valued in terms of biodiversity, natural resources and cultural heritage. Such areas include, for example, habitats of endangered and vulnerable species, forest ecosystems which provide multiple ecosystem services, etc. These sites are not always legally protected but often enjoy certain levels of protection through different international conventions, policy instruments and sustainable management practices.

The reason for including such features in the *very high sensitivity* group is the precautionary principle. Namely, the development of the maps did not encompass targeted field research and the evaluation of potential impacts arising from specific projects, which are necessary to conduct before a project is actually implemented. Therefore, the *very high sensitivity* label on the map indicates the need to carefully evaluate potential impacts and trade-offs before designating these areas for wind and/or solar power plant(s) development.

### **Step 3**

In Step 3, the territory outside of the *exclusion zones* and areas of *very high sensitivity* are analysed against a set of indicators and sub-indicators. These indicators and sub-indicators serve as the building blocks for the sensitivity evaluation using an MCA and are divided into three categories:

1. Nature and biodiversity,
2. Natural resources important for economic activities, and
3. Social and cultural features.

The assessment area is evaluated against each indicator or sub-indicator and, based on the prevailing characteristics and defined thresholds, given a score between 1 and 5. If scored 1, the area is considered to have low sensitivity to the potential impacts of wind/solar power plant; a score of 5 indicates high sensitivity for that specific indicator.

A weighting factor (WF) is allocated for each indicator or sub-indicator, and thus the final sensitivity level of the assessed area within the respective category is obtained by summing the products of indicator/sub-indicator score and its weighting factor. Some of the indicators were composed of sub-indicators to facilitate the defining of the weighting factors through the Analytic Hierarchy Process (AHP) (Department for Communities and Local Government, 2009).

In the final step, the scores obtained for each indicator group are summed to get the overall sensitivity level of the assessed area. In order to allow for a better determination of the sensitivity, the scores are then normalised on a scale from 0 to 100 using min-max normalisation.

Areas with a score of 0-40 are defined as low, 40-70 as medium and 70-100 as high sensitivity areas. Finally, the sensitivity of the assessed area on the map is presented with a colour ramp (Table 2.3).

**Table 2.3. The colour ramp for presentation of sensitivity maps**

| Final sensitivity score | Colour | Label description     |
|-------------------------|--------|-----------------------|
|                         |        | Exclusion Zones       |
|                         |        | Very high sensitivity |
| 70-100                  |        | High sensitivity      |
| 40-70                   |        | Medium sensitivity    |
| 0-40                    |        | Low sensitivity       |

## 2.2 Exclusion and Very High Sensitivity areas

Exclusion zones are eliminated from further analysis in this study due to the legal restrictions placed on the development of projects there in general, including RES. The siting of WPP and SPP would not be permitted in these areas. The regulations prohibiting the implementation of WPP and SPP projects, e.g. acts, regulations, ordinances, spatial plans etc., are listed in Table 2.4 and Annex 1.

**Table 2.4. Legal restrictions on the siting of wind power plants and solar power plants**

| Restriction   | Rationale  |
|---|--|
| <b>WPP and SPP</b>  |  |
| National park, strict reserve, special reserve, forest park, natural monument, park | Economic activities exploiting natural resources are prohibited in national parks and strict reserves (Act on Nature Protection OG 80/13, 15/18, 14/19, 127/19; Articles 112 and 113). Activities that might threaten the features due to which an area has become protected are not allowed in special reserves, natural monuments, park-forests, monuments of park architecture, and significant |

|  |  |
|--|--|
| architecture monument, significant landscape   | landscapes (Articles 114, 117, 118, 119, 120). Given the characteristics of these areas and their smaller size, it is considered that WPP and SPP would threaten the characteristics for which they were designated.   |
| Ramsar sites, UNESCO natural heritage, UNESCO biosphere reserves, UNESCO geoparks                        | These are internationally designated protected areas of exceptional value. Due to their international value and protection, these areas are extremely sensitive to interventions.  |
| Protected coastal area (ZOP) (coastal cities/municipalities) – 1km from the coastline (restriction zone) | Area of restrictions under the Physical Planning Act (OG 153/13, 65/17, 114/18, 39/19, 98/19; Article 45 - 48).  |
| I zone of sanitary water protection  | In the I zone of sanitary protection of springs with abstraction of water from aquifers, all activities are prohibited except those related to the abstraction, conditioning, and transport of water into the water supply system (Ordinance on Conditions for Determining Zones of Sanitary Protection of Springs, OG 66/11, 47/13).  |
| Inundation zone around water bodies  | According to the Water Act (OG 66/19), Article 22: 'In the inundation area, it is prohibited to perform actions that may worsen the water regime and increase the risk of harmful effects on water'. The minimum zone width for certain water bodies is defined within the Zadar County Spatial Plan (Amendments, 2014): '10 m along the river Zrmanja, the watercourse Kotarka and Miljašić ravine; 10 m along the defensive embankment facilities in the protected area; 5 m from the upper edge of other torrent watercourses and drainage channels, i.e. the edge of public water good parcel. Depending on the size and condition of the watercourse or facility, the width of the inundation protection area can be smaller than stated above, but not less than 3 m, which will be determined by the water conditions for each object separately.'<br>For the analysis, a conservative 10 m buffer around waterbodies was applied for both WPP and SPP. |
| Airports (sports airport, airfield); Heliports   | The Spatial Plan of Zadar County defines the Airport Security Zone and restrictions within this zone. It prohibits the construction of barracks, industrial facilities, residential buildings, hospitals, schools, kindergartens, resorts and other public facilities (with larger groups of people), main roads and transmission lines. Construction of other roads, transmission lines and warehouses is allowed depending on the type of facility. WPP and SPP are not directly mentioned, but it can be concluded that they fall under this ban, especially WPP. Additionally, in the case of WPP, a buffer area around airports is set due to security reasons.   |
| Motorways and expressways; State and local roads   | The Roads Act (OG 84/11, 22/13, 54/13, 148/13, 92/14, 110/19), Article 55, defines protection zones for different types of roads (measured from the outer edge of the land area): motorways – 40 m; expressways – 40 m; state roads – 25 m; county roads – 15 m; local roads – 10 m. In the analysis, roads are grouped in two categories to which buffers for SPP and WPP, based on regulations and security reasons, are assigned.   |
| Railway  | The Regulation on general conditions for construction in a protective railway zone (OG 93/10) defines protective areas. Based on this and security reasons, a buffer is defined for WPP and SPP.   |
| Gas pipelines (main gas pipeline)  | The Regulation on technical conditions and standards for the safe transport of liquid and gaseous hydrocarbons through main oil and gas pipelines and oil and gas pipelines for international transport (OG SFRY 26/85, NN 53/91) defines protective areas for different types of construction. WPP and SPP are not explicitly mentioned; thus, general distance from settlements is considered for SPP, while a larger buffer is considered for WPP due to security reasons.  |
| Power lines  | Rules of the transmission system network, Art. 222 (OG 67/17) defines the distance that other infrastructure must be from power lines. For this analysis, they are different for SPP and WPP and are based on the precautionary principle.   |

|                         |   |
|-------------------------|---|
| Military zones          | Special purpose areas defined by the Spatial Plan and planned for military purposes. They are mostly located outside settlements.   |
| Sport zones             | Special purpose areas defined by the Spatial Plan and intended for recreation activities (sport fields, etc.).  |
| Tourist zones           | Special purpose areas defined by the Spatial Plan and planned for tourism development (existing and planned zones). A buffer was defined to secure the attractiveness of the area for tourism development.  |
| Settlements             | Area defined by the Spatial Plan as build-up area. This area is already occupied for other activities (housing, commercial, production) and is therefore not foreseen for other uses. Additional buffer around settlements is defined due to safety and aesthetic values.   |
| Protected cultural good | Archaeological and historical sites, cultural heritage sites, aqueducts, protected cultural landscapes should be preserved and any construction should be avoided at these sites (Law on Protection and Preservation of Cultural Heritage OG 69/99, 151/03, 157/03, 100/04, 87/09, 88/10, 61/11, 25/12, 136/12, 157/13, 152/14, 98/15, 44/17, 90/18, 32/20, 62/20). |
| <b>Only SPP</b>         |   |
| Flooded areas           | Even though there are no legal restrictions on building in flooded areas, the construction of SPP in these areas would be questionable.   |
| <b>Only WPP</b>         |   |
| Antennas, radars        | Due to the potential negative impact of WPP on their operation, a buffer around these systems is defined in line with the Spatial Plan.   |

Within Zadar County, there are areas where the construction of SPP and WPP is not legally prohibited, but which, due to their characteristics and importance, are potentially very sensitive. For example, construction of SPP and WPP in nature parks is not prohibited, but due to the biological, ecological and landscape value of the parks, interventions could easily have a major effect on the characteristics that are the grounds for protection. Additionally, some habitats (e.g. cliffs, rocks and forests) are characterised as very highly sensitive based on the precautionary principle and due to the lack of precise data about species inhabiting these areas, habitat quality and the potentially significant negative impacts of WPP and SPP. When conducting an SEA or EIA, special attention should be given to these areas. Very highly sensitive areas are presented in Table 2.5 and Annex 1.

**Table 2.5. Areas of very high sensitivity for the siting of wind power plants and solar power plants**

| Very high sensitivity areas    | Rationale  |
|--------------------------------|--|
| <b>WPP and SPP</b>             |  |
| Nature park                    | According to the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19), nature parks have specific characteristics based on which they can be characterised as areas of very high sensitivity and should not be threatened.   |
| High forests                   | According to the Forest Act (OG 68/18, 115/18, 98/19), forests and forest land are natural resources, and, together with the general useful functions of forests, require special management. According to their purpose, forests are classified as production or protection forests. In the forest and on forest land owned by the Republic of Croatia, an easement might be given for the purpose of building RES plants (Article 58). Deforestation may be allowed (Article 39) under certain conditions: for the purpose of building forest infrastructure; if the forest or forest land needs to serve another purpose in the interests of the Republic of Croatia; if required by the security or defence interests of the country; or for the purpose of carrying out interventions in accordance with spatial plans if needed for the construction of buildings that according to the spatial plan or special regulation can be built outside the construction area. Forests also provide a variety of ecosystem services; thus, deforestation is not recommended to accommodate facilities that require significant areas, such as SPP. |
| Waterbodies (natural lakes and | For this analysis, waterbodies include natural lakes and rivers, artificial canals and accumulations. According to the type of waterbody, a buffer is assigned. Waterbodies  |

|  |   |
|--|---|
| rivers) and artificial canals  | are habitats to sensitive freshwater species, but also have an important role in other sectors such as energy (accumulations) and agriculture (canals). Interference with waterbodies should therefore be avoided.  |
| Cliffs and rocks   | Cliffs and rocks are often habitats for endemic flora and important fauna species and present important migratory routes. Some bird species nest on such habitats, and they are therefore considered sensitive.   |
| EUROBATS (internationally important underground sites)   | Underground sites include caves, tunnels, abandoned mines, fortifications, etc. that are used by bat colonies. They play a vital role in the life cycle of many European bat species, which use them for hibernation, breeding and transitional roost-sites, including during migration. Especially sensitive are sites used as maternity colonies, as females with cubs and cubs use the area around their shelter for foraging.   |
| <b>Only SPP</b>  |   |
| Highly valuable and valuable arable land (P1 or P2 category of agricultural land)  | Article 5, Paragraph 2 of the Agricultural Land Act (OG 20/18, 115/18, 98/19) considers the conversion of agricultural land (including for energy facilities) as the deterioration of agricultural land. The conversion of agricultural land for non-agricultural purposes is carried out in accordance with spatial plans and other regulations. Article 22, Paragraph 3 states that highly valuable (P1) and valuable (P2) arable land outside the boundaries of a construction area cannot be used for non-agricultural purposes except: when there is no lower value agricultural land in the immediate vicinity, which does not include the construction of a golf course; when the interest of the Republic of Croatia for the construction of facilities that are built outside the construction area according to special regulations has been determined; for the construction of agricultural buildings intended exclusively for agricultural activity and processing of agricultural products; and for the buildings that are legalised on the basis of a special law. |
| Highly suitable habitats for bear dens   | Includes areas identified as very high and medium sensitivity for bear dens. It is important to avoid the deterioration of potential breeding habitats for large carnivores in order to maintain populations at the desired level. Data was available only for bear dens and not for other large carnivores.  |
| Animal passages  | Animal passages are important to maintain the connectivity of the habitats and allow the movement and migration of species. This is especially important for large carnivores that need large territories and travel great distances in search of food, shelter and mates. The area around such passages (over roads) should not be further fragmented.   |
| <b>Only WPP</b>  |   |
| SPA/SCI with sensitive species of birds, bats and large carnivores as target species   | Special protected areas (SPA) and Sites of Community Importance (SCI) with target species sensitive to WPP (bats, birds and large carnivores) are considered areas of very high sensitivity.  |
| Territories of golden eagle ( <i>Aquila chrysaetos</i> )   | Known territories of critically endangered (CR) species sensitive to WPP.   |
| Particularly valuable area - natural landscape;<br>Particularly valuable area - natural and cultural landscape;<br>Site of special landscape value | Due to the negative visual impact of WPP, areas with high aesthetic value are considered as very high sensitivity.  |

## 2.3 Indicators

With the exclusion of potential sites in the ‘exclusion’ and ‘very high sensitivity’ areas, it is essential to evaluate the remaining areas according to a set of indicators that establish their sensitivity according to the potential impacts of SPP and WPP if developed in these areas. To estimate the sensitivity of the area within the Zadar County (Step 3 of the analysis), a set of 20 indicators (including 13 sub-indicators) for WPP and 18 indicators (including 8 sub-indicators) for SPP are used. Definition of indicators was based on the most important impacts of each technology and the availability of data. For instance, although nesting locations of sensitive bird species or den locations of large carnivores would be highly important information for such an analysis, this information was not available. Proxy indicators, e.g. based on the habitats that are important for sensitive species, are used to overcome this problem. Indicators and sub-indicators used in the analysis are presented in Table 2.6 and Table 2.7, while the whole evaluation methodology (including the definition of grades) is presented in Annex 2.

Data sources used for each indicator are presented in Annex 3. Data on selected indicators is obtained from publicly available sources, relevant institutions and experts. The data was prepared and processed in QGIS.

Weighting factors (WF) were developed using AHP for sub-indicators (under one indicator) and among indicators (within a group of indicators). The WFs are based on the significance of a potential impact, reliability and the precision of available data and information already considered in defining exclusion zones and areas of very high sensitivity. WFs are presented in Annex 4.

