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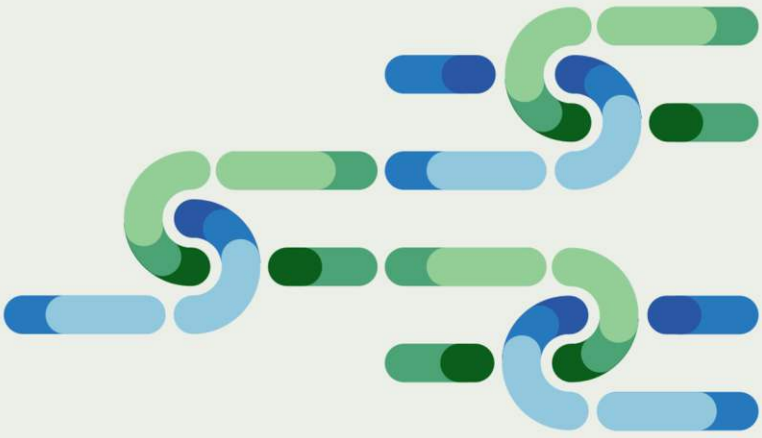
Alpine Space

PlanToConnect

GBI-network: Land use conflicts for RE production and other threats

Pilot area: Caorle Lagoon Wetland System

Deliverable D2.4.1



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PlanToConnect

GBI-network Land use conflicts

Mapping report outlining GBI network elements and areas of land use conflicts for renewable energy production and other major developments

Activity 2.4 Case Studies 3rd step: Identify unsuitable locations/mitigation measures for impact assessment of renewable energy systems and other major developments that may threaten GBI connectivity function

Authors:

Gioia Gibelli, Alessandra Pandolfi, Elena Moncalvo (Studio Gibelli),

Claudio Chiapparini (Regione Veneto)

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EXECUTIVE SUMMARY

The PlanToConnect project aims to develop and test a spatial planning strategy for ecological connectivity in the Alpine region, in close collaboration with stakeholders in selected pilot areas. The project focuses on adapting spatial planning systems and territorial policies to better support ecological connectivity.

As part of this initiative, the Veneto Region - supported by Studio Gibelli - is carrying out a case study in the Caorle Lagoon Wetland System, a wetland area spanning the municipalities of Caorle, San Michele al Tagliamento, and Concordia Sagittaria. This area is currently managed under a voluntary governance framework known as the "Wetland Contract," which regulates the use and conservation of natural capital.

The design of a multifunctional GBI network for connectivity in the pilot area has been developed and described in the D2.3.1 report. This report (D2.4.1) examines land-use conflicts arising from renewable energy developments and other urban transformations that may pose a threat to the connectivity of the Green and Blue Infrastructure (GBI) network. It provides a detailed analysis of the potential impacts of these infrastructures on ecological connectivity, maps the resulting land-use conflicts, and identifies criteria for determining unsuitable locations for various types of infrastructure. In addition, the report proposes potential compensation measures to mitigate the negative effects of such developments on the GBI network.

In the case study due to the absence of data concerning the anticipated development of renewable energy sources and in accordance with the principle that any intervention or new urbanisation of the land may result in substantial impacts on the ecosystem and ecological value of the territory, it was decided to consider all transformative projects and regard them as posing a threat to ecological connectivity.

The pilot area is currently protected through several conservation activities; however, there are also significative potential threats to connectivity that can be identified. The main issues described above can be summarized as follows: infrastructure developments that fragment the territory (for example, disposal plants, road infrastructure); other direct pressures on habitats, such as activities or other human-induced effects that lead to the direct degradation of the connectivity functions of habitats in corridors (such as unsustainable deforestation, intensive agricultural practices, tourist pressure); indirect pressures and related determining factors (economic, cultural, social, or institutional factors that lead to the occurrence of direct pressures, such as income needs, lack of knowledge, shortcomings in application); pressures from the main settlement future developments, as detailed in the following chapters. Negative effects (pressures) and future threats are both considered in the pilot region, considering pressures as factors that have affected habitats and species, and threats are factors that are anticipated to be likely to have an impact in future.

This report (D2.4.1) focuses on the land-use conflicts arising from renewable energy facilities and other infrastructural developments that may threaten the GBI network for connectivity in the pilot region. The objectives are:

- to assess potential impacts of renewable energy infrastructures or other infrastructures that may threaten the GBI network for connectivity,
- to assess evaluation criteria for unsuitable locations for the various types of infrastructures with a focus on renewable energy,
- to map the land use conflicts for renewable energy production and
- to suggest possible mitigation measures.

This report covers all spatially relevant infrastructures that have already had a negative impact on connectivity (pressures) as well as those that pose a threat to connectivity in the future (threats)[1]. As a thematic delimitation, this report focusses on renewable energies and excludes urban/industrial development and infrastructures. While agricultural land use also affects ecological connectivity (see report D1.2.1), mitigation measures are not specifically addressed in the scope of this report as it is mostly driven by market conditions and agricultural practices. Spatial planning and its instruments virtually have no mandate or steering influence.

[1] Pressures are factors that have affected habitats and species, threats are factors that are anticipated to be likely to have an impact in future (European Environment Agency 2020).

REPORT

1 Introduction

The PlanToConnect project aims to develop and test an Alpine spatial planning strategy for ecological connectivity in cooperation with stakeholders in pilot areas. Proposals for the adaptation of spatial planning systems and territorial policies will be developed.

As part of the PlanToConnect project, the Veneto Region - supported by Studio Gibelli - is carrying out a case study on integrated planning of a multifunctional GBI network (green and Blue Infrastructure) in the Caorle Lagoon Wetland System, a wetland area spanning the municipalities of Caorle, San Michele al Tagliamento, and Concordia Sagittaria currently managed under a voluntary governance framework known as the "Wetland Contract," which regulates the use and conservation of natural capital. The project is structured around an analysis of the ecosystem performance of the wetland area, particularly the current degree of ecological connectivity and the fragmentation of ecological corridors. The identification of key anthropogenic threats to connectivity functions and biodiversity preservation will guide the definition of the main challenges that the Green and Blue Infrastructure will need to address. The design of a GBI network for multifunctional connectivity in the pilot region has been developed and described in the D2.3.1. Priority areas for conservation of connectivity and restoration were identified there. This pressure and threats report (D2.4.1) represent a step of their implementation. It focuses on the land-use conflicts arising from renewable energy facilities and the other urban transformations that may threaten the GBI network for connectivity in the pilot area. The objectives are:

- to describe and to assess the potential impacts of renewable energy infrastructures or other infrastructures that may threaten the GBI network for connectivity,
- to propose evaluation criteria for unsuitable locations for the various types of infrastructures,
- to map the land use conflicts for threatening transformations
- to suggest possible compensation measures.