**Table 2.6. Indicators used in the sensitivity analysis of WPP**

| Indicator                               | Sub-indicator                               | Description  |
|---|---|--|
| <b>Nature</b>                           |   |  |
| Protected areas (P_VE_111)              |   | Estimation of sensitivity is based on the level of protection with regard to the protection status according to the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19). Data on regional parks, SCI, SPA and areas proposed for protection are considered.   |
| Endangered and rare habitats (P_VE_121) |   | Estimation is based on the potential quality deterioration of sensitive habitats (target habitats within the SCI, rare and endangered habitats defined by the Ordinance on habitat types, habitat maps and endangered and rare habitat types (OG 88/14)).  |
| Bats                                    | Habitats important for bats (P_VE_131a)     | Estimation is based on the proximity to habitats important for bats (forests, rivers, streams, ponds).   |
|   | Distribution area (P_VE_131b)               | Estimation is based on the presence of sensitive bat species (threatened species (EN, CR), species with high risk of collision with wind turbines (EUROBATS, 2014)) ( <i>Tadarida teniotis</i> , <i>Hypsugo savii</i> , <i>Miniopterus schreibersii</i> , <i>Nyctalus lasiopterus</i> , <i>Nyctalus leisleri</i> , <i>Nyctalus noctule</i> , <i>Pipistrellus kuhlii</i> , <i>Pipistrellus nathusii</i> , <i>Pipistrellus pipistrellus</i> , <i>Pipistrellus pygmaeus</i> , <i>Vespertilio murinus</i> ). |
| Birds                                   | Habitats important for birds I (P_VE_132a)  | Estimation is based on the proximity to habitats important for birds (lakes and wetlands).   |
|   | Habitats important for birds II (P_VE_132b) | Estimation is based on the proximity to habitats important for birds (rivers, cliffs and rocks).   |

|   |  |  |
|---|--|--|
|   | Area of distribution of sensitive bird species (P_VE_132c) | Estimation is based on the presence of sensitive bird species (threatened (VU, EN, CR) species sensitive to WPP) ( <i>Circaetus gallicus</i> , <i>Gyps fulvus</i> , <i>Aquila chrysaetos</i> , <i>Haliaeetus albicilla</i> , <i>Circus aeruginosus</i> , <i>Circus pygargus</i> , <i>Falco naumanni</i> , <i>Falco peregrinus</i> ). |
| Habitat suitability for large carnivores (P_VE_133) |  | Estimation is based on species distribution and habitat sensitivity classes for each species ( <i>Ursus arctos</i> , <i>Canis lupus</i> , <i>Lynx lynx</i> ).  |
| <b>Natural resources and development potentials</b> |  |  |
| Agricultural land (PR_VE_P)                         |  | Estimation is based on the presence and quality of agricultural land, including highly valuable and valuable arable land (categories P1 and P2), other arable land (P3) and other agricultural land and forest land (PS), i.e. on the probability of impact on the quality and sustainability of the natural resource.               |
| Forests (PR_VE_S)                                   |  | Estimation is based on the presence and maintenance of forest functions (for degraded forests / succession to forests), i.e. on the probability of impact on the quality and sustainability of the natural resource.   |
| Waters (PR_VE_VG)                                   |  | Estimation is based on the importance of resources for water supply, i.e. the possibility of direct or indirect impact on the quality and sustainability of the natural resource.  |
| Tourism and recreation                              | Tourist zones (PR_VE_T1)                                   | Estimation is based on the possible impairment of a tourist zone (based on the type of use, attendance) with regard to visual impacts, noise and flickering.   |
|   | Tourist zones – planned (PR_VE_T2)                         | Estimation is based on the possible impairment of a planned tourist zone (based on the type of use, attendance) with regard to visual impacts, noise and flickering.   |
|   | Recreation zones (PR_VE_T3)                                | Estimation is based on the possible impairment of a recreation zone (based on the type of use, attendance) with regard to visual impacts, noise and flickering.  |
| <b>Human environment (social values)</b>            |  |  |
| Population  | Distance from the settlement (CO_VE_N1)                    | Estimation is based on visibility, noise and flickering impacts in the case of WPP construction.   |
|   | Number of inhabitants (CO_VE_N2)                           | Estimation is based on the number of people who may be directly exposed to visual impacts, noise and flickering.   |
| Distance from cultural goods (CO_VE_KD)             |  | Estimation is based on the possible impairment (based on the type of use, attendance) with regard to visual impacts in the case of construction of WPP.  |
| Landscape and visual exposure                       | Landscape values (CO_VE_KV)                                | Estimation is based on the possible impairment of protected areas (due to deterioration of characteristics for which protection has been declared, type of use and attendance) regarding visual impacts, noise and flickering in the case of WPP.  |
|   | Panoramic values (CO_VE_P1)                                | Estimation is based on the potential reduction of the landscape's panoramic value.   |
|   | Visual quality (visual exposure) (CO_VE_P2)                | Estimation is based on visual exposure from highways and expressways.  |

**Table 2.7. Indicators used in the sensitivity analysis of SPP**

| Indicator   | Sub-indicator                      | Description   |
|---|------------------------------------|---|
| <b>Nature</b>   |                                    |   |
| Protected areas (P_SE_111)                                      |                                    | Estimation is based on the level of protection with regard to the protection status according to the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19). Data on regional parks and areas proposed for protection are considered.   |
| Ecological network (P_SE_112)                                   |                                    | Estimation is based on the information about the ecological network (Decree on the ecological network and the responsibility of public institutions for the management of ecological network areas, OG 80/2019), i.e. target species within SPA and SCI.  |
| Endangered and rare habitats (P_SE_121)                         |                                    | Estimation is based on the potential quality deterioration of sensitive habitats (target habitats within SCI, rare and endangered habitats defined by the Ordinance on habitat types, habitat maps and endangered and rare habitat types (OG 88/14)).   |
| EUROBATS internationally important habitats for bats (P_SE_131) |                                    | Estimation is based on the possibility of direct impacts on species and populations in the most sensitive areas, especially areas for feeding females with cubs and independent feeding of cubs.  |
| Habitats important for sensitive bird species (P_SE_132)        |                                    | Estimation is based on the presence of habitats suitable for sensitive species in the area of their distribution (threaten species (VE, EN, CR) using grassland habitats) ( <i>Crex crex</i> , <i>Circus pygargus</i> , <i>Falco naumanni</i> , <i>Calandrella brachydactyla</i> , <i>Melanocorypha calandra</i> , <i>Burhinus oediconemus</i> ). |
| Habitat suitability for large carnivores (P_VE_133)             |                                    | Estimation is based on species distribution and habitat sensitivity classes for each species ( <i>Ursus arctos</i> , <i>Canis lupus</i> , <i>Lynx lynx</i> ).   |
| <b>Natural resources and development potentials</b>             |                                    |   |
| Agricultural land (PR_SE_P)                                     |                                    | Estimation is based on the presence and quality of agricultural land (including other arable land (P3) and other agricultural land and forest land (PS)), i.e. on the probability of impact on the quality and sustainability of the natural resource.  |
| Forests (PR_SE_S)   |                                    | Estimation is based on the presence and maintenance of forest functions (for degraded forests / succession to forests), i.e. on the probability of impact on the quality and sustainability of the natural resource.  |
| Waters (PR_SE_VG)   |                                    | Estimation is based on the importance of resources for water supply, i.e. the possibility of direct or indirect impact on the quality and sustainability of the natural resource.   |
| Tourism and recreation  | Tourist zones (PR_SE_T1)           | Estimation is based on the possible impairment of a tourist zone (based on the type of use, attendance) with regard to visual impacts.  |
|   | Tourist zones – planned (PR_SE_T2) | Estimation is based on the possible impairment of a planned tourist zone (based on the type of use, attendance) with regard to visual impacts.  |
|   | Recreation zones (PR_SE_T3)        | Estimation is based on the possible impairment of a recreation zone (based on the type of use, attendance) with regard to visual impacts.   |
| <b>Human environment (social values)</b>                        |                                    |   |

|   |   |   |
|---|---|---|
| Population  | Distance from the settlement (CO_SE_N1)     | Estimation is based on potential visibility from the settlement and visual impacts.   |
|   | Number of inhabitants (CO_SE_N2)            | Estimation is based on the number of people who may be directly exposed to visual impacts.  |
| Distance from protected cultural goods (CO_SE_KD) |   | Estimation is based on the possible impairment of cultural goods (based on the type of use, attendance) with regard to the visual impacts of SPP and possible damage in the case of archaeological sites (and potential undiscovered adjacent sites). |
| Landscape and visual exposure                     | Landscape values (CO_SE_KV)                 | Estimation is based on the possible impairment of the landscape value of the area (cultural landscape and location of special landscape value, especially valuable landscapes, natural and cultural landscapes).                                      |
|   | Panoramic values (CO_SE_P1)                 | Estimation is based on the potential reduction of the landscape's panoramic value at important viewpoints and view-lines.   |
|   | Visual quality (visual exposure) (CO_SE_P2) | Estimation is based on visual exposure from highways and expressways.   |

## 2.4 Stakeholder engagement

In the process of methodology development, broad stakeholder consultations were conducted in order to obtain: 1) stakeholders' comments on the proposed methodology and 2) any additional data that might not be publicly available. The selection of stakeholders was based on the results of stakeholder mapping<sup>2</sup>, their relevance for the project, and above all, willingness to participate in the project. The stakeholders were introduced to the general concept and project partners at a workshop held in October 2019, prior to the beginning of the project. All the participants that attended the workshop were also invited to participate in the project consultation activities.

The initial stakeholders' workshop was held in February 2020 with the aim to familiarise stakeholders with the project and its expected results. The workshop was attended by representatives from the Ministry of Environment and Energy (MZOE), the Ministry of Construction and Physical Planning (MGIPU)<sup>3</sup>, Zadar County and nature protection associations (BIOM and Tragus) (Annex 5).

The Ministry of Agriculture (MPS) was also invited to participate at the workshop, but no feedback was received.

Additional efforts were made to identify experts for expert consultations that were organised in the form of guided interviews. Experts were selected based on their expertise and willingness to participate. Overall, seven expert consultations were performed with 13 external experts (Annex 5). Due to the situation with COVID-19, consultations were performed online via the Zoom platform, with a duration of approximately two hours each. The concept of the consultations was to present the

<sup>2</sup> More information is available in the document *Pilot project: Integrated Wind and Solar Planning in Zadar county Detailed - Workplan and baseline methodology*.

<sup>3</sup> Later in 2020, the names of the Ministries were changed as follows:  
Ministry of Environment and Energy (MZOE) to Ministry of Economy and Sustainable Development (MINGOR)  
Ministry of Construction and Physical Planning (MGIPU) to Ministry of Physical Planning, Construction and State Assets (MPGI)

general methodology for the sensitivity assessment and then raise specific questions about wind and solar energy that would enable the formulation of the indicators. After the expert consultations, the list of indicators was developed together with the proposed weighting factors. Experts were again contacted via e-mail and invited to comment on the latter (only one reply was received).

The project results were presented at the 'Peer review workshop' held in November 2020 via Zoom. The workshop was attended by 22 participants (Annex 5). The participants provided final comments on the study and were invited to participate in an online survey to validate the weighting factors used in the MCA. The input from stakeholders was taken into consideration and the WF were adjusted accordingly.

Meetings with the beneficiary, Zadar County (Institute for Spatial Planning, Department for Physical Planning, Environmental Protection and Public Utilities), were held on two occasions: 1) at the beginning of the project in Zadar, and 2) after the peer reviewed workshop via Zoom. They were also consulted on several other occasions during the project's lifetime. A workshop for various stakeholders in Zadar County was initially planned for the end of the project, but due to the COVID-19 pandemic and restrictions on public gatherings, it was agreed that the presentation of the project results would be organised in Zadar as soon as conditions allow. Furthermore, wider stakeholder engagement focused on the public (primarily residents) was planned via the application of an online tool that would allow the public to draw the outlines of their preferred areas for SPP and WPP development on a map. The tool was developed by TNC and EIHP and sent to the Zadar County for dissemination. However, due to difficulties that arose from the pandemic, including the internal organisation of work activities, Zadar County did not proceed with the dissemination of the tool to the public. Nevertheless, the county recognised the relevance of this tool and approach and indicated that the tool could potentially be applied to other projects in the future.

Overall, several stakeholders showed strong interest in participating in the project activities, mainly the stakeholders from the nature and environmental protection sector. On the other hand, stakeholders from the agriculture, forestry, energy and climate sectors did not choose to participate in project activities. Their response was not negative, but rather passive, even though they were contacted through both official and personal channels. The impression was that they either do not understand the relevance of the topic for their sector (agriculture, forestry), or consider that RES development will happen regardless (energy, climate).

## **2.5 Sensitivity maps**

The sensitivity map for solar power plants developed using the described methodology, including exclusion zones and areas of very high sensitivity, is presented in the Figure 2-1. The total area within each sensitivity level is shown in Table 2.8. The exclusion zone covers 63.7% (232,182 ha), while the very high sensitivity area covers 18.8% (68,499 ha) of Zadar County. The remaining area includes 10.5% (38,151 ha) of low sensitivity area, 6.5% (23,656 ha) of medium sensitivity area, and 0.6% (2,232 ha) of high sensitivity area.

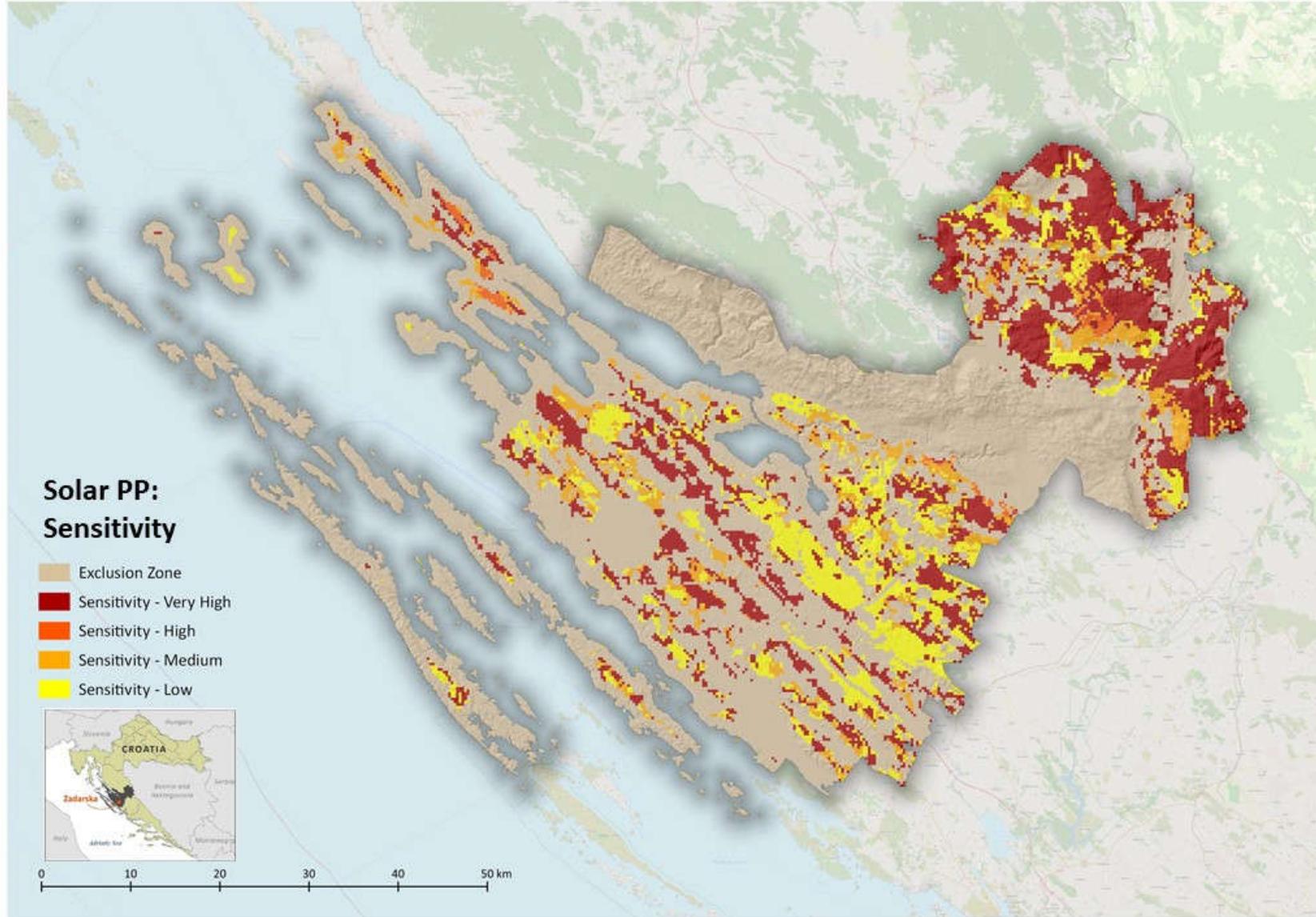


Figure 2-1. Sensitivity map of Zadar County for solar power plants

**Table 2.8. Area of each sensitivity level for SPP**

|                          | <b>Area (ha)</b> | <b>Area (%)</b> |
|--------------------------|------------------|-----------------|
| Exclusion Zones          | 232,182          | 63.7%           |
| Very high sensitivity    | 68,499           | 18.8%           |
| <b>Sensitivity level</b> |                  |                 |
| High (70-100)            | 2,232            | 0.6%            |
| Medium (40-70)           | 23,652           | 6.5%            |
| Low (0-40)               | 38,151           | 10.5%           |
| <b>Total</b>             | <b>364,716</b>   | <b>100.0%</b>   |

The sensitivity map for wind power plants and the total area within each sensitivity level are presented in Figure 2-2 and Table 2.9. In the case of wind power plants, the exclusion zone covers 73.4% (267,876 ha) and very high sensitivity area covers 21.4% (78,084 ha) of Zadar County. The remaining area includes 3.2% (11,511 ha) of low sensitivity area, 1.9% (6,966 ha) of medium sensitivity area, and 0.1% (315 ha) of high sensitivity area.