This report covers all spatially relevant infrastructures that have already had a negative impact on ecosystem asset and ecological connectivity (pressures) as well as those that pose a threat to connectivity in the future (threats)[2]. Due to the absence of data concerning the anticipated development of renewable energy sources and in accordance with the principle that any intervention or new urbanisation of the land may result in substantial impacts on the ecosystem and ecological value of the territory, it was decided to consider all transformative projects and regard them as posing a threat to ecological connectivity.

[2] Pressures are factors that have affected habitats and species, threats are factors that are anticipated to be likely to have an impact in future (European Environment Agency 2020).

Structure of the report

Chapter 2 shortly describes the pilot area.

Chapter 3 deals with the methodological approach used in the pilot area.

Chapter 4 shows the major pressures and threats to ecological connectivity in the pilot area (findings).

Chapter 5 discusses opposing factors for major developments / renewable energy facilities (exclusion zones) in the pilot area.

Chapter 6 describes the possible mitigation and compensation measures for the existing and planned infrastructures in the pilot area.

2 Pilot area Caorle Lagoon

The pilot area “Caorle Lagoon Wetland System” is in the eastern part of Regione Veneto and includes the territories of the municipalities of Caorle, Concordia Sagittaria and San Michele al Tagliamento.

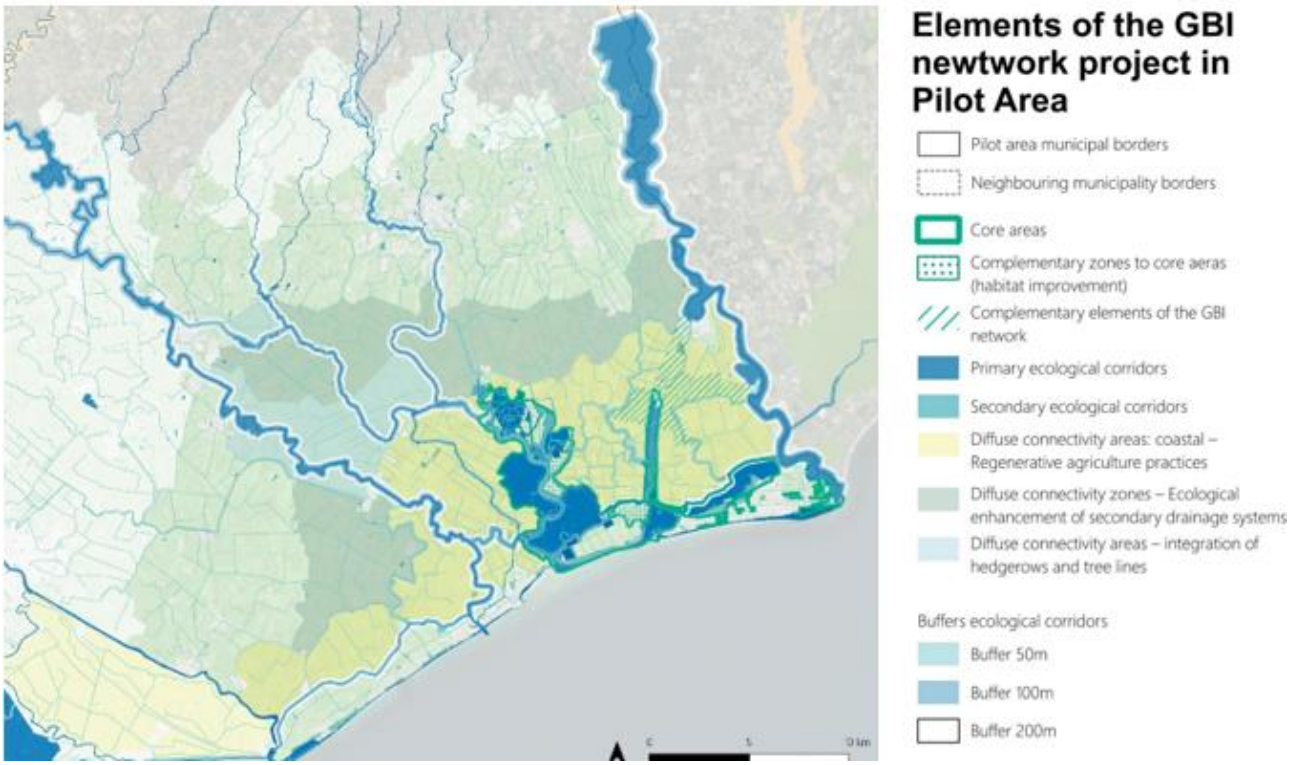

Figure 1 Overview – Pilot area: project of the Caorle Lagoon Wetland System

As indicated in report D.2.3.1 on the design of the Green and Blue Infrastructure (GBI) for the pilot area, an ecological network is already present within the territorial plans of the three municipalities and has been developed in alignment with the ecological network plans of higher-level authorities (Metropolitan City of Venice and regional territorial plans).

However, there is a need to promote greater consistency between the cartographic representations and regulatory frameworks of these planning tools, and to integrate them with the concepts of natural capital, Green and Blue Infrastructure, multifunctionality, and the priority Ecosystem Services identified for the study area — particularly in relation to connectivity zones.

In this complex framework, the PlanToConnect project and its objective of integrating ecological connectivity into planning tools should aim to generate positive impacts or effects in the transformation of the territory/landscape.

The GBI network project for the pilot area aims to promote a new approach to local governance, through the application of ecosystem services, as a tool for greater knowledge

and management and monitoring of the pilot area. The strategy of integrating ecosystem services into planning tools wants, in fact, to orient design approaches towards a reversal of current and traditional processes, also induced by existing evaluation procedures, towards a proactive orientation, in which natural capital can become one of the most important actors in the planning landscape, as a recognized resource, with multiple values.

The wetland system is a typical example of how the interaction between man and nature can shape the landscape, influencing the evolution of a territory and determining its environmental and cultural value. Despite having undergone major transformations, the lagoon continues to maintain an essential role for fishing and traditional lagoon fish farming “vallicultura”, as well as being an area of great value for biodiversity and ecosystem conservation. The current challenge is to maintain a balance between human activities and the protection of the lagoon environment, to preserve this unique heritage for future generations (for further description see D 2.3.1).

It is a coastal wetland that “collects”, through fresh water from the Alps, what happens on the Alpine side and in the catchment area underlying it. The relationships with the two main rivers, the Livenza and the Tagliamento, ecological corridors of regional importance, are among the elements of greatest interest for the PlanToConnect project.

The lagoon is a fragment of a much larger wetland area, which survived the reclamation of the 60s. The Caorle Lagoon constitutes a unique ecosystem, defined as a biodiversity hotspot, to which important ecological and socio-economic functions are associated. In Veneto, the transitional waters are represented by the Venice lagoon, further south by the Po delta complex and further north by the lagoons of Caorle and Baseleghe. To these are added the countless fishing valleys, i.e. portions of the lagoon in which the influx of fresh and salt water is artificially regulated and within which numerous human activities are carried out, mainly related to the breeding and fishing of mollusks and fish species as well as hunting.

The pilot area is located near the eastern border of the region, not far from the lagoon of Marano in Friuli and the lagoon of Venice, Averto valley, both wetlands of international importance under the Ramsar Convention. It is therefore an area of great importance in the Adriatic lagoon system, not only for its own values, but also for its “position value” in the coastal wetland system. The boundaries of the basin occupied by the lagoon are placed at different altitudes. To the east, the countryside is higher than the areas along the course of the Livenza, creating depressed areas north of Caorle. The riverbeds of the Loncon, Reghena, Lemene and Lugugnana rivers have a good part of their course in a N-SW direction, and then arrange themselves along the coastline in an almost perpendicular way, assuming, when the altitude values tend to attenuate and uniform, a sinuous naturaliform course.The ecological network within the Caorle lagoon is made up of a set of interconnected natural and semi-natural elements that form a mosaic of habitats that are fundamental for the maintenance of biodiversity. In summary, the ecological network of the Caorle lagoon represents a complex system of interdependent habitats that support a rich biodiversity and guarantee the maintenance of the fundamental ecological functions for the entire lagoon ecosystem.

The “Wetland Area Contract of the Caorle Lagoon System” operates in this area: a participatory governance tool that involves public bodies, associations, citizens and local operators with the aim of managing, protecting and enhancing the lagoon environment. Through this agreement, concrete actions are promoted for the conservation of biodiversity, the sustainable management of natural resources and the improvement of water quality, promoting sustainable development of the territory and the involvement of the local community.

The Veneto-Orientale Water Management Consortium plays a crucial role in the management of the Caorle Lagoon, ensuring water control through drainage systems, water level regulation and hydrogeological risk prevention. This consortium ensures proper management of fresh and brackish water, contributing to the conservation of the lagoon ecosystem and promoting the coexistence of agricultural activities, fishing and biodiversity. In addition, it collaborates in environmental redevelopment and monitoring projects, maintaining a balance between human needs and environmental protection.

3 Methodological steps

The ecological network of the Caorle lagoon represents a complex system of interdependent habitats that support a rich biodiversity and guarantee the maintenance of the fundamental ecological functions for the entire lagoon ecosystem.

A green and blue infrastructure (components and functions) network at the pilot area level has been design and its multifunctional value assessed by mapping of GBIs both physically and in terms of priority ecosystem services it provides.

The importance of mapping ecosystem services is linked to their diagnostic capacity in terms of identifying socio-ecological values in a system of natural and socio-economic capitals that have a multiscalar and multisectoral character, to build in a territorial strategic framework that can give effective answers to systemic problems. In the case study a methodology of environmental and landscape analysis and assessment was set up and tested to highlight the problems (Vulnerability), the opportunities (Resilience) of the territory and the possible responses in terms of benefits (Ecosystem Services) provided by the Green and Blue Infrastructures (GBI). All this in a participatory process aimed at giving concreteness and continuity to the strategies, flanked by the economic evaluation of the benefits induced by the scenario proposals resulting from the meeting between technicians and stakeholders.

Compared to traditional planning, this approach is based on disciplines, Landscape Ecology, and key concepts, such as Multiscalarity, the concept of Vulnerability, understood as the inverse property of the integration between the two main properties used by ecosystems to develop and self-regenerate, Resistance (or Robustness) and Resilience. In addition, the paradigm of Ecosystem Services (SE) to identify the “needs” of the environmental landscape system, to reduce vulnerabilities, through Green and Blue Infrastructures (IVB), to be achieved through suitable Nature Based Solutions.

The new IVB will no longer be able to represent only as a tool for protection but also as a real territorial project aimed at providing:

- an integrated planning response to biodiversity and landscape policies for the reduction of environmental vulnerabilities and adaptation to climate change, a preferential place for the conservation and increase of the stock of resources that constitute “natural capital” and its ecological functions, which are the basis of any development policy,

- a reference framework, for example for the address of the environmental compensation charges envisaged in the context of the EIA, SEA and VIC procedures.

3.1 Description of the approach/working steps

The process of identifying threats to ecological connectivity and the natural capital in the project area began with an analysis of municipal, provincial and regional planning documents (PTRC and PTCP). These plans helped highlight areas at risk-both from future developments, where preventive actions are still possible, and from existing impacts linked to the pilot area long-standing tourism and agricultural activities.

As detailed later in the document, the main threats identified include major transport infrastructure, scattered settlements and facilities, planned developments for residential, tourism activities and limited renewable energy plants.

The identification of current and planned threats also included an assessment of renewable energy installations and their potential impact on the GBI project connectivity goals. This analysis was more complex than previous ones, as regulations connecting renewable energy development to environmental risks are relatively new.

The analysis of renewable energy installations has been carried out considering existing renewable energy installations, considering the main typologies identified through land use maps, energy plans and energy atlas maps, including photovoltaic installations (mostly single small installations), biogas and biomasses production.