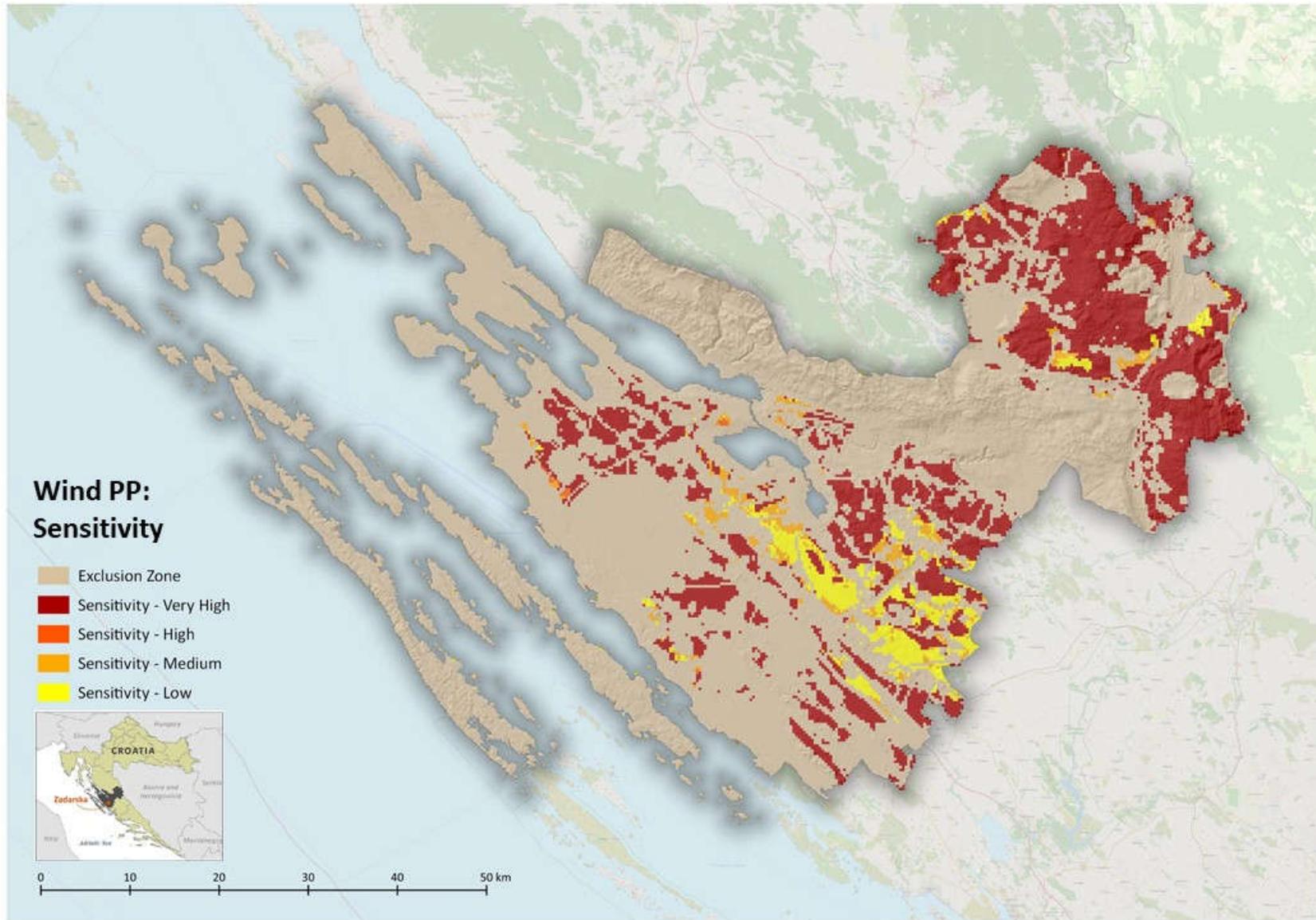


Figure 2-2. Sensitivity map of Zadar County for wind power plants

**Table 2.9 Area of each sensitivity level for WPP**

|                          | <b>Area (ha)</b> | <b>Area (%)</b> |
|--------------------------|------------------|-----------------|
| Exclusion zones          | 267,876          | 73.4%           |
| Very high sensitivity    | 78,084           | 21.4%           |
| <b>Sensitivity level</b> |                  |                 |
| High (70-100)            | 315              | 0.1%            |
| Medium (40-70)           | 6,966            | 1.9%            |
| Low (0-40)               | 11,511           | 3.2%            |
| <b>Total</b>             | <b>364,761</b>   | <b>100.0%</b>   |

### 3 SUITABILITY FOR RES

The suitability model, which includes criteria important for the development of RES projects, defines spatial characteristics that favour the location of RES. The suitability model includes both elimination criteria and criteria for area comparison. Suitability of the area for the development of SPP and WPP was divided into four categories (excellent, very good, good, and marginal suitability) based on the defined criteria.

#### 3.1 Suitability for solar power plants

In the case of SPP, the only elimination criteria is the slope of the terrain larger than 5°, due to the impact that larger slopes can have on the utilisation of space and complexity of plant construction. The spatial siting of SPP could also be limited by distance from the grid. The type of grid (in terms of voltage level) and the distance from the grid impact the cost of SPP projects. Since this will depend on the general condition of the grid in the area, the size of the plant etc., this aspect was not considered in this analysis. Furthermore, the grid is subject to change, due to new grid expansions on one side and reduced capacity to receive energy from new power plants on the other. Therefore, this is something to bear in mind when micro-locating SPP. The criteria for area comparison include solar insolation (expressed in MWh/m<sup>2</sup>), which is an indicator of natural potential for solar energy production in a certain area (Table 3.1).

**Table 3.1. Suitability criteria for SPP**

| Slope (°) | Solar insolation (MWh/m <sup>2</sup> ) | Suitability |
|-----------|--|-------------|
| <= 5      | 1.5 - 1.55                             | Excellent   |
| <= 5      | 1.4 - 1.5                              | Very good   |
| <= 5      | 1.3 - 1.4                              | Good        |
| <= 5      | 1.25 - 1.3                             | Marginal    |

The spatial distribution of suitability for SPP is presented in Figure 3-1.

The analysis shows that there are 33,472 ha with excellent, 113,155 ha with very good, 36,537 ha with good, and 4,730 ha with marginal suitability for the development of SPP in Zadar County. The suitable area within different sensitivity levels is presented in Table 3.2. There are 31,833 ha of area with good to excellent suitability within very high sensitivity areas, 1,302 ha within high sensitivity areas, 12,734 ha within medium sensitivity areas and 22,188 within low sensitivity areas. These numbers indicate that there is considerable potential for low-conflict development in low sensitivity areas. Under the conservative assumption that only 5% of the low sensitivity area with good to excellent suitability is used for SPP development, it would be possible to achieve an installed capacity of approximately 555 MW. This equals to 72% of the total targeted installation capacity in Croatia by 2030 (768 MW) (Figure 3-2).

**Table 3.2. Area suitable for SPP development within each sensitivity level**

| Sensitivity               | Suitability | Area (ha) |
|---------------------------|-------------|-----------|
| Very high sensitivity     | Excellent   | 3,457     |
|                           | Very good   | 20,257    |
|                           | Good        | 8,119     |
|                           | Marginal    | 1,209     |
| High sensitivity (70-100) | Excellent   | 0         |

|                            |           |        |
|----------------------------|-----------|--------|
|                            | Very good | 635    |
|                            | Good      | 667    |
|                            | Marginal  | 1      |
| Medium sensitivity (40-70) | Excellent | 1,536  |
|                            | Very good | 8,283  |
|                            | Good      | 2,915  |
|                            | Marginal  | 296    |
| Low sensitivity (<40)      | Excellent | 2,950  |
|                            | Very good | 16,188 |
|                            | Good      | 3,050  |
|                            | Marginal  | 341    |

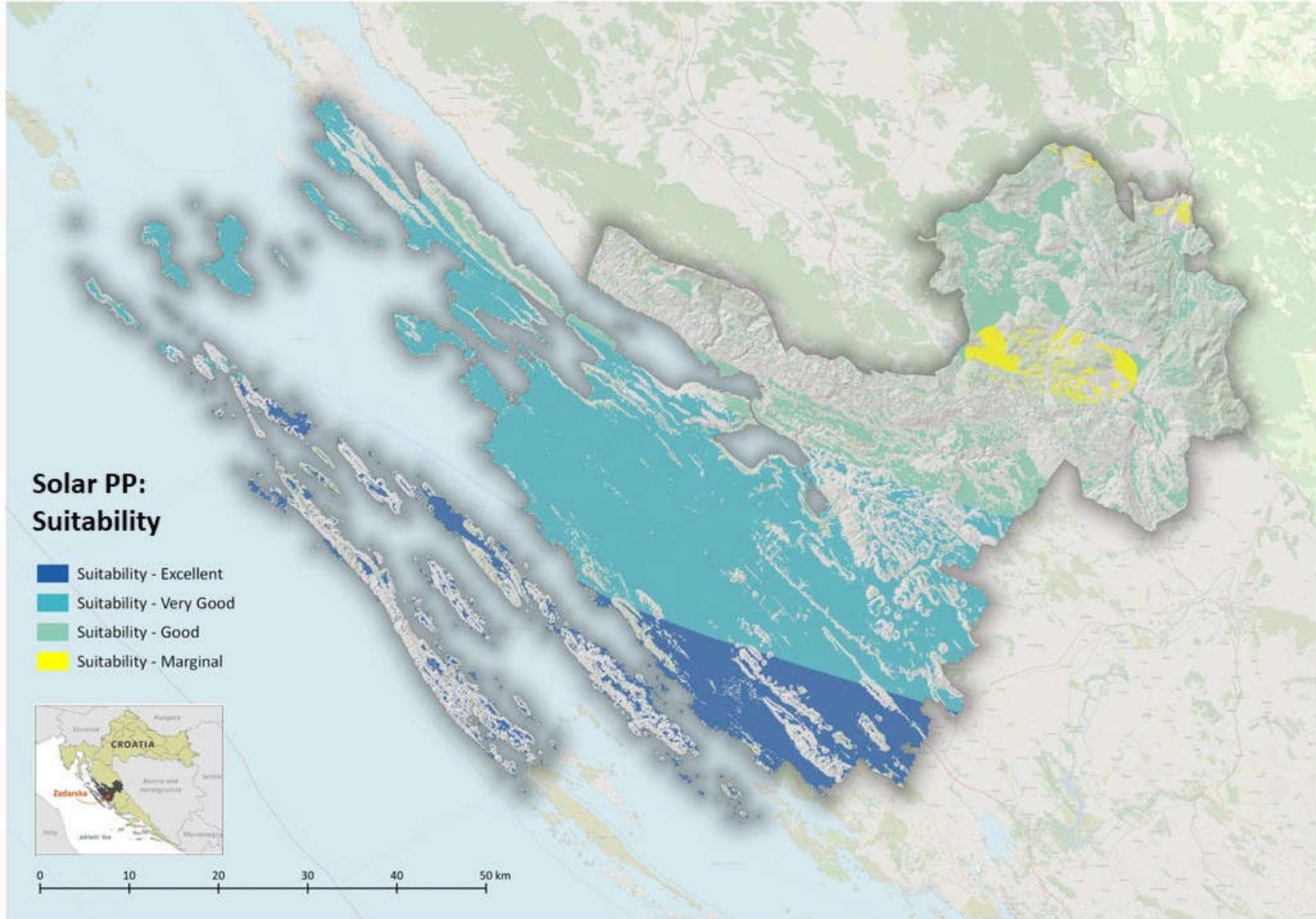


Figure 3-1. Suitability map for SPP

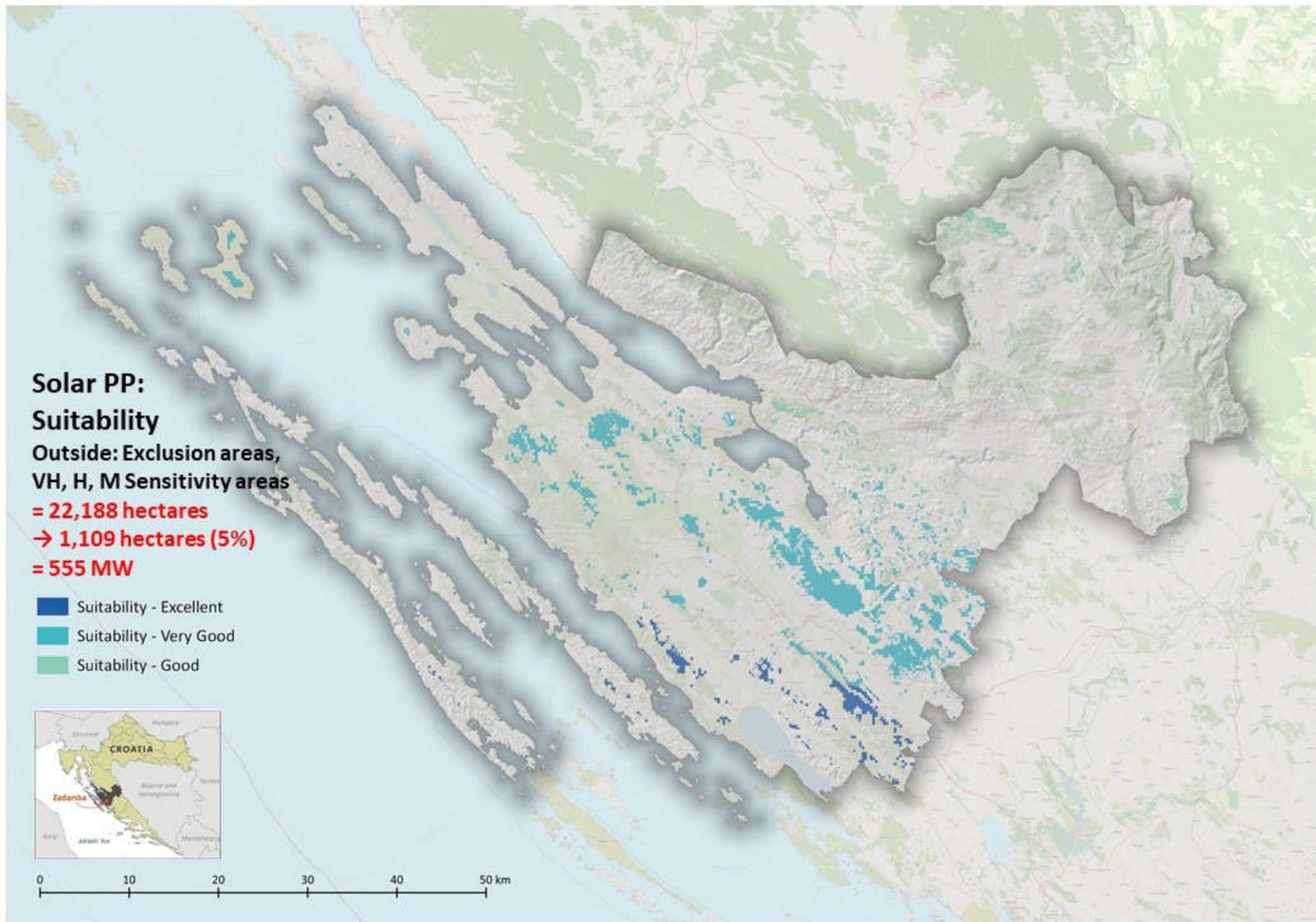


Figure 3-2. Area suitable for SPP within low sensitivity areas

## 3.2 Suitability for wind power plants

In the case of WPP, elimination criteria and criteria for area comparison include the slope of the terrain (minimum 16°), wind speed (minimum 5.3 m/s) and distance from a transmission line (110 kV) (maximum 10 km) (Table 3.3).