Table 1 Overview – Main working steps in the pilot area Caorle Lagoon

Working Step	Description
1 **General threats of infrastructures and land uses posed to GBI ecological networks**	The first step is to identify which infrastructures, or land uses generally have a negative impact on connectivity. See the list provided in the 1.3.1 report, including: 1. Infrastructural developments that fragment the territory (e.g., disposal plants, road infrastructures) 2. Other direct pressures on habitat, such as human-induced activities or other effects leading to the direct degradation of habitat connectivity functions in corridors (such as unsustainable logging, intensive agricultural practices, tourist pressure) 3. Indirect pressures and related determinants (economic, cultural, social or institutional) that determine the occurrence of direct pressures, such as income needs, lack of knowledge, lack of enforcement) 4. Pressures deriving from the main settlement projects
2 **Definition of relevant infrastructures**	The second step is to identify which existing or planned infrastructures in the pilot area are spatially relevant. For this purpose, threshold values from EU's Environmental Impact Assessment Directive and the German Environmental Impact Assessment Act are compiled and analysed.

Working Step	Description
3 **Existing pressures and expected major threats in the pilot area**	In a third step, all spatially relevant existing and planned infrastructures in the pilot area are compiled based on • references to existing relevant infrastructure by the Regional Connectivity Working Group • interviews with planning experts from the pilot site (or at regional level) to identify major infrastructural developments being projected for the coming years • search for official, publicly available lists of planned projects required to conduct an EIA.
4 **Compilation of general criteria for unsuitable locations**	General criteria for unsuitable locations: - protected areas, natural habitats, buffer zones, - agricultural areas with extensive regime.
5 **Development of specific criteria for unsuitable locations in the pilot area (exclusion zones)**	Exclusion zones in this context are areas where certain infrastructures are not allowed to be built or operated (unsuitable areas). For the definition of exclusion zones, it is not sufficient to use only the boundaries of the developed GBI network for connectivity (including priority areas for conservation and restoration). Many infrastructure projects have far-reaching effects. The question is: What distances must be kept ensuring that an ecologically valuable area is not adversely affected by a certain infrastructure project. Two aspects are important to consider when answering this question: • Compilation of existing standards or guidelines for determining unsuitable areas for a certain type of infrastructure and • Compilation of the maximum impact ranges of infrastructure projects used as a buffer around ecologically valuable area. This is followed by an evaluation of existing standards/guidelines to check whether they provide effective criteria to protect areas with ecological connectivity function.
6 **Mapping the land use conflicts for renewable energy production**	About ecological connectivity a map of the exclusion zones for each relevant type of infrastructure (hydropower, wind power, solar power) is generated (using simple overlay functions and proximity tools). Biomass, high voltage transmission lines, roads, railways and urban/industrial development are not being considered in this report.
7 **Possible mitigation and compensation measures**	Possible mitigation or compensation measures for renewable energy facilities (existing and planned) in the pilot area “Caorle Lagoon” are proposed referring to the threats report (D.1.3.1) and the report on conflicting land uses (D1.2.1).

3.2 Data used

The table presents the plans, regulations and elaborations that proved useful in the drafting of this document. The plans and regulations relate to the different spatial planning scales instruments, ranging from national to provincial. With regard to the elaborations, data from the project PlanToConnect were drawn from both the comparative reports of the various pilot cases and own elaborations related to the realisation of the project for the pilot area.

The activity required direct downloads from existing map portals and the sending of numerous data request emails, many of which were successful.

Table 2 Overview of local or regional data used

Data	Source	Description
Natura 2000 Network	National geoportal	Areas of interest for biodiversity and core areas, belonging to the Natura 2000 network and connected elements
Infrastructural developments	Regione Veneto	Future developments included in the Regional development plan
Renewable energy developments	Regione Veneto	Future developments included in the Regional development plan
Coastal habitats	Regional Cartographic Portal of Regione Veneto	Habitats of the coastal area defined through the habitat classifications
River basins	Regional Cartographic Portal of Regione Veneto	River basins limit as defined by the national legislation
Wetlands	Regional Cartographic Portal of Regione Veneto	Wetlands as defined by the habitat classifications
Land use	Regional Cartographic Portal of Regione Veneto	Land use classes as defined by the Corine classification
Infrastructural and other linear developments	Metropolitan city of Venice	Future developments included in the Metropolitan City development plan
PAT (Piani di assetto territoriale)	Municipalities of Caorle, Concordia Sagitta and San Michele al Tagliamento	Urban planning tools for the definition of future settlement developments

Data	Source	Description
Future developments of the water management network	Eastern Veneto Water Management Consortium	Hydraulic management of the lagoon and surrounding areas information, including future maintenance and development works
Hydrogeological risk	Eastern Alps District Basin Authority	Hydraulic risk management including future management and development works
General impacts and threats on the environment state	ARPAV (Regional Agency for Environmental Prevention and Protection of Veneto)	Periodic reports on biodiversity, the management of lagoon ecosystems and water quality
General impacts and threats on the environment state	ISPRA (Higher Institute for Environmental Protection and Research)	Reports on biodiversity, the management of lagoon ecosystems and water quality

The available data collected and analyzed also include:

- Cartography: Geological, hydrographic, morphological,
- Hydraulic and meteorological data: Water levels, rainfall, tide, sedimentation,
- Biodiversity: Protected species, habitats, lagoon ecosystems,
- Urban planning and planning: Master plans, land use, protected areas.

The portals consulted and from which data were taken are:

- https://gn.mase.gov.it/portale/catalogo-metadati
- https://idt2.regione.veneto.it/idt/downloader/download
- https://geomap.arpa.veneto.it/
- https://www.piave.veneto.it/web/utilita/cartografia
- https://geoportale.cartografia.agenziaentrate.gov.it/age-inspire/srv/ita/catalog.search#/home
- http://www.catastogrotteveneto.it/geoportale
- https://ica.cultura.gov.it/geoportale/repertorio-preliminare-delle-banche-dati-territoriali-reperibili-on-line/veneto/
- https://www.comune.venezia.it/it/geoportale

4 Major pressures and threats to ecological connectivity

The chosen pilot area is currently subject to several protection activities, however, there are several potential threats to connectivity that can be summarized as follows:

1. Infrastructural developments that fragment the territory (e.g., disposal plants, road infrastructures):
   - the existing infrastructure network is already sufficiently widespread, but the PTRC provides for further lines of upgrading towards the coast, since the area between the coastal strip to the south and the infrastructural arteries that run along the line, which divides the historically consolidated territory from the more recent reclamation to the north, will be included in a wider infrastructural development project,
   - the settlement areas and the related service system is quite limited and the planned expansions rather concentrated, although some trend lines identified by the municipality spatial plans could increase the level of interference with areas of naturalistic value determined by new infrastructural developments and lifelines networks connected to the settlement system, that were highlighted in chapter 4.3;
2. Other direct pressures on habitat, such as human-induced activities or other effects leading to the direct degradation of habitat connectivity functions in corridors (such as unsustainable logging, intensive agricultural practices, tourist pressure):
   - agricultural and fishing practices: the main vulnerabilities are related to the property regime, the use of pesticides and fertilizers in agriculture and the burial of the minor hydrographic network in agricultural areas (in favor of underground tubular drainage), water pollution (with respect to chemical-physical alterations, eutrophication, organic compounds for agriculture, metals, civil and industrial discharges), the alteration of the structure of watercourses (catchment and regulation of waters that can cause changes in the flow regime, construction of works that prevent the passage of fish fauna, poor management and hydraulic maintenance of riparian environments, riverbeds and banks, erosion phenomena), to changes in agricultural practices;
   - pressures on the forest sectors present in the area (of different origins, i.e. anthropogenic, such as Valle Vecchia and Bibione, and natural, such as Foce del Tagliamento, Valli Grandi di Bibione): active silvicultural management is necessary aimed at increasing the biodiversity of forest coenosis;
   - tourist pressure: there are impacts along the coast due to the use and expansion of settlements and infrastructures developed as a result of the growing seaside tourist activities, with the conversion of beaches and dunes, the interruption of spontaneous dune dynamics and the very strong building expansion in correspondence with the major seaside resorts;
   - rising of the saline water and other effects deriving from the increase in soil salinity: the interventions that will be proposed will have to take due account of this component

to avoid negative interactions with the irrigation system and damage to specific elements of the ecosystem;

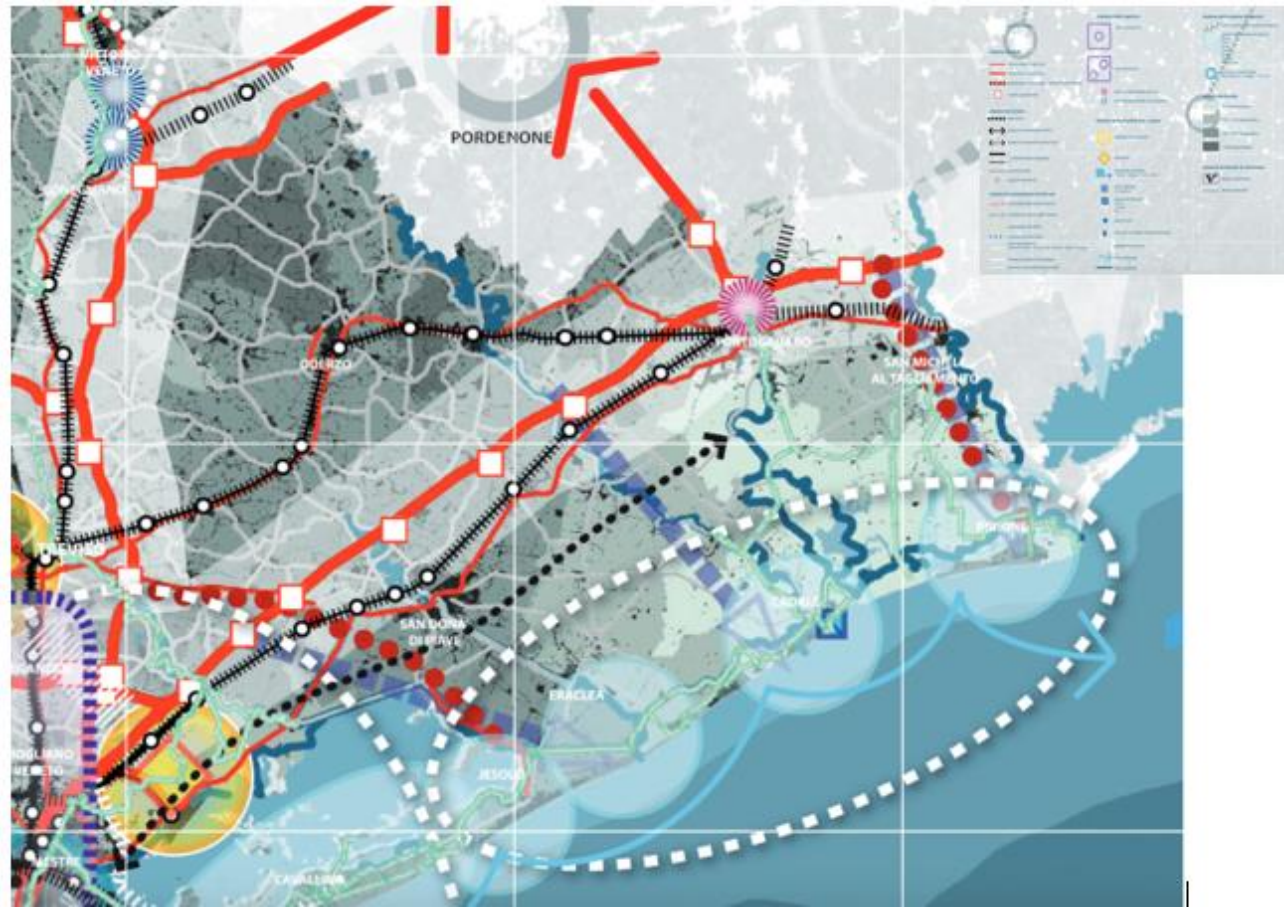

Figure 2 Infrastructural projects interfering with the Caorle lagoon wetland system in the Regional Plan

3. Indirect pressures and related determinants (economic, cultural, social or institutional) that determine the occurrence of direct pressures, such as income needs, lack of knowledge, lack of enforcement):
   - changes in the morphology of the territory due to the natural evolution of the lagoon system and the mouths of the rivers that converge on it,
   - hydraulic safety and related interventions, also to protect existing habitats,
   - abandonment of traditional agricultural and fishing activities, with modification of existing agroecosystems and fish habitats, could make their balances more fragile, as well as causing the loss of the consolidated landscapes present, which could lead to the loss of identity of the places concerned, a further driving force of degradation of socio-economic derivation typically found in stalemate situations;
4. Pressures deriving from the main settlement projects.

Mitigation and compensation strategies for areas of high ecological value are essential to ensure that land transformations are compatible with biodiversity conservation and environmental sustainability. It is crucial that these strategies are integrated from the early stages of planning, with an evidence-based approach and involving local communities for effective implementation and adaptation of measures over time.

The mitigation and compensation strategies to be adopted in environmental impact assessments (EIA), and environmental suitability assessments are essential to reduce the negative effects deriving from territorial transformations in areas of high ecological value. The goal of these strategies is to maintain ecological balance and preserve the functionality of ecosystems, ensuring that development takes place in a sustainable way. The main strategies of mitigation and compensation are presented below:

1. Mitigation strategies

Mitigation strategies aim to prevent, reduce or eliminate the negative effects of a project before, during and after its implementation.

Avoid direct impacts: The first mitigation measure is the selection of design and location alternatives that completely avoid direct impacts on areas of high ecological value. This can include changing the layout of the project, reducing the floor space it occupies, and choosing less sensitive sites.

2. Compensation strategies

Offsetting strategies are adopted when impacts cannot be fully avoided or mitigated and it is necessary to compensate for the loss of habitat or ecological functionality elsewhere.

Environmental restoration: Interventions aimed at restoring a degraded area to a natural or semi-natural condition. This can include planting native vegetation, removing invasive species, renaturalizing river banks, or creating wetlands.

3. Monitoring and adaptation

Environmental monitoring plans: implement monitoring programs to assess the effects of mitigation and compensation interventions, with specific indicators for biodiversity, water quality and ecological connectivity.

Adaptation of measures: use the data collected from monitoring to adapt and improve mitigation and compensation measures, ensuring a flexible approach that responds to environmental dynamics and impacts detected.

Local stakeholder engagement: Collaborate with local communities, environmental associations and research groups to promote a participatory approach to managing compensation measures and monitoring impacts.

4. Specific measures for protected or sensitive areas

Restrictions on new settlements: limit new construction and land changes in areas adjacent to natural parks, reserves and wetlands.

Incentives for sustainable practices: Offer incentives for the adoption of sustainable agricultural, forestry and fishing practices, reducing pressure on areas of high ecological value.

Ban on invasive species: Strengthen controls on the introduction of invasive species and provide eradication programs for existing species that threaten local biodiversity.

5. Long-term retention strategies

Long-term management plans for natural areas: develop management plans for natural areas of interest, including maintenance, surveillance and awareness of local communities.

In situ and ex situ conservation: Integrate in situ habitat conservation with ex situ strategies, such as the creation of seed banks or captive breeding of threatened species, to ensure biodiversity conservation.

Enhancement of ecosystem services: recognizing and promoting the economic and social value of the ecosystem services offered by natural areas (such as water regulation, biodiversity and nature tourism), to integrate conservation into economic and development choices.

For the territorial planning schemes (Piani di assetto territoriale, PAT) at municipal and inter-municipal level (PATI), the Metropolitan area general plan (PGTM) provides for the transposition of the core areas and a design that goes so far as to detail the ecological corridors and the elements of the provincial network. The PAT/PATI are, in fact, called upon to preferentially adopt the scheme of ecological networks in the identification of the territorial areas to which the corresponding objectives of protection, redevelopment and enhancement are attributed, as well as in the identification of suitable areas for interventions aimed at improving urban and territorial quality. In addition, the PAT/PATI are called upon to define appropriate procedures for achieving the following results:

- defragmentation through environmental mitigation and compensation works;
- improvement of the self-purification capacity of minor hydrographic networks;
- reduction and mitigation of hydraulic risk;
- redevelopment of degraded areas such as quarries, landfills, abandoned industrial areas.

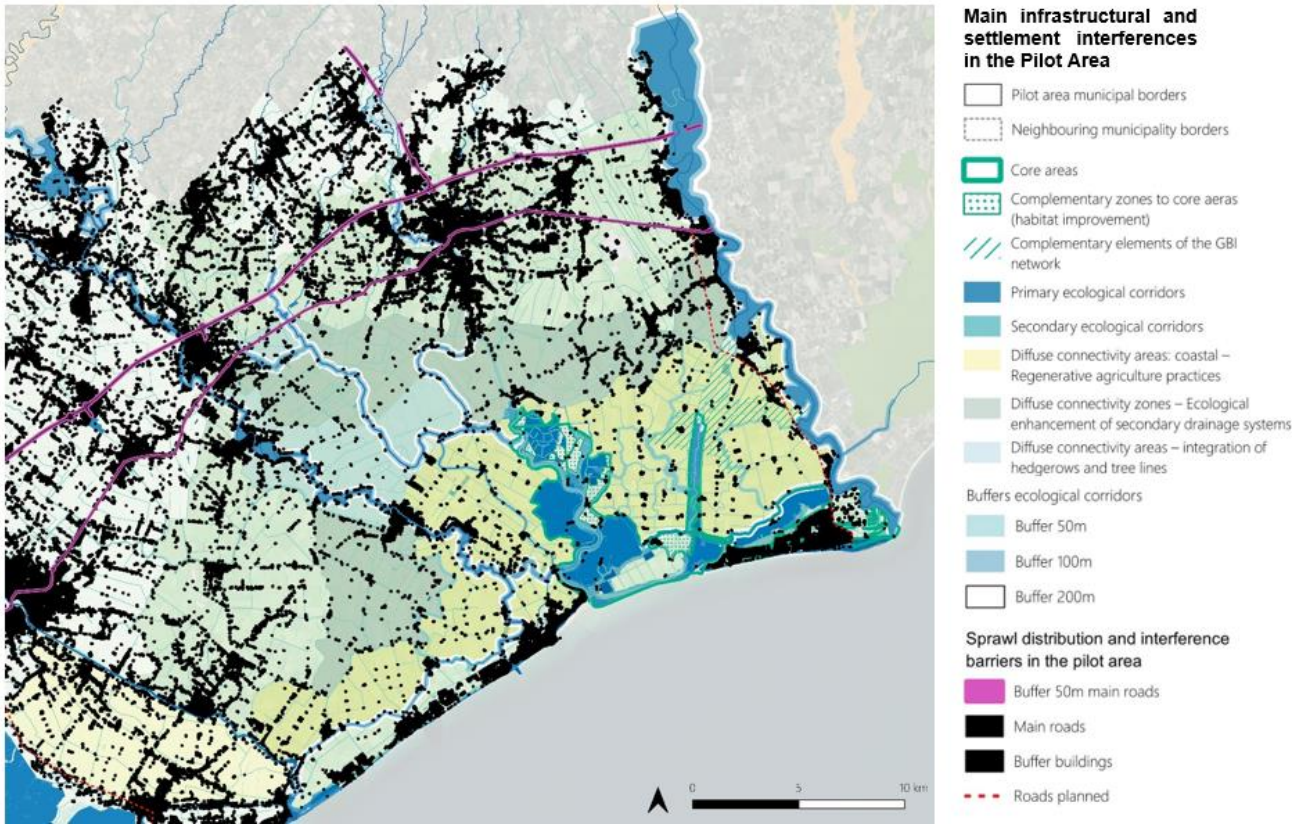

Figure 3 Main infrastructural and settlement interferences in the pilot area (source: authors)