**Table 3.3. Suitability criteria for WPP**

| Slope (°) | Wind speed (m/s) | Distance from a transmission line (110 kV) | Suitability |
|-----------|------------------|--|-------------|
| < 16      | > 8              | < 5  | Excellent   |
| < 16      | 6.5 - 8          | < 5  | Very good   |
| < 16      | > 8              | 5 - 10                                     | Very good   |
| < 16      | 5.8 - 6.5        | < 3  | Good        |
| < 16      | 5.3 - 5.8        | < 1.5                                      | Marginal    |

The spatial distribution of suitability for WPP is presented in Figure 3-3. There are 55,939 ha with excellent, 107,464 ha with very good, 28,111 ha with good, and 5,293 ha with marginal suitability for the development of WPP in Zadar County. The suitable area within different sensitivity levels is presented in Table 3.4. There are 40,910 ha of area with good to excellent suitability within very high sensitivity areas, 117 ha within high sensitivity areas, 5,655 ha within medium sensitivity areas and 8,451 ha within low sensitivity areas (around 1,000 ha of the low sensitivity area are located within areas already designated for WPP projects in operation). Assuming that 15 ha of land are required per 1 MW of wind energy, the potential capacity within low sensitivity areas in Zadar County amounts to 563 MW (a small share of this area is already occupied by WPP) (Figure 3-4).

**Table 3.4. Area suitable for WPP development within each sensitivity level**

| Sensitivity                | Suitability | Area (ha) |
|----------------------------|-------------|-----------|
| Very high sensitivity      | Excellent   | 9,897     |
|                            | Very good   | 26,516    |
|                            | Good        | 4,498     |
|                            | Marginal    | 589       |
| High sensitivity (70-100)  | Excellent   | 17        |
|                            | Very good   | 100       |
|                            | Good        | -         |
|                            | Marginal    | 195       |
| Medium sensitivity (40-70) | Excellent   | 1,601     |
|                            | Very good   | 2,797     |
|                            | Good        | 1,257     |
|                            | Marginal    | 139       |
| Low sensitivity (<40)      | Excellent   | 4,003     |
|                            | Very good   | 3,981     |
|                            | Good        | 467       |
|                            | Marginal    | -         |

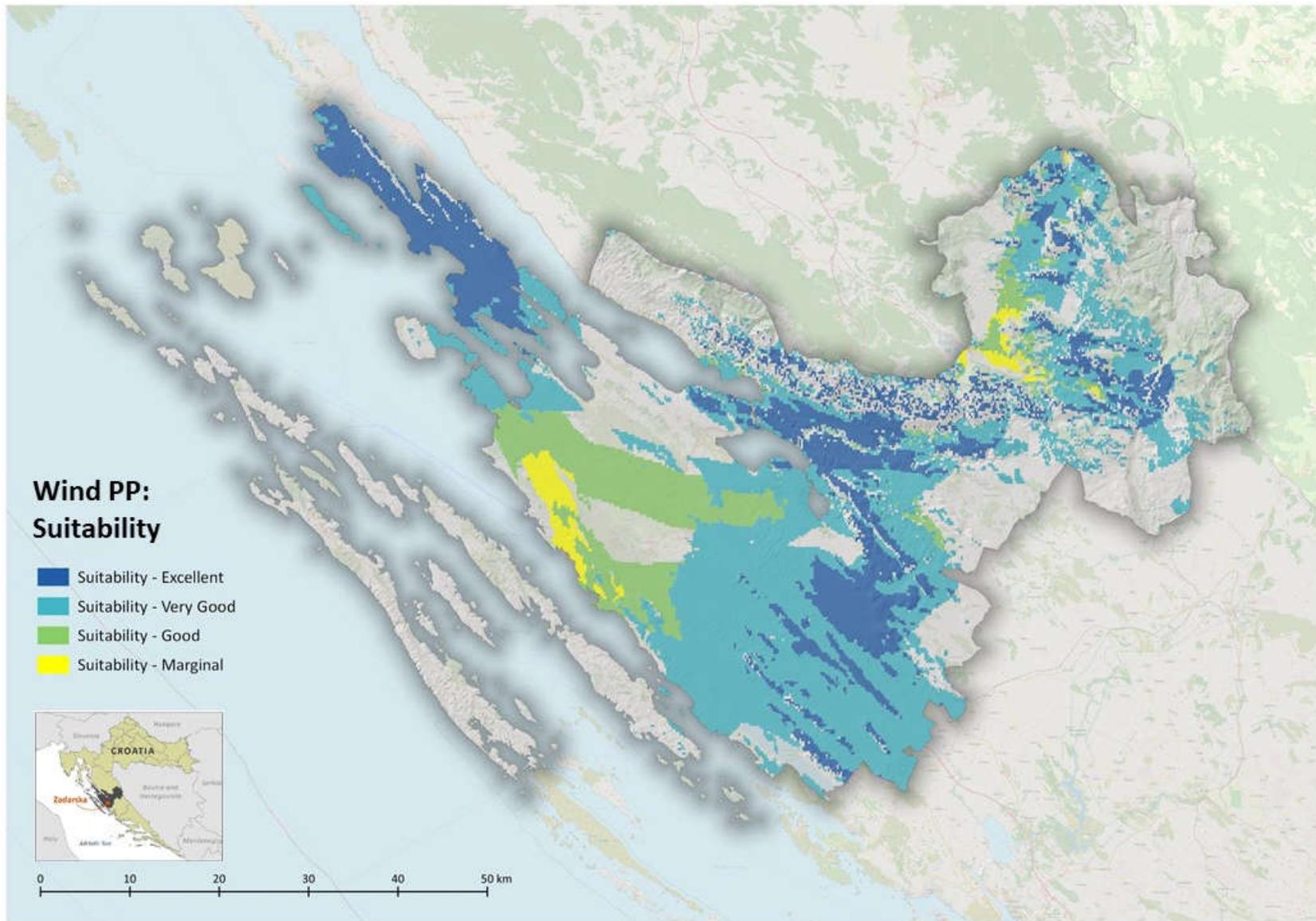


Figure 3-3. Suitability map for WPP

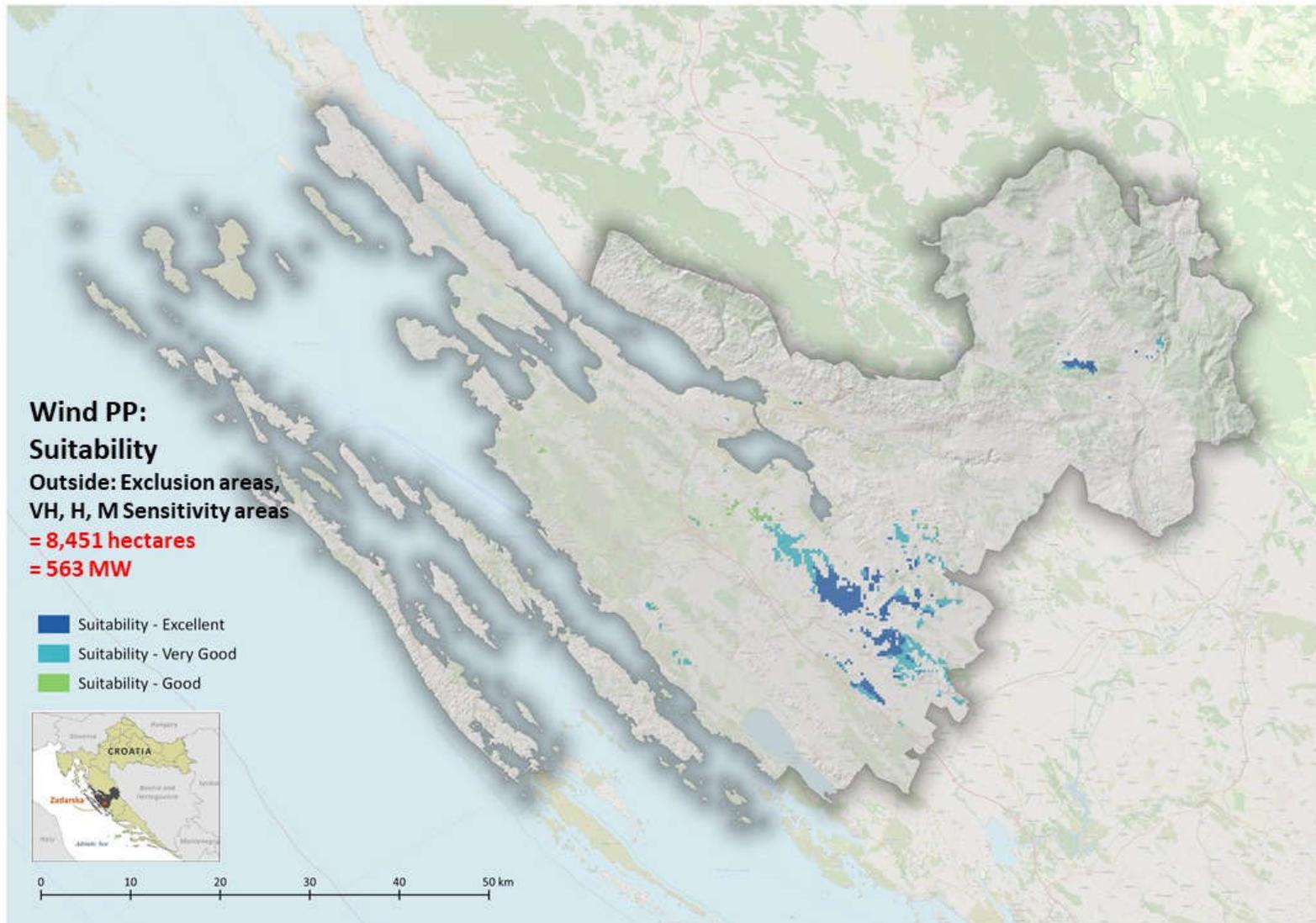


Figure 3-4. Area suitable for WPP within low sensitivity areas

## 4 CONCLUSIONS

---

These sensitivity maps were created with the objective to identify the spatial sensitivity of Zadar County to the development of SPP and WPP, indicating areas where such projects are likely to encounter conflicts with other land uses and nature protection, as well as areas where such conflicts are less likely to occur. The maps are primarily intended to help spatial planners designate areas for project development, so that development is directed towards the areas with the lowest possibility for conflict.

The analysis shows that there are 31,833 ha of potentially suitable land (good to excellent suitability) for SPP within very high sensitivity areas and 1,302 ha within high, 12,734 ha within medium, and 22,188 ha within low sensitivity areas in Zadar County. Assuming that 2 ha of land are required for 1 MW of solar energy capacity, the potential capacity of Zadar County amounts to 15,917 MW in very high sensitivity areas and 651 MW within high, 6,367 MW within medium, and 11,094 MW within low sensitivity areas.

The results show that under the conservative assumption that only 5% of low sensitivity area with good to excellent suitability is used for SPP development, it would be possible to achieve an installed capacity of approximately 555 MW. This equals 72% of the total targeted installation capacity (768 MW) in Croatia by 2030 as defined by the NECP. This indicates that significant potential for SPP development exists in low sensitivity areas and that through focusing on these areas alone, a significant contribution to national RES targets could be achieved.

In the case of WPP, there are 40,910 ha of potentially suitable land (good to excellent suitability) for WPP within very high sensitivity areas and 117 ha within high, 5,655 ha within medium, and 8,451 ha within low sensitivity areas in Zadar County. Assuming 15 ha of land is required per 1 MW of wind energy capacity (based on recent WPP built in Croatia, although this number varies significantly), the potential capacity for Zadar County amounts to 2,727 MW in very high sensitivity areas and 8 MW within high, 377 MW within medium, and 563 MW within low sensitivity areas. Although WPP potential within low sensitivity areas (563 MW) is significantly smaller than that of SPP, it can still provide a considerable contribution to the achievement of the targets defined in the NECP (1,364 MW in 2030).

It is important to keep in mind that the areas designated low sensitivity are not necessarily areas for development. The sensitivity indicates the possibility of encountering different constraints that might affect the duration and cost of project development. Therefore, sensitivity is just an indication of the severity of possible conflicts but does not say that a location is appropriate for development or not. This will be established through official procedures defined by legislation, which often require field work and an in-depth analysis of each location. The sensitivity maps include only available data and focus on the most sensitive elements. Depending on the location, other elements (primarily related to biodiversity and nature protection) might need to be included when considering a specific RES project proposal. However, the sensitivity maps are a valuable source of information for identifying sites that have more capacity to support sustainable, low-impact solar and wind energy and can serve as guidance for the spatial planning of RES at the regional or national level.

During the process, several issues were raised that could improve the methodology in the future. The most important of these are: lack of data (especially in the case biodiversity), resolution of the analysis (300 x 300 m pixel size is too coarse for certain criteria), limitations of the MCA, the possibility to grade the sensitivity within very high sensitivity areas, and the lack of involvement of experts from forestry and agriculture sectors. Nevertheless, the methodology developed can easily be adjusted to

incorporate the availability of new information or to be applied to new areas with different data requirements and availability.

## 5 REFERENCES

---

Agencija za razvoj Zadarske županije – ZADRA NOVA (2016) Županijska razvojna strategija Zadarske županije 2016. –2020. (Development Strategy of Zadar County 2016-2020)

Antolovic, J., E. Flajšman, A. Frković, M. Grgurev, M. Grubešić, D. Hamidović, D. Holcer, I. Pavlinić, M. Vuković, N. Tvrtković (ur.) (2006) Crvena knjiga sisavaca Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb. (Red Book of the mammals of Croatia).

Bioportal, Ministry of Economy and Sustainable Development (MIGOR)  
(<http://services.bioportal.hr/wfs>).

CORINE Land Cover (CLC) (<http://servisi.azo.hr/tlo/wfs?service=WFS&request=GetCapabilities>).

Department for Communities and Local Government (2009) Multi-criteria analysis: a manual.

Energy Strategy of the Republic of Croatia (OG 25/2020).

EUROBATS (2014) Guidelines for consideration of bats in wind farm projects Revision 2014.

Ministry of Environment and Energy (2019) Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030.

Spatial Plan of Zadar County

Tutiš, V., Kralj, J., Radović, D., Ćiković, D., Barišić, S. (ur.) (2013) Crvena knjiga ptica Hrvatske. Ministarstvo zaštite okoliša i prirode, Državni zavod za zaštitu prirode, Zagreb, 258 str. (Red Book of the birds of Croatia).

## 6 ANNEXES

### Annex 1 – List of exclusion zones and very high sensitivity areas

#### WPP

| Criteria group                   | Criteria                 | Indicator  | Description  | Data source  |
|----------------------------------|--------------------------|--|--|--|
| <b>Legal restriction - ZZ_VE</b> |                          |  |  |  |
|                                  | <b>Protected areas</b>   |  |  |  |
|                                  | <b>ZZ_VE_P1</b>          | National park, strict reserve, special reserve, forest park, natural monument, park architecture monument, significant landscape | Economic activities of the use of natural resources are prohibited in a national park and strict reserve (Act on Nature Protection OG 80/13, 15/18, 14/19, 127/19; Articles 112 and 113). Activities that may disturb the features due to which an area has become protected are not allowed for the categories of special reserves, natural monuments, park-forests, and monuments of park architecture (Articles 114, 117, 118, 119, 120). Given the characteristics of these areas and their size, it is considered that WPP in such areas could jeopardise the characteristics for which these areas were designated. Nature parks and regional parks, although protected, are not completely excluded from consideration as these are mainly large areas where small-scale interventions do not necessarily undermine the features for which an area was protected. | <b>Bioportal - protected areas</b>                 |
|                                  | <b>ZZ_VE_P2</b>          | Ramsar sites, UNESCO natural heritage, UNESCO biosphere reserves, UNESCO geoparks  | Internationally designated protected areas of exceptional value. Due to their international value and protection, these areas are extremely sensitive to interventions.  | <b>Bioportal - internationally important areas</b> |
|                                  | <b>ZZ_VE_P3</b>          | Protected coastal area (ZOP) – 1000 m from the coastline of mainland and islands   | Area of restrictions under the Physical Planning Act (OG 153/13, 65/17, 114/18, 39/19, 98/19), Article 45.   | <b>Coastline (1000 m buffer)</b>                   |
|                                  | <b>Natural resources</b> |  |  |  |
|                                  | <b>ZZ_VE_PR1</b>         | I zone of sanitary water protection  | In the I zone of sanitary protection of springs with abstraction of water from aquifers, all activities are prohibited except those related to the abstraction, conditioning and transport of water for the water supply system (Ordinance on Conditions for Determining Zones of Sanitary Protection of Springs, OG 66/11, 47/13).  | <b>Croatian Waters</b>                             |
|                                  | <b>ZZ_VE_PR2</b>         | Inundation zone around water bodies (10m buffer)   | Water Act (OG 66/19), Article 22: In the inundation area, it is prohibited to perform actions that may worsen the water regime and increase the risk of harmful effects of water.  | <b>Croatian Waters + Open street maps</b>          |

|  |  |  |                                     |
|--|--|--|-------------------------------------|
| <b>Infrastructure and infrastructure corridors</b> |  |  |                                     |
| <b>ZZ_VE_I1</b>                                    | Airports (sports airport, airfield), heliports + 3 km buffer       | Airport Security Zone - Restricted Construction Zone 1<br>Urban Development Plan of Economic Zone Crno in Zadar: Limited Construction Zone I:<br>- ban on the construction of barracks, industrial facilities, residential buildings, hospitals, schools, kindergartens, resorts and other public facilities (with larger groups of people), main roads and transmission lines<br>- construction of other roads and transmission lines and warehouses is allowed (depending on the type of facility) | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_VE_I2</b>                                    | Motorways and expressways + 300 m buffer                           |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_VE_I3</b>                                    | State and local roads + 150 m buffer                               |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_VE_I4</b>                                    | Railway + buffer 150 m   |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I5</b>                                    | Main gas pipeline + 200 m buffer                                   | Regulation on technical conditions and standards for the safe transport of liquid and gaseous hydrocarbons through main oil and gas pipelines and oil and gas pipelines for international transport (OG SFRY 26/85, NN 53/91).   | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_VE_I6</b>                                    | Power lines + 150 m buffer   | Rules of the transmission system network, Art. 222 (OG 67/17)  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_VE_I7</b>                                    | Antennas + 1000 m buffer   |  | <b>Spatial Plan of Zadar County</b> |
| <b>Special purpose areas</b>                       |  | Areas already occupied or designated for some other use.   |                                     |
| <b>ZZ_SE_PN1</b>                                   | Military training grounds + 100 buffer                             |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_PN2</b>                                   | Sports zones + 1000 m buffer                                       |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_PN3</b>                                   | Tourist zones + 1000 m buffer                                      |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_PN4</b>                                   | Tourist zones - planned + 1000 m buffer                            |  | <b>Spatial Plan of Zadar County</b> |
| <b>Settlements</b>                                 |  |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_VE_N1</b>                                    | The area of a settlement + 500 m buffer from the construction area | Zadar County Spatial Plan  |                                     |
| <b>Protected cultural goods</b>                    |  |  |                                     |
| <b>ZZ_VE_K1</b>                                    | Protected cultural good + 500 m buffer                             |  | <b>Spatial Plan of Zadar County</b> |

| Criteria group               | Criteria                             | Indicator   | Description   | Data source   |
|------------------------------|--------------------------------------|---|---|---|
| <b>Very high sensitivity</b> |                                      |   | Areas where, according to legal regulations, the construction of WPP is not directly excluded, but which, due to their characteristics and importance, can be very sensitive to the construction of WPP. When conducting an SEA for spatial plans or an EIA and assessment of the acceptability of a project for the ecological network, special attention should be given to these areas. Based on the analyses mentioned, it must be determined whether and under what conditions the construction of WPP is acceptable in these areas. |   |
|                              | <b>Protected areas</b>               |   |   |   |
|                              | <b>VV_VE_P1</b>                      | Nature park   | According to Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19), nature parks have the characteristics on the basis of which they can be characterised as an area of very high sensitivity.   | <b>Bioportal - protected areas</b>                            |
|                              | <b>VV_VE_P2</b>                      | SPA/SCI with sensitive species of birds, bats and large carnivores as target species  |   | <b>Bioportal</b>  |
|                              | <b>Habitats</b>                      |   |   |   |
|                              | <b>P_VE_121</b>                      | High forests  |   | <b>CORINE CLC2018 - deciduous, coniferous, mixed forests.</b> |
|                              | <b>VV_VE_S2</b>                      | Water bodies (natural lakes and rivers) and artificial canals + 400 m buffer  |   | <b>Spatial Plan of Zadar County</b>                           |
|                              | <b>VV_VE_S3</b>                      | Cliffs and rocks  |   | <b>Habitat map</b>  |
|                              | <b>Species</b>                       |   |   |   |
|                              | <b>VV_VE_V1</b>                      | Internationally important underground sites identified by EUROBATS + 5 km buffer  |   | <b>EUROBATS</b>   |
|                              | <b>VV_VE_V2</b>                      | Internationally important underground sites identified by EUROBATS + 5 km buffer  |   | <b>MESD</b>   |
|                              | <b>Landscape and visual exposure</b> |   |   |   |
|                              | <b>VV_VE_KV</b>                      | Particularly valuable area - natural landscape;<br>Particularly valuable area - natural and cultural landscape;<br>Site of special landscape value + 500 m buffer |   | <b>Spatial Plan of Zadar County</b>                           |

## SPP

| Criteria group                   | Criteria                 | Indicator  | Description  | Data source                         |
|----------------------------------|--------------------------|--|--|-------------------------------------|
| <b>Legal restriction - ZZ_SE</b> |                          |  |  |                                     |
|                                  | <b>Protected areas</b>   |  |  |                                     |
|                                  | <b>ZZ_SE_P1</b>          | National park, strict reserve, special reserve, forest park, natural monument, park architecture monument, significant landscape | Economic activities of the use of natural resources are prohibited in a national park and strict reserve (Act on Nature Protection OG 80/13, 15/18, 14/19, 127/19; Articles 112 and 113). Activities that may disturb the features due to which an area has become protected are not allowed for the categories of special reserves, natural monuments, park-forests, and monuments of park architecture (Articles 114, 117, 118, 119, 120). Given the characteristics of these areas and their size, it is considered that SPP in such areas could jeopardise the characteristics for which these areas were designated. Nature parks and regional parks, although protected, are not completely excluded from consideration as these are mainly large areas where small-scale interventions do not necessarily undermine the features for which an area was protected.   | <b>Biportal</b>                     |
|                                  | <b>ZZ_SE_P2</b>          | Ramsar sites, UNESCO natural heritage, UNESCO biosphere reserves, UNESCO geoparks  | Internationally designated protected areas of exceptional value. Due to their international value and protection, these areas are extremely sensitive to interventions.  | <b>Biportal</b>                     |
|                                  | <b>ZZ_SE_P3</b>          | Protected coastal area (ZOP) – 1000 m from the coastline of mainland and islands   | Area of restrictions under the Physical Planning Act (OG 153/13, 65/17, 114/18, 39/19, 98/19), Article 45.   | <b>Spatial Plan of Zadar County</b> |
|                                  | <b>Natural resources</b> |  |  |                                     |
|                                  | <b>ZZ_SE_PR1</b>         | I. zone of sanitary water protection   | In the I zone of sanitary protection of springs with abstraction of water from aquifers, all activities are prohibited except those related to the abstraction, conditioning and transport of water for the water supply system (Ordinance on Conditions for Determining Zones of Sanitary Protection of Springs, OG 66/11, 47/13).  | <b>Spatial Plan of Zadar County</b> |
|                                  | <b>ZZ_SE_PR2</b>         | Inundation zone around water bodies (10 m buffer)  | Water Act (OG 66/19), Article 22: In the inundation area, it is prohibited to perform actions that may worsen the water regime and increase the risk of harmful effects of water.<br>Zadar County Spatial Plan (Amendments, 2014): For the purpose of technical maintenance and construction works, an inundation-protection zone should be provided with minimum widths:<br>- 10.0 m along the river Zrmanja, the watercourse Kotarka and Miljašić ravine<br>- 10.0 m along the defensive embankment facilities in the protected area<br>- 5.0 m from the upper edge of other torrent watercourses and drainage channels, i.e. the edge of public water good parcel.<br>Depending on the size and condition of the watercourse or facility, the width of the inundation protection area can be smaller than stated above, but not less than 3.0 m, which will be determined by the water conditions for each object separately. | <b>Spatial Plan of Zadar County</b> |
|                                  | <b>ZZ_SE_PR3</b>         | Flood area   |  | <b>Spatial Plan of Zadar County</b> |

|  |  |  |                                     |
|--|--|--|-------------------------------------|
| <b>Infrastructure and infrastructure corridors</b> |  |  |                                     |
| <b>ZZ_SE_I1</b>                                    | Airports (sports airport, airfield) - airport area | Airport Security Zone - Restricted Construction Zone 1<br>Urban Development Plan of Economic Zone Crno in Zadar: Limited Construction Zone I:<br>- ban on the construction of barracks, industrial facilities, residential buildings, hospitals, schools, kindergartens, resorts and other public facilities (with larger groups of people), main roads and transmission lines<br>- construction of other roads and transmission lines and warehouses is allowed (depending on the type of facility)                                       | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I2</b>                                    | Heliports and other airports + buffer 50m          |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I3</b>                                    | Motorways and expressways + buffer 40m             | The Roads Act (OG 84/11, 22/13, 54/13, 148/13, 92/14, 110/19), Article 55, protection zone: if a location permit is issued for the construction of facilities and installations within the protection zone of a public road, the conditions of Croatian Highways Ltd., Croatian Roads Ltd or a county administration for roads has to be requested in advance. The protection zone shall be measured from the outer edge of the land area: motorway - 40 m; expressways - 40 m; state road - 25 m; county roads - 15 m; local road - 10 m. | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I4</b>                                    | State and local roads + buffer 25 m                | The categories are not separated; the distance fro state roads was considered.   | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I5</b>                                    | Railway + buffer 100 m                             | Regulation on general conditions for construction in a protective railway zone (OG 93/10). The buffer zone also includes the infrastructure area.  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I6</b>                                    | Main gas pipeline + buffer 30 m                    | Regulation on technical conditions and standards for the safe transport of liquid and gaseous hydrocarbons through main oil and gas pipelines and oil and gas pipelines for international transport (OG SFRY 26/85, NN 53/91).   | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_I7</b>                                    | Power lines and underground cables + 50 m buffer   | Rules of the transmission system network, Art. 222 (OG 67/17)  | <b>Spatial Plan of Zadar County</b> |
| <b>Special purpose areas</b>                       |  | Areas already occupied or designated for some other use.   |                                     |
| <b>ZZ_SE_PN1</b>                                   | Military training grounds + 100 m buffer           |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_PN2</b>                                   | Sports zones                                       |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_PN3</b>                                   | Tourist zones + 500 m buffer                       |  | <b>Spatial Plan of Zadar County</b> |
| <b>ZZ_SE_PN4</b>                                   | Tourist zones planned + 500 m buffer               |  | <b>Spatial Plan of Zadar County</b> |
| <b>Settlements</b>                                 |  |  |                                     |
| <b>ZZ_SE_N1</b>                                    | The area of a settlement + buffer 500 m            |  | <b>Spatial Plan of Zadar County</b> |
| <b>Protected cultural goods</b>                    |  |  |                                     |
| <b>ZZ_SE_K1</b>                                    | Protected cultural good + buffer 500 m             | Archaeological and historical sites, cultural heritage, aqueduct, protected cultural landscape.  | <b>Spatial Plan of Zadar County</b> |

| Criteria group        | Criteria               | Indicator        | Description  | Data source                  |
|-----------------------|------------------------|------------------|--|------------------------------|
| Very high sensitivity |                        |                  | Areas where, according to legal regulations, the construction of solar power plants is not directly excluded, but which by their characteristics and importance, can be very sensitive to the construction of solar power plants. When conducting an SEA for spatial plans or an EIA and assessment of the acceptability of a project for the ecological network, special attention should be given to these areas. Based on analyses mentioned, it must be determined whether and under what conditions the construction of solar power plants is acceptable in this area.  |                              |
|                       | <b>Protected areas</b> |                  |  |                              |
|                       | VV_SE_P1               | Nature park      | According to Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19), nature parks have the characteristics on the basis of which they can be characterised as an area of very high sensitivity.  | Bioportal                    |
|                       | <b>Habitats</b>        |                  |  |                              |
|                       | VV_SE_S1               | High forests     | According to the Forest Act (OG 68/18, 115/18, 98/19), forests and forest land are natural resource and, together with the general useful functions of forests, require a special management. According to their purpose, forests are classified as economic and protective. In the forest and on forest land owned by the Republic of Croatia, an easement may be established for the purpose of building RES plants (Article 58). Deforestation may be allowed (Article 39) under certain conditions: for the purpose of building forest infrastructure; if the forest or forest land needs to be brought to another purpose of the interests of the Republic of Croatia; if required by the security or defence interests of the country; for the purpose of carrying out interventions in space in accordance with spatial plans if necessary for the construction of buildings that according to the spatial plan or special regulation can be built outside the construction area.<br>Forests also provide variety of other ecosystem services; thus, deforestation is not recommended to accommodate facilities that require significant areas, such as solar plants. | CORINE CLC2018               |
|                       | VV_SE_S2               | Water bodies     | Natural lakes and rivers + buffer of 100, artificial canals + 15 m buffer; accumulations + 50 m buffer   | Spatial Plan of Zadar County |
|                       | VV_SE_S3               | Cliffs and rocks | Habitats classified according to habitat map as B.1=rocks; B.2= cliffs. These habitats are common habitats of protected species; especially endemic.   | Bioportal                    |