Among the elements of protection that affect the pilot area we find, in addition to the direct protections deriving from the presence of Natura 2000 sites, naturalistic areas at regional level and wetlands recognized by the PTRC, the perimeter of the surface water environment, referred to in Royal Decree 1775/1933, which protects the bodies of water included in the appropriate list, but also the areas of hydrogeological constraint (R.D. 3267/1923), the flood risk protection strips (Flood Risk Management Plan), the hydraulic and landscape constraints established by law (300 meters from the shoreline) or by direct founding decree (area of the valley district located in the territories of the Municipalities of Caorle and Concordia Sagittaria, area between the mouth of the Tagliamento, the Lugugnana canal and the navigation basin and the area of the mouth of the Tagliamento located in the Municipality of San Michele).

This chapter reports, then, the outcome of the identification of the barriers to connectivity to be solved, integrated with the results of the previous study and planning activities of the Caorle Lagoon. The pilot area is covered by a Wetland Area Contract (CdAU), the action programme of which will be complemented by the CdAU Action Programme No. 66 of 18 March 2024. From the previous images emerges the importance of the regulation ES (the first 5), in which the wetland elements are all present with bright colors (scores from 3 to 5, above average), while the supply ES are scarce, emphasizing 2 aspects. The first is the rebalancing vocation of the Caorle lagoon, the second, the confirmation of the incompatibility

in the significant production of ecosystem services (ES) of supply in the presence of fundamental regulation ES.

The main pressures encountered by reading the territory concern:

- Infrastructure projects of the PTRC (coast-inland infrastructure corridor link),
- Pressures on the deep and surface water system: agglomerations, discharges (civil and industrial) and purifiers, waste management plants, polluting loads of agro-livestock origin,
- Changing quality of transitional water and saline wedge,
- Further critical aspects may derive from tourist pressure, the increase in the uncontrolled abandonment of waste (especially plastic) and the hydrological effects of climate change.

The boundaries of the basin occupied by the lagoon lie at varying elevations. To the east, the countryside is situated at a higher altitude compared to the areas along the Livenza River, creating low-lying zones north of Caorle. The riverbeds of the Loncon, Reghena, Lemene, and Lugugnana generally flow in a north–southwest direction, before turning and aligning almost perpendicularly to the coastline. As the elevation levels out and becomes more uniform, the rivers adopt a meandering, naturalistic course.

The pilot area is currently subject to various protection activities; however, several existing barriers/interruptions and potential threats to connectivity can be identified and summarized as follows:

1. Infrastructure developments that fragment the territory (e.g. disposal plants, road infrastructure):
    - the existing infrastructure network is already sufficiently widespread, but the PTRC provides for further lines of upgrading towards the coast, since the area between the coastal strip to the south and the infrastructural arteries that run along the line, which divides the historically consolidated territory from the more recent reclamation to the north,
    - the settlement and the related service systems are quite limited and the planned expansions rather concentrated, although some trend lines identified by the PAT could increase the level of interference with areas of naturalistic value;
2. Presence of extensive urban systems along the coastline,
3. Intra-area connectivity limited by the presence of extensive water elements with high hydraulic risk and intensive agricultural activities (with the related pressures).

The challenges to be faced, the problems to be solved and the related expected benefits place the case study of the wetland of the Caorle lagoon in the context of an intermediate territory between the sea and the agricultural plain, in a very complex and precious ecological and hydrological system, which resists threats to biodiversity and contributes to the functioning of ecosystems at local and regional scale.

The main system challenges affecting this area are:

- create a biodiversity stronghold to strengthen the regional ecological network and in particular its connectivity areas,
- contribute to adaptation to climate change, with reference to responses to droughts and indirect effects (rising salt wedge, rebalancing the water cycle) and rising sea levels.

For protecting and enhancing the natural capital of the Caorle lagoon and ecological connectivity inside and outside it, the PlanToConnet project intends to promote a series of differentiated actions based on the different characteristics of the territory. As for the geomorphological and hydrological characteristics, through the description and interpretation of the physical structure of the subsoil and the water system, the project aims to protect both the specific values of the geomorphological and hydrogeological emergencies, and the naturalistic-vegetational characteristics.

The project will therefore have the objectives of:

- identifying the areas and habitats of value or of naturalistic value to be subjected to protection and conservation through a unified discipline in local and supralocal planning tools;
- ascertaining the evolutionary dynamics and trends in progress to understand which human activities most threaten the stability of existing habitats and ecological connectivity;
- the coordination and exploitation of the investments already made in the EC pilot area can improve its ecological connectivity.

The project will have a positive impact on the governance of the regional territory at various levels, and in a transversal way. The project sees the Caorle Lagoon as a pilot area and aims to improve the external connectivity of the wetland and its ecological functionality in general.

4.1 General threats to GBI ecological networks posed by infrastructure and land uses

The table below lists infrastructures and land uses analysed in report D1.3.1 and assesses their impact on connectivity across the landscape. A distinction is made between structural and functional connectivity (see report D1.3.1).