|                          |   |  |  |  |
|--------------------------|---|--|--|--|
| <b>Natural resources</b> |   |  |  |  |
| <b>VV_SE_PR1</b>         | Highly valuable and valuable arable land (P1 or P2 category of agricultural land)       |  | Article 5, Paragraph 2 of the Agricultural Land Act (OG 20/18, 115/18, 98/19) considers the conversion of agricultural land (including for energy facilities) as damage to agricultural land. The conversion of agricultural land for non-agricultural purposes is carried out in accordance with spatial plans and other regulations. Article 22, Paragraph 3 states that highly valuable (P1) and valuable arable (P2) land outside the boundaries of a construction area may not be used for agricultural purposes except: a) when there is no lower value agricultural land in the immediate vicinity, which does not include the construction of a golf course; b) when the interest of the Republic of Croatia for the construction of facilities that are built outside the construction area according to special regulations has been determined; c) for the construction of agricultural buildings intended exclusively for agricultural activity and processing of agricultural products; d) for the use of buildings that are legalized on the basis of a special law. | <b>Spatial plan of Zadar County</b>                    |
| <b>Species</b>           |   |  |  |  |
| <b>VV_SE_V1</b>          | EUROBATS (internationally important underground sites) maternity colonies - 1 km buffer |  | These are the most sensitive areas, as females with cubs and cubs are using area around a shelter. If the colonies are mixed and one species has maternity colonies, the area is taken as a maternity colony.  | <b>Ministry of Economy and Sustainable Development</b> |
| <b>VV_SE_V2</b>          | Potential animal crossings over highway - 1 km buffer                                   |  | Areas important for connectivity of habitats for species, especially large carnivores.   | <b>Ministry of Economy and Sustainable Development</b> |
| <b>VV_SE_V3</b>          | Bear den of high and medium sensitivity   |  | This is important to avoid deterioration of breeding habitats that are more difficult to replace. Data was available only for bear dens. High and medium sensitivity breeding habitats were considered (9-4 class).  | <b>Ministry of Economy and Sustainable Development</b> |

## Annex 2 – List of indicators

### WPP

| 1. Nature |                 |                              |   |   |
|-----------|-----------------|------------------------------|---|---|
| 1.1       | Protected areas |                              |   |   |
| 1.1.1     | P_VE_111        | Protected areas              | Sensitivity based on the level of protection with regard to the protection status based on the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19; Articles 115, 116). |   |
|           |                 | High sensitivity             | 5   | Regional park, SPA, SCI   |
|           |                 |                              | 4   |   |
|           |                 |                              | 3   | Areas proposed for protection   |
|           |                 |                              | 2   |   |
|           |                 | Low sensitivity              | 1   | Outside protected areas   |
| 1.2       | Habitats        |                              |   |   |
| 1.2.1     | P_VE_121        | Endangered and rare habitats | Sensitivity regarding the possibility of deterioration of habitat quality, i.e. their values in case of WPP.  |   |
|           |                 | High sensitivity             | 5   | Target habitat within the SCI   |
|           |                 |                              | 4   |   |
|           |                 |                              | 3   | Rare and endangered habitats based on the Ordinance on habitat types, habitat maps and endangered and rare habitat types (OG 88/14) |
|           |                 |                              | 2   |   |
|           |                 | Low sensitivity              | 1   | Habitats not included in the Ordinance  |

|            |                  |   |   |  |                                     |
|------------|------------------|---|---|--|-------------------------------------|
| <b>1.3</b> |                  |   |   |  |                                     |
| 1.3.1      | <b>Bats</b>      |   |   |  |                                     |
| 1.3.1.a    | <b>P_VE_131a</b> | <b>Habitats important for bats</b>                    | <b>Sensitivity with respect to distance from habitats important for bats (forests, rivers, streams, ponds).</b> |  |                                     |
|            |                  | High sensitivity                                      | 5   | < 1000 m   | Bioportal                           |
|            |                  |   | 4   |  |                                     |
|            |                  |   | 3   | 1000-3000 m  |                                     |
|            |                  |   | 2   |  |                                     |
|            |                  | Low sensitivity                                       | 1   | > 3000 m   |                                     |
| 1.3.1.b    | <b>P_VE_131b</b> | <b>Distribution area of bats</b>                      | <b>Sensitivity due to the presence of bat species.</b>  |  |                                     |
|            |                  | High sensitivity                                      | 5   | Distribution area of ≥9 sensitive species                              | MESD, EUROBATS, Red Book of Mammals |
|            |                  |   | 4   | Distribution area of 5-8 sensitive species                             |                                     |
|            |                  |   | 3   | Distribution area of 3-5 sensitive species                             |                                     |
|            |                  |   | 2   | Distribution area of 1-2 sensitive species                             |                                     |
|            |                  | Low sensitivity                                       | 1   | Without sensitive species  |                                     |
| 1.3.2      | <b>Birds</b>     |   |   |  |                                     |
| 1.3.2.a    | <b>P_VE_132a</b> | <b>Habitats important for birds I</b>                 | <b>Sensitivity with respect to distance from habitats important for birds (lakes, wetlands).</b>                |  |                                     |
|            |                  | High sensitivity                                      | 5   | < 1000 m   | Bioportal                           |
|            |                  |   | 4   | 1000-2000 m  |                                     |
|            |                  |   | 3   | 2000-3000 m  |                                     |
|            |                  |   | 2   | 3000-5000 m  |                                     |
|            |                  | Low sensitivity                                       | 1   | > 5000 m   |                                     |
| 1.3.2.c    | <b>P_VE_132c</b> | <b>Area of distribution of sensitive bird species</b> | <b>Sensitivity due to the presence of sensitive bird species.</b>   |  |                                     |
|            |                  | High sensitivity                                      | 5   | Habitat important for ≥ 4 sensitive species in their distribution area | MESD                                |
|            |                  |   | 4   | Habitat important for 3 sensitive species in their distribution area   |                                     |
|            |                  |   | 3   | Habitat important for 2 sensitive species in their distribution area   |                                     |
|            |                  |   | 2   | Habitat important for 1 sensitive species in their distribution area   |                                     |
|            |                  | Low sensitivity                                       | 1   | Habitat is not in the area of distribution of sensitive species        |                                     |
| 1.3.3      | <b>P_VE_133</b>  | <b>Habitat suitability for large carnivores</b>       | <b>Sensitivity with respect to species distribution and habitat sensitivity.</b>                                |  |                                     |
|            |                  | High sensitivity                                      | 5   | Habitat sensitivity class 7-9  | MESD                                |
|            |                  |   | 4   | Buffer of 2000 m from habitats important for reproduction              |                                     |
|            |                  |   | 3   | Habitat sensitivity class 4-6  |                                     |
|            |                  |   | 2   | Habitat sensitivity class 2-3  |                                     |
|            |                  | Low sensitivity                                       | 1   | Habitat sensitivity class 1  |                                     |

| 2. The natural resources and development potentials |          |                   |   |   |   |
|---|----------|-------------------|---|---|---|
| 2.1   |          |                   |   |   |   |
| 2.1.1   | PR_VE_P  | Agricultural land | Sensitivity regarding the importance and maintenance of agricultural land functions, i.e. the probability of direct or indirect impact on the quality and sustainability of the natural resource. |   |   |
|   |          |                   | High sensitivity  | 5 | Highly valuable arable land (category P1 and P2), permanent crops |
|   |          |                   |   | 4 |   |
|   |          |                   |   | 3 | Other arable land (category P3)                                   |
|   |          |                   |   | 2 |   |
|   |          |                   | Low sensitivity   | 1 | Other agricultural land and forest land (category PS)             |
|   |          |                   |   |   | Spatial Plan of Zadar County                                      |
| 2.2   |          |                   |   |   |   |
| 2.2.1   | PR_VE_S  | Forests           | Sensitivity regarding the importance and maintenance of forest functions, i.e. the probability of direct or indirect impact on the quality and sustainability of the natural resource.            |   |   |
|   |          |                   | High sensitivity  | 5 | Degraded forests/ succession to forests (macchia, etc.)           |
|   |          |                   |   | 4 |   |
|   |          |                   |   | 3 |   |
|   |          |                   |   | 2 |   |
|   |          |                   | Low sensitivity   | 1 | Out of forest   |
|   |          |                   |   |   | CORINE land cover   |
| 2.3   |          |                   |   |   |   |
| 2.3.1   | PR_VE_VG | Waters            | Sensitivity with regard to the importance of resources for water supply, i.e. the possibility of direct or indirect impact on the quality and sustainability of the natural resource.             |   |   |
|   |          |                   | High sensitivity  | 5 | II zone of sanitary protection                                    |
|   |          |                   |   | 4 | III zone of sanitary protection                                   |
|   |          |                   |   | 3 | IV zone of sanitary protection                                    |
|   |          |                   |   | 2 | Sanitary protection zone BB                                       |
|   |          |                   | Low sensitivity   | 1 | Outside sanitary protection zones                                 |
|   |          |                   |   |   | Spatial Plan of Zadar County                                      |

| 2.4     |          |                         |  |               |                              |
|---------|----------|-------------------------|--|---------------|------------------------------|
| 2.4.1.a | PR_VE_T1 | Tourist zones           | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts, noise and flickering in case of WPP. Distance from the existing tourist zone. |               | Spatial Plan of Zadar County |
|         |          |                         | High sensitivity   | 5 < 1500 m    |                              |
|         |          |                         |  | 4 1500-2000 m |                              |
|         |          |                         |  | 3 2000-2500 m |                              |
|         |          |                         |  | 2 2500-3000 m |                              |
|         |          |                         | Low sensitivity  | 1 > 3000 m    |                              |
| 2.4.1.b | PR_VE_T2 | Tourist zones - planned | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts, noise and flickering in case of WPP. Distance from the planned tourist zone.  |               | Spatial Plan of Zadar County |
|         |          |                         | High sensitivity   | 5 < 1500 m    |                              |
|         |          |                         |  | 4 1500-2000 m |                              |
|         |          |                         |  | 3 2000-2500 m |                              |
|         |          |                         |  | 2 2500-3000 m |                              |
|         |          |                         | Low sensitivity  | 1 > 3000 m    |                              |
| 2.4.2.c | PR_VE_T3 | Recreation zones        | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts, noise and flickering in case of WPP. Distance from the recreation zone.       |               | Spatial Plan of Zadar County |
|         |          |                         | High sensitivity   | 5 < 1500 m    |                              |
|         |          |                         |  | 4 1500-2000 m |                              |
|         |          |                         |  | 3 2000-2500 m |                              |
|         |          |                         |  | 2 2500-3000 m |                              |
|         |          |                         | Low sensitivity  | 1 > 3000 m    |                              |

| 3. Human environment (social values) |                |                              |   |  |                                      |  |
|--------------------------------------|----------------|------------------------------|---|--|--------------------------------------|--|
| 3.1                                  | Population     |                              |   |  |                                      |  |
| 3.1.1.                               | Settlements    |                              |   |  |                                      |  |
| 3.1.1.a                              | CO_VE_N1       | Distance from the settlement | Sensitivity regarding visibility, noise and flickering effects in the case of WPP.  |  |                                      |  |
|                                      |                | High sensitivity             | 5   | <1000 m from the boundaries of the settlement        | Open Street Map - buildings + buffer |  |
|                                      |                |                              | 4   | 1000 m - 1500m from the boundaries of the settlement |                                      |  |
|                                      |                |                              | 3   | 1500 m - 2000m from the boundaries of the settlement |                                      |  |
|                                      |                |                              | 2   | 2000 m - 2500m from the boundaries of the settlement |                                      |  |
|                                      |                | Low sensitivity              | 1   | >2500 m from the boundaries of the settlement        |                                      |  |
| 3.1.1.b                              | CO_VE_N2       | Number of inhabitants        | Sensitivity based on the number of people who may be directly exposed to visual impacts, noise and flickering in the case of WPP. |  |                                      |  |
|                                      |                | High sensitivity             | 5   | > 5000 inhabitants                                   | Spatial Plan of Zadar County         |  |
|                                      |                |                              | 4   | 1000 - 5000 inhabitants                              |                                      |  |
|                                      |                |                              | 3   | 100 - 1000 inhabitants                               |                                      |  |
|                                      |                |                              | 2   | do 100 inhabitants                                   |                                      |  |
|                                      |                | Low sensitivity              | 1   | Uninhabited  |                                      |  |
| 3.2                                  | Cultural goods |                              |   |  |                                      |  |
| 3.2.1                                | CO_VE_KD       | Distance from cultural goods | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts in the case of WPP.             |  |                                      |  |
|                                      |                | High sensitivity             | 5   | Distance < 1000 m                                    | Spatial Plan of Zadar County         |  |
|                                      |                |                              | 4   | Distance 1000-1500 m                                 |                                      |  |
|                                      |                |                              | 3   | Distance 1500-2000 m                                 |                                      |  |
|                                      |                |                              | 2   | Distance 2000-2500 m                                 |                                      |  |
|                                      |                | Low sensitivity              | 1   | Distance > 2500 m                                    |                                      |  |

|              |                                      |   |   |   |  |
|--------------|--------------------------------------|---|---|---|--|
| <b>3.3</b>   | <b>Landscape and visual exposure</b> |   |   |   |  |
| <b>3.3.1</b> | <b>Landscape</b>                     |   |   |   |  |
| 3.3.1.a      | <b>CO_VE_KV</b>                      | <b>Landscape values</b>                 | <b>Sensitivity regarding possible impairment (by deteriorating the characteristics for which protection has been declared, type of use, attendance) with regard to visual impacts, noise and flickering in the case of WPP.</b> |   |  |
|              |                                      | High sensitivity                        | <b>5</b>  | Cultural landscape  | <b>Spatial Plan of Zadar County, Bioportal</b> |
|              |                                      |   | <b>4</b>  | 800 m distance from particularly valuable areas and protected areas   |  |
|              |                                      |   | <b>3</b>  | 800-3000 m distance from particularly valuable areas, sites of special landscape value and protected areas  |  |
|              |                                      |   | <b>2</b>  | 3000-6000 m distance from particularly valuable areas, sites of special landscape value and protected areas |  |
|              |                                      | Low sensitivity                         | <b>1</b>  | > 6000 m distance from particularly valuable areas, sites of special landscape value and protected areas    |  |
| 3.3.1.b      | <b>CO_VE_P1</b>                      | <b>Panoramic values</b>                 | <b>Sensitivity due to the reduction of the panoramic value of the landscape.</b>  |   |  |
|              |                                      | High sensitivity                        | <b>5</b>  | Viewshed < 6000 m   | <b>Spatial Plan of Zadar County</b>            |
|              |                                      |   | <b>4</b>  | Viewshed 6000-7000 m  |  |
|              |                                      |   | <b>3</b>  | Viewshed 7000-8000 m  |  |
|              |                                      |   | <b>2</b>  | Viewshed 8000-10000 m   |  |
|              |                                      | Low sensitivity                         | <b>1</b>  | Viewshed > 10000 m  |  |
| 3.3.1.c      | <b>CO_VE_P2</b>                      | <b>Visual quality (visual exposure)</b> | <b>Sensitivity to visual exposure from highways and express roads.</b>  |   |  |
|              |                                      | High sensitivity                        | <b>5</b>  | Viewshed < 1000 m   | <b>Spatial Plan of Zadar County</b>            |
|              |                                      |   | <b>4</b>  | Viewshed 1000-3000 m  |  |
|              |                                      |   | <b>3</b>  | Viewshed 3000-5000 m  |  |
|              |                                      |   | <b>2</b>  | Viewshed 5000-6000 m  |  |
|              |                                      | Low sensitivity                         | <b>1</b>  | Viewshed > 6000 m   |  |

## SPP

| 1. Nature |                 |                              |  |   |
|-----------|-----------------|------------------------------|--|---|
| 1.1.      | Protected areas |                              |  |   |
| 1.1.1     | P_SE_111        | Protected areas              | Sensitivity based on the level of protection with regard to the protection status based on the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19; Articles 115, 116) – economic and other activities are allowed, as long as the essential features and purpose of the area are not endangered.  |   |
|           |                 | High sensitivity             | 5  | -   |
|           |                 |                              | 4  | Regional park   |
|           |                 |                              | 3  | Areas proposed for protection in spatial plan   |
|           |                 |                              | 2  | -   |
|           |                 | Low sensitivity              | 1  | Outside protected areas   |
|           |                 |                              |  | Bioportal; Spatial Plan of Zadra county   |
| 1.1.2.    | P_SE_112        | Ecological network           | Sensitivity based on the ecological network (Decree on the ecological network and the responsibility of public institutions for the management of ecological network areas, OG 80/2019). The ecological network is an area inhabited by important plant and animal species; however, some species and groups are more sensitive than others. |   |
|           |                 | High sensitivity             | 5  | All SPA areas and those SCI areas important for the conservation of sensitive groups (bats, large carnivores, flora, butterflies, reptiles) |
|           |                 |                              | 4  | -   |
|           |                 |                              | 3  | Other terrestrial SCI that do not contain sensitive groups and species  |
|           |                 |                              | 2  | -   |
|           |                 | Low sensitivity              | 1  | Areas outside SPA and SCI and SCI marine areas  |
|           |                 |                              |  | Bioportal   |
| 1.2.      | Habitats        |                              |  |   |
| 1.2.1     | P_SE_121        | Endangered and rare habitats | Sensitivity regarding the possibility of deterioration of habitat quality, i.e. their values in case of SPP.   |   |
|           |                 | High sensitivity             | 5  | Target habitat within the SCI. Target habitats for individual SCI within that same SCI have a high sensitivity.                             |
|           |                 |                              | 4  | -   |
|           |                 |                              | 3  | Rare and endangered habitats based on the Ordinance on habitat types, habitat maps and endangered and rare habitat types (OG 88/14)         |
|           |                 |                              | 2  | -   |
|           |                 | Low sensitivity              | 1  | Habitats not included in the Ordinance  |
|           |                 |                              |  | Bioportal   |

|              |  |   |  |  |   |
|--------------|--|---|--|--|---|
| <b>1.3.</b>  | <b>Species</b>                             |   |  |  |   |
| <b>1.3.1</b> | <b>Bats</b>                                |   |  |  |   |
|              | <b>P_SE_131</b>                            | <b>EUROBATS internationally important habitats for bats</b> | <b>Sensitivity with regard to the possibility of direct impacts on species and populations in the most sensitive areas, especially areas of feeding females with cubs and independent feeding of cubs.</b> |  |   |
|              |  | High sensitivity  | <b>5</b>   | 2 km buffer around maternity colonies  | <b>Ministry of Economy and Sustaina</b> |
|              |  |   | <b>4</b>   | 2- 5 km buffer around maternity colonies; 2 km buffer around other colonies        |   |
|              |  |   | <b>3</b>   | 2-5 km buffer around other colonies  |   |
|              |  |   | <b>2</b>   | 5- 10 km buffer around all colonies  |   |
|              |  | Low sensitivity   | <b>1</b>   | > 10 km from all colonies  |   |
| <b>1.3.2</b> | <b>Birds</b>                               |   |  |  |   |
|              | <b>P_SE_132</b>                            | <b>Habitats important for sensitive bird species</b>        | <b>Sensitivity due to the presence of habitats suitable for sensitive species in the area of their distribution. The protection of its habitat is essential for the survival of the species.</b>           |  |   |
|              |  | High sensitivity  | <b>5</b>   | Habitat significant for 3 or more sensitive species within their distribution area | <b>Ministry of Economy and Sustaina</b> |
|              |  |   | <b>4</b>   | Habitat significant for 2 sensitive species within their distribution area         |   |
|              |  |   | <b>3</b>   | Habitat significant for 1 sensitive species within its distribution area           |   |
|              |  |   | <b>2</b>   | -  |   |
|              |  | Low sensitivity   | <b>1</b>   | Habitat without sensitive species  |   |
| <b>1.3.3</b> | <b>Large carnivores (wolf, bear, lynx)</b> |   |  |  |   |
|              | <b>P_SE_133</b>                            | <b>Habitat suitability for large carnivores</b>             | <b>Sensitivity with respect to species distribution and habitat sensitivity.</b>   |  |   |
|              |  | High sensitivity  | <b>5</b>   | Habitat sensitivity class 7-9 within larger continuous habitat area                | <b>Ministry of Economy and Sustaina</b> |
|              |  |   | <b>4</b>   | -  |   |
|              |  |   | <b>3</b>   | Habitat sensitivity class 4-6 within larger continuous habitat area                |   |
|              |  |   | <b>2</b>   | -  |   |
|              |  | Low sensitivity   | <b>1</b>   | Other areas  |   |

| 2. Natural resources and development potentials |                         |                   |   |   |                              |
|---|-------------------------|-------------------|---|---|------------------------------|
| <b>2.1.</b>                                     | <b>Agriculture</b>      |                   |   |   |                              |
| 2.1.1   | PR_SE_P                 | Agricultural land | Sensitivity regarding the importance and maintenance of agricultural land functions, i.e. the probability of direct or indirect impact on the quality and sustainability of natural resource. |   |                              |
|   |                         | High sensitivity  | 5   | -   | Spatial Plan of Zadar County |
|   |                         |                   | 4   | -   |                              |
|   |                         |                   | 3   | Other arable land (category P3)                         |                              |
|   |                         |                   | 2   | -   |                              |
|   |                         | Low sensitivity   | 1   | Other agricultural land and forest land (category PS)   |                              |
| <b>2.2.</b>                                     | <b>Forestry</b>         |                   |   |   |                              |
| 2.2.1   | PR_SE_S                 | Forests           | Sensitivity regarding the importance and maintenance of forest functions, i.e. the probability of direct or indirect impact on the quality and sustainability of natural resource.            |   |                              |
|   |                         | High sensitivity  | 5   | -   | CORINE land cover            |
|   |                         |                   | 4   | -   |                              |
|   |                         |                   | 3   | Degraded forests/ succession to forests (macchia, etc.) |                              |
|   |                         |                   | 2   | -   |                              |
|   |                         | Low sensitivity   | 1   | Out of forest   |                              |
| <b>2.3.</b>                                     | <b>Water management</b> |                   |   |   |                              |
| 2.3.1   | PR_SE_VG                | Waters            | Sensitivity with regard to the importance of resources for water supply, i.e. the possibility of direct or indirect impact on the quality and sustainability of natural resource.             |   |                              |
|   |                         | High sensitivity  | 5   | II zone of sanitary protection                          | Spatial Plan of Zadar County |
|   |                         |                   | 4   | III zone of sanitary protection                         |                              |
|   |                         |                   | 3   | IV zone of sanitary protection                          |                              |
|   |                         |                   | 2   | Sanitary protection zone BB                             |                              |
|   |                         | Low sensitivity   | 1   | Outside sanitary protection zones                       |                              |

| 2.4.    |           | Tourism and recreation  |  |   |                         |                              |
|---------|-----------|-------------------------|--|---|-------------------------|------------------------------|
| 2.4.1.a | PR_SE_T1  | Tourist zones           | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts in the case of SPP. Distance from the existing tourist zone. |   |                         | Spatial Plan of Zadar County |
|         |           |                         | High sensitivity   | 5 | -                       |                              |
|         |           |                         |  | 4 | -                       |                              |
|         |           |                         |  | 3 | 500 - 1000 m from zones |                              |
|         |           |                         | Low sensitivity  | 2 | -                       |                              |
|         |           | 1                       | > 1000 m from zones  |   |                         |                              |
| 2.4.1.b | PR_SE_T2  | Tourist zones - planned | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts in the case of SPP. Distance from the planned tourist zone.  |   |                         | Spatial Plan of Zadar County |
|         |           |                         | High sensitivity   | 5 |                         |                              |
|         |           |                         |  | 4 |                         |                              |
|         |           |                         |  | 3 | 500 - 1000 m from zones |                              |
|         |           |                         | Low sensitivity  | 2 |                         |                              |
|         |           | 1                       | > 1000 m from zones  |   |                         |                              |
| 2.4.1.c | PR_SE_TR3 | Recreation zones        | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts in the case of SPP. Distance from the recreation zone.       |   |                         | Spatial Plan of Zadar County |
|         |           |                         | High sensitivity   | 5 | < 500 m from zones      |                              |
|         |           |                         |  | 4 |                         |                              |
|         |           |                         |  | 3 | 500 - 1000 m from zones |                              |
|         |           |                         | Low sensitivity  | 2 |                         |                              |
|         |           | 1                       | > 1000 m from zones  |   |                         |                              |

| 3. Human environment (social values) |                |                              |   |                                   |
|--------------------------------------|----------------|------------------------------|---|-----------------------------------|
| 3.1.                                 | Population     |                              |   |                                   |
| 3.1.1.                               | Settlements    |                              |   |                                   |
| 3.1.1. a                             | CO_SE_N1       | Distance from the settlement | Sensitivity with respect to possible visibility from the settlement and visual impacts.                               |                                   |
|                                      |                | High sensitivity             | 5   | 500 - 1000 m from the settlement  |
|                                      |                |                              | 4   | 1000 - 1500 m from the settlement |
|                                      |                |                              | 3   | -                                 |
|                                      |                |                              | 2   | -                                 |
|                                      |                | Low sensitivity              | 1   | >1500 m from the settlement       |
|                                      |                |                              |   | Spatial Plan of Zadar County      |
| 3.1.1. b                             | CO_SE_N2       | Number of inhabitants        | Sensitivity with respect to the number of people who may be exposed to visual impacts.                                |                                   |
|                                      |                | High sensitivity             | 5   | > 5000 inhabitants                |
|                                      |                |                              | 4   | 1000 - 5000 inhabitants           |
|                                      |                |                              | 3   | 100 - 1000 inhabitants            |
|                                      |                |                              | 2   | < 100 inhabitants                 |
|                                      |                | Low sensitivity              | 1   | Uninhabited                       |
|                                      |                |                              |   | Spatial Plan of Zadar County      |
| 3.2.                                 | Cultural goods |                              |   |                                   |
| 3.2.1                                | CO_SE_KD       | Distance from cultural goods | Sensitivity regarding possible impairment (type of use, attendance) with regard to visual impacts in the case of SPP. |                                   |
|                                      |                | High sensitivity             | 5   | 500 - 1000 m from listed areas    |
|                                      |                |                              | 4   | -                                 |
|                                      |                |                              | 3   | 1000 m - 1500 m from listed areas |
|                                      |                |                              | 2   | -                                 |
|                                      |                | Low sensitivity              | 1   | > 1500 m from listed areas        |
|                                      |                |                              |   | Spatial Plan of Zadar County      |

|               |                                      |   |   |  |
|---------------|--------------------------------------|---|---|--|
| <b>3.3.</b>   | <b>Landscape and visual exposure</b> |   |   |  |
| <b>3.3.1.</b> | <b>Landscape</b>                     |   |   |  |
| 3.3.1.a       | <b>CO_SE_KV</b>                      | <b>Landscape values</b>                 | <b>Sensitivity with respect to possible impairment of the landscape value of the area.</b>                              |  |
|               |                                      | High sensitivity                        | <b>5</b>  | Cultural landscape, location of special landscape value, especially valuable landscapes, natural and cultural landscapes |
|               |                                      |   | <b>4</b>  | < 500 m from listed areas  |
|               |                                      |   | <b>3</b>  | 500 - 1000 m from listed areas   |
|               |                                      |   | <b>2</b>  | -  |
|               |                                      | Low sensitivity                         | <b>1</b>  | > 1000 m from listed areas   |
|               |                                      |   |   | <b>Spatial Plan of Zadar County</b>  |
| 3.3.1.b       | <b>CO_SE_P1</b>                      | <b>Panoramic values</b>                 | <b>Sensitivity due to the reduction of the panoramic value of the landscape at important viewpoints and view lines.</b> |  |
|               |                                      | High sensitivity                        | <b>5</b>  | Viewshed 500 m buffer from important panoramic sights  |
|               |                                      |   | <b>4</b>  | Viewshed 500 - 1000 m  |
|               |                                      |   | <b>3</b>  | Viewshed 1000- 2000 m  |
|               |                                      |   | <b>2</b>  | Viewshed 2000 - 3000 m   |
|               |                                      | Low sensitivity                         | <b>1</b>  | Viewshed > 3000 m  |
|               |                                      |   |   | <b>Spatial Plan of Zadar County</b>  |
| 3.3.1.c       | <b>CO_SE_P2</b>                      | <b>Visual quality (visual exposure)</b> | <b>Sensitivity to visual exposure from highways and express roads</b>   |  |
|               |                                      | High sensitivity                        | <b>5</b>  | Viewshed < 500 m   |
|               |                                      |   | <b>4</b>  | Viewshed 500 -1000 m   |
|               |                                      |   | <b>3</b>  | Viewshed 1000-1500 m   |
|               |                                      |   | <b>2</b>  | Viewshed 1500-2000 m   |
|               |                                      | Low sensitivity                         | <b>1</b>  | Viewshed > 2000 m  |
|               |                                      |   |   | <b>Spatial Plan of Zadar County</b>  |

### Annex 3 - Datasets used for sensitivity analysis

| Data  | Description  | Type and characteristics  | Source  |
|---|--|---|---|
| Protected areas (national and international protection) | Database of protected areas of the Republic of Croatia designated in accordance with national categories of protection: strict reserve, national park, nature park, special reserve, regional park, nature monument, significant landscape, park-forest and park architecture monument. Database of internationally important sites: Ramsar sites, UNESCO world heritage, biosphere reserves and geoparks. | Polygons of nationally and internationally protected areas in Croatia.                                    | Bioportal, Ministry of Economy and Sustainable Development (MINGOR)<br><a href="http://services.bioportal.hr/wfs">http://services.bioportal.hr/wfs</a>    |
| Natura 2000 network                                     | The Natura 2000 ecological network contains the most important areas for the conservation of species and habitats. It is comprised of conservation areas significant for birds (SPA) and conservation areas significant for species and habitat types (SAC).   | Polygons with boundaries of Natura 2000 sites (SPA and SAC) in Croatia.                                   | Bioportal, MINGOR<br><a href="http://services.bioportal.hr/wfs">http://services.bioportal.hr/wfs</a>  |
| Habitats  | Habitat map with land habitats other than forests (2016) with spatial representation of individual habitat types in Croatia. It includes 155 habitat types.  | Polygons of habitat types on a scale of 1:25,000. Applicable for all habitats except for forest habitats. | Bioportal, MINGOR<br><a href="http://services.bioportal.hr/wfs">http://services.bioportal.hr/wfs</a>  |
|   | CORINE Land Cover (CLC) High Resolution Layers (HRL) 2018 with information on specific land cover characteristics. It contains five groups of land cover: Artificial surfaces, Agricultural areas, Forests and seminatural areas, and Wetlands and Water bodies. CLC is used for the identification of forest habitats.  | Polygons for coniferous forests, broad-leaved forests and mixed forests. Minimum mapping unit is 25 ha.   | <a href="http://servisi.azo.hr/tlo/wfs?service=WFS&amp;request=GetCapabilities">http://servisi.azo.hr/tlo/wfs?service=WFS&amp;request=GetCapabilities</a> |
| Habitat suitability (sensitivity) for large carnivores  | Indicates probability of presence (%), sensitivity classes (1-9) and area of importance (unsuitable, low, medium and high suitability) for large carnivores (bear, wolf, lynx, bear dens).   | Polygons developed based on raster data with pixel size of 250 x 250 m.                                   | MINGOR  |
| Important underground                                   | Underground habitats for bats, such as caves, mines, fortifications  | Points indicating exact position of an  | MINGOR  |

|  |   |   |  |
|--|---|---|--|
| sites for bats in Europe                                 | and tunnels, where important bat colonies were recorded.  | important underground site.   |  |
| Distribution of important bird and bat species.          | Data on species distribution gathered for reporting under Habitats and Birds Directive.                                     | Polygons with species distribution recorded in quadrants 10x10km.   | MINGOR   |
| Infrastructure   | Airports and heliports, military polygons   | Polygons, points and lines indicating exact infrastructural corridor/area.  | Spatial Plan of Zadar County                         |
|  | Roads (highways, expressways and other national and local roads)  |   |  |
|  | Railway   |   |  |
|  | Gas pipeline  |   |  |
|  | Transmission lines  |   |  |
| Settlements and zones of use                             | Sport zones   | Polygons and points of the zones and settlements.   | Spatial Plan of Zadar County                         |
|  | Tourist zones (existing and planned)  |   | Spatial Plan of Zadar County                         |
|  | Settlements   |   | Google Open Street Map, Spatial Plan of Zadar County |
| Areas important due to panoramic and recreational values | Areas recorded in the Spatial Plan as panoramic viewpoints and view-lines and points of interest for their landscape value. | Polygons indicating viewsheds based on viewpoints, view-lines and other sites of interest. Viewsheds were made for different distances from the points. | Spatial Plan of Zadar County, DEM of Croatia         |
| Water bodies and zones                                   | Water protection zones  | Polygons of different protection zones.   | Spatial Plan of Zadar County                         |
|  | Water bodies and inundation belts   | Lines corresponding to water bodies (rivers, creeks, canals) and polygons presenting describing ponds, lakes, etc.                                      | Croatian Waters, Google Open Street Map              |
|  | Flooded areas   | Polygons of flooded areas.  | Spatial Plan of Zadar County                         |
| Coastal protection area                                  | Area of 1 km from coastal line into the land territory.   | 1 km buffer from the coastal line of the Zadar County.  | Spatial Plan of Zadar County                         |
| Cultural heritage  | Aqueducts, archaeological and historical areas, cultural heritage sites, cultural landscape.                                | Lines, polygons and points of sites.  | Spatial Plan of Zadar County                         |
| Agricultural land  | Valuable agricultural land according to its designated use in the Spatial Plan.   | Polygon indicating valuable agricultural areas.   | Spatial Plan of Zadar County                         |

## Annex 4 – Weighting factors used for sensitivity analysis

### WPP

| Indicator  | WF   |
|--|------|
| <b>Nature</b>  |      |
| Protected areas (P_VE_111)                                 | 0.16 |
| Endangered and rare habitats (P_VE_121)                    | 0.27 |
| Habitats important for bats (P_VE_131a)                    | 0.11 |
| Distribution area (P_VE_131b)                              | 0.11 |
| Habitats important for birds I (P_VE_132a)                 | 0.11 |
| Habitats important for birds II (P_VE_132b)                | 0.04 |
| Area of distribution of sensitive bird species (P_VE_132c) | 0.07 |
| Habitat suitability for large carnivores (P_VE_133)        | 0.13 |
| <b>Natural resources and development potentials</b>        |      |
| Agricultural land (PR_VE_P)                                | 0.18 |
| Forests (PR_VE_S)  | 0.18 |
| Waters (PR_VE_VG)  | 0.23 |
| Tourist zones (PR_VE_T1)                                   | 0.29 |
| Tourist zones – planned (PR_VE_T2)                         | 0.03 |
| Recreation zones (PR_VE_T3)                                | 0.08 |
| <b>Human environment (social values)</b>                   |      |
| Distance from the settlement (CO_VE_N1)                    | 0.10 |
| Number of inhabitants (CO_VE_N2)                           | 0.51 |
| Distance from cultural goods (CO_VE_KD)                    | 0.10 |
| Landscape values (CO_VE_KV)                                | 0.19 |
| Panoramic values (CO_VE_P1)                                | 0.07 |
| Visual quality (visual exposure) (CO_VE_P2)                | 0.03 |

## SPP

| Indicator   | WF   |
|---|------|
| <b>Nature</b>   |      |
| Protected areas (P_SE_111)                                      | 0.13 |
| Ecological network (P_SE_112)                                   | 0.20 |
| Endangered and rare habitats (P_SE_121)                         | 0.26 |
| EUROBATS internationally important habitats for bats (P_SE_131) | 0.19 |
| Habitats important for sensitive bird species (P_SE_132)        | 0.14 |
| Habitat suitability for large carnivores (P_SE_133)             | 0.09 |
| <b>Natural resources and development potentials</b>             |      |
| Agricultural land (PR_SE_P)                                     | 0.38 |
| Forests (PR_SE_S)   | 0.11 |
| Waters (PR_SE_VG)   | 0.19 |
| Tourist zones (PR_SE_T1)  | 0.23 |
| Tourist zones – planned (PR_SE_T2)                              | 0.03 |
| Recreation zones (PR_SE_T3)                                     | 0.06 |
| <b>Human environment (social values)</b>                        |      |
| Distance from the settlement (CO_SE_N1)                         | 0.04 |
| Number of inhabitants (CO_SE_N2)                                | 0.22 |
| Distance from cultural goods (CO_SE_KD)                         | 0.15 |
| Landscape values (CO_SE_KV)                                     | 0.39 |
| <b>Panoramic values (CO_SE_P1)</b>                              |      |
| Visual quality (visual exposure) (CO_SE_P2)                     | 0.05 |

## Annex 5 – Stakeholder engagement

### 1) Participant list for the initial project presentation (12<sup>th</sup> February 2020, EIHP, Zagreb)

Pilot projekt integriranog i participativnog planiranja prostora za smještaj sunčanih elektrana i vjetroelektrana

12. veljče 2020. Energetski institut Hrvoje Požar

| Ime I prezime             | Institucija                        | Email                        | Potpis     |
|---------------------------|------------------------------------|------------------------------|------------|
| Loris Elez                |                                    |                              |            |
| Karolina Majsec           | MZO E                              | karolina.majsec@mzo.hr       | Majsec     |
| Petra Derežić             | MZO E                              | petra.derezic@mzo.hr         | Derežić    |
| Mirna Mazija              | TRAGUS                             | mirna.mazija@quint.com       | Mazija     |
| Stipe Renje               | TRAGUS                             | stipe.renje@quint.com        | Renje      |
| Natalija Čengić Zglavnik  | MZO E                              | natalija.cengic@mzo.hr       | Čengić     |
| Elena Patčev              |                                    |                              |            |
| Vesna Kuzmanović-Marohnić | MGI PU                             |                              | Kuzmanović |
| Renata Kapitanović        |                                    |                              |            |
| Morana Bačić              | JU Netva Jadera                    | morana.baic@netva-jadera.com | Bačić      |
| Stipe Gverić              | Zavod za prostorno uređenje Zadara | gveric@zpu-zadar.hr          | Gverić     |
| Zvonimir Dorkin           |                                    |                              |            |
| Elena Patčev              |                                    |                              |            |
| Dražena Milešević         | TNC → 5                            | d.milesevic@tnc.org          | Milešević  |
| Mate Zec                  | BIOM                               | mate.zec@biom.hr             | Zec        |
| Dunja Delić               | BIOM                               | dunja.delic@biom.hr          | Delić      |
| Robert J. Jakuš           | MGI PU                             |                              | Jakuš      |

### 2) List of experts included in the technical consultations

| External expert  | Association/Institution  | Discussion points  |
|--|--|--|
| 11 <sup>th</sup> March 2020, Zadar                         |  |  |
| Zvonimir Dorkin - assistant to the head of the department  | Zadar County, Department for Physical Planning, Environmental Protection and Public Utilities        | - Visions for spatial development of the county (including both mainland and islands)<br>- Requests for new spatial elements on the territory of the county, especially wind and solar power plants  |
| Stjepan Gverić - director                                  | Zadar County - Institute for Spatial Planning of Zadar County  | - Areas and landscapes that are especially vulnerable to new developments<br>- Experience of wind and solar project development<br>- Discussion on the most appropriate ways to set up discussion with the WPP and SPP operators and developers<br>- Request for data within the spatial plans |
| 3 <sup>rd</sup> April 2020, via Zoom                       |  |  |
| Dunja Delić, Mate Zec - conservation experts, bird experts | BIOM - Non-governmental organization dedicated to nature conservation, promotion and popularisation. | - Approach and methodology<br>- The key issues related to biodiversity and habitats<br>- Quality of the available data   |

|   |   |  |
|---|---|--|
| Mirna Mazija,<br>Stjepan Renje – bat<br>experts   | TRAGUS - The Association<br>for Bat Conservation  | - Indicators and thresholds to be used for<br>criteria<br>- Spatial dataset which is not publicly available  |
| 21 <sup>st</sup> April 2020, via Zoom   |   |  |
| Vlatka Dumbović<br>Mazal;<br>Ramona Topić;<br>Marija Sabolić;<br>Jasna Jeremić;<br>Tamara Kirin;<br>Daniela Hamidović;<br>Gabrijela Šestani | Ministry of Environment<br>and Energy, Institute for<br>Environmental and Nature<br>Conservation                                    | - Approach and methodology<br>- The key elements of biodiversity and<br>habitats to pay attention to<br>- Quality of the available data<br>- Indicators and thresholds to be used for<br>criteria<br>- Spatial dataset which is not publicly available   |
| 22 <sup>nd</sup> April 2020, via Zoom   |   |  |
| Ramona Topić;<br>Marija Sabolić   | Ministry of Environment<br>and Energy, Institute for<br>Environmental and Nature<br>Conservation                                    | - The key elements of biodiversity and<br>habitats to pay attention to<br>- Quality of the available data<br>- Indicators and thresholds to be used for<br>criteria<br>- Spatial dataset which is not publicly available   |
| 24 <sup>th</sup> April 2020, via Zoom   |   |  |
| mr. sc. Vesnica<br>Koščak Miočić<br>Stošić – landscape<br>expert  | University of Zagreb,<br>Faculty of Agriculture,<br>Department of Ornamental<br>Plants, Landscape<br>Architecture and Garden<br>Art | - Approach and methodology<br>- Best way to include landscape aspects and<br>how to define indicators and thresholds<br>related to social acceptance and visual<br>impacts into the methodology<br>- Elements that are crucial to be analysed as<br>possible barriers to wind and solar<br>development<br>- Landscape aspects that should be considered<br>and possible indicators (proxies) to be used<br>for categorisation of landscape vulnerability |
| 28 <sup>th</sup> April 2020, via Zoom   |   |  |
| Josip Kusak, PhD.<br>Prof. – large<br>carnivore expert  | University of Zagreb,<br>Faculty of Veterinary<br>Medicine, Department of<br>Veterinary Biology                                     | - Approach and methodology<br>- Guidelines on how to minimize impact of RES<br>on large carnivores<br>- Indicators and thresholds for sensitivity<br>mapping<br>- Availability of datasets on large carnivores   |
| 6 <sup>th</sup> May 2020, via Zoom  |   |  |
| Tamara Kirin;<br>Luka Katušić;<br>Vlatka Dumbović<br>Mazal;<br>Daniela Hamidović  | Ministry of Environment<br>and Energy, Institute for<br>Environmental and Nature<br>Conservation                                    | - The key elements of biodiversity and<br>habitats to pay attention to<br>- Quality of the available data<br>- Indicators and thresholds to be used for<br>criteria<br>- Spatial dataset which is not publicly available   |

3) Participants in the Peer review workshop (26<sup>th</sup> November 2020, via Zoom)

| Name                       | Association/Institution                                      | Contact                           |
|----------------------------|--|-----------------------------------|
| Marija Sabolić             | Ministry of Economy and Sustainable Development              | marija.sabolic@mingor.hr          |
| Vlatka Dumbović Mazal      | Ministry of Economy and Sustainable Development              | vlatka.dumbovicmazal@mingor.hr    |
| Margareta Zidar            | EIHP   | mzidar@eihp.hr                    |
| Mirna Mazija               | TRAGUS   | mirna.mazija@gmail.com            |
| Fabijan Peronja            | WWF Adria  | fperonja@wwfadria.org             |
| Andrea Solić               | WWF Adria  | astefan@wwfadria.org              |
| Vesna Marohnić Kuzmanović  | Ministry of Physical Planning, Construction and State Assets | vesna.marohnickuzmanovic@mptgi.hr |
| Mate Zec                   | BIOM   | mate.zec@biom.hr                  |
| Dunja Delić                | Independent consultant                                       | dunjadelic1988@gmail.com          |
| Vesna Koščak Miočić-Stošić | UNI Zagreb, Faculty of Agriculture                           | vkoscak@agr.hr                    |
| Dubravko Dender            | BIOM   | dubravko.dender@biom.hr           |
| Sven Kapelj                | BIOM   | sven.kapelj@biom.hr               |
| Irma Popović Dujmović      | WWF Adria  | ipopovic@wwfadria.org             |
| Enea Bajlo                 | Institute for Spatial Planning of Zadar County               | enea@zpu-zadzup.hr                |
| Lana Stipičić              | Institute for Spatial Planning of Zadar County               | zavodzadarska@gmail.com           |
| Ana Đinđić                 | Institute for Spatial Planning of Zadar County               | info@zpu-zadzup.hr                |
| Elena Patčev               | Geonatura d.o.o.   | epatcev@geonatura.hr              |
| Maja Maslač Mikulec        | Geonatura d.o.o.   | mmmikulec@geonatura.hr            |
| Šime Mračić                | Institute for Spatial Planning of Zadar County               | sime.mracic@gmail.com             |
| Daniela Hamidović          | Ministry of Economy and Sustainable Development              | daniela.hamidovic@mingor.hr       |
| Gabrijela Šestani          | Ministry of Economy and Sustainable Development              | gabrijela.sestani@mingor.hr       |
| Ramona Topić               | Ministry of Economy and Sustainable Development              | ramona.topic@mingor.hr            |