Table 3 Infrastructures and land uses with their impact on connectivity

Sector	Type of infrastructure/ Land use	Comments on Connectivity
Renewable energy	Hydropower - hydroelectric reservoir (dam)	high impact on structural and functional connectivity because of usually large land take and barrier/ fragmentation effects
	Hydropower - Run-off-river power plants	low impact on structural connectivity because of minimal land take high impact on functional connectivity because of barrier/ fragmentation effects in the water body
	Windpower - windmills	low impact on structural connectivity because of minimal land take partly high impact on functional connectivity because of collisions (birds, bats)
	Solar Power - Photovoltaics: Ground-mounted solar panels	mostly low impact on structural and functional connectivity because of usually low soil sealing and marginal barrier effects. Effects depend on the area size and design! large area photovoltaics: high impact due to extensive habitat changes (structural connectivity) and to fragmenting effects if fenced (functional connectivity). Above a length of 500 metres, fragmenting effects on large mammals are to be expected.
	Bioenergy - Biomass	Bioenergy plants: Mostly low impact on structural and functional connectivity because of usually low land take and marginal barrier effects. Effects depend on the area size of the facility! Change of land management and land use: no general statements possible because effects depend on the area size, the location and intensity of the biomass production!
Energy sector as a whole	Transmission of electricity - High voltage transmission line	low impact on structural connectivity because of minimal land take outside of forests; partly high impact on functional connectivity because of collisions (birds)

Sector	Type of infrastructure/ Land use	Comments on Connectivity
Transport	roads/ highways	high impact on structural and functional connectivity because of usually large land take, barrier effects, wildlife mortality due to traffic and impacts due to noise, dust and pollutants
Transport	railway	high impact on structural and functional connectivity because of land take (habitat loss), barrier effects, wildlife mortality due to traffic and impacts due to noise, dust, pollutants and vibrations
Urban /industrial development	Urban/ industrial development	high impact on structural and functional connectivity because of land take (habitat loss), barrier effects and impacts due to noise and other pollutants

.

4.2 Definition of relevant infrastructures

As already described in report D1.3.1 and in **Errore. L'origine riferimento non è stata trovata.** it depends on the size and design of a certain infrastructure whether negative impacts on the environment are to be expected. For example, it makes a big difference whether the size of a PV system is one hectare or 20 hectares. Therefore, it must first be analysed which infrastructures generally pose a pressure or a threat to connectivity and are relevant for spatial planning. The question is: Are there threshold values for projects above which significant negative effects on the environment can be assumed? Or to put it another way: Are there any small-scale infrastructure projects that are not relevant to spatial planning and therefore do not need to be considered in the context of this report?

The EU's Environmental Impact Assessment Directive provides specifications for which projects an Environmental Impact Assessment (EIA) are obligatory. These specifications can be interpreted as an orientation for the spatial planning significance of different infrastructures. In the EU's Environmental Impact Assessment Directive relevance thresholds are not specified for all project types. EU Member States can provide further details with regard to the necessity of an environmental impact assessment or a preliminary environmental impact assessment (on a case-by-case basis or by setting specific criteria such as the location, size or type of project).

Germany defines project types for which an EIA or a preliminary assessment must be carried out in Annex 1 to the EIA Act (UVPG). We have decided to define all projects as spatially relevant for which an EIA or a preliminary environmental impact assessment is mandatory. The derivation of these threshold values can be found in the Annex 1.

The following table shows the project types that are spatially relevant and thus may have negative impacts on the environment and connectivity.

Table 4 Identification of projects thresholds for spatial planning

	Relevance for spatial planning
Hydropower	Any construction and operation of a hydropower plant Any river canalisation and stream correction work
Windpower (windmills)	Wind farm with 3 wind turbines with a total height of more than 50 metres each
Solar power (ground mounted photovoltaic systems)	ground mounted photovoltaic system with a size of at least 2 hectares
Biomass (biogas plant)	Biogas plant with more than 1.2 million standard cubic metres of raw gas per year
High voltage transmission line	transmission line with a voltage of 110 kV or more
Roads/ highways	four-lane or multi-lane federal road with continuous length of 5 km or more
Railways	railway track associated operating facilities with more than 2000 m²

This said, it is important to remember that the project aims to improve the external connectivity of the wetland and its ecological functionality in general, as well as to verify the possibilities of expanding the area included in the contract. The project will also have a positive impact on the implementation of the Wetland Contract, with reference to the programme of actions, the sharing of priorities, the launch of the project of an initial intervention and the communication and dissemination of the values of the area.

4.3 Existing pressures and expected major threats in the pilot area

The following table lists all projects with spatial relevance in the pilot area (based on the definition of spatially relevant project types, see **Errore. L'origine riferimento non è stata trovata.**. A distinction is made between existing infrastructure (pressures) and planned projects (threats).

Table 5 Overview – Existing pressures and expected major threats in the pilot area Caorle Lagoon

Type of infrastructure/ Land use	**Existing (pressures)**	**Expected (threats)**	**Description**
Hydropower - Hydroelectric reservoir (dam)	-	-	No existing or planned major infrastructure

Type of infrastructure/ Land use	Existing (pressures)	Expected (threats)	Description
Hydropower - Run-off-River power plant	-		No existing or planned major infrastructure
Windpower - windmills	-		No existing or planned major infrastructure
Solar Power - Photovoltaics: Ground-mounted solar panels	-	-	No existing or planned major infrastructure Several single solar panels in urban areas and on farms
Bioenergy - Biomass	-	-	No existing or planned major infrastructure Single plants in farms
Transmission of electricity - High voltage transmission line	-	-	No major transmissions lines are existing or planned
Roads/Highways	Main state roads and regional roads, local network	Autostrada del Mare	No further major roads or highways are planned
Railway	-	-	No existing or planned major infrastructure
Urban/industrial development	Urban systems of Caorle, San Miche al Tagliamento, Concordia Sagitta	See PAT proposals as in the following pictures	-

The Territorial Planning Scheme (Piano di Assetto del Territorio – PAT) **is the primary land-use planning instrument at the local level**, guiding and regulating the development of the municipal area.It identifies the specific vocations and constraints of the territory — including geological, geomorphological, hydrogeological, landscape, environmental, naturalistic, historical, and architectural characteristics — in alignment with the objectives and guidelines set forth in provincial and regional spatial planning, and in response to the needs and priorities of the local community. The pilot area extends over the territory of the municipalities of Caorle, Concordia Sagittaria and San Michele al Tagliamento, all equipped with PAT.

PATs identify the core areas belonging to the regional ecological network located within the reference territory, consisting of the habitats of the sites of the Natura 2000 Network, identified pursuant to Directives 2009/147/EC21 and 92/43/EEC. In these areas, the protection of biodiversity is pursued through measures to safeguard the system. For each identified naturalistic invariant, specific objectives and actions are established to promote the conservation of widespread environmental quality.

Moreover, the Caorle PAT integrates core areas and ecological corridors with targeted measures addressing territorial zones of environmental significance within the agricultural landscape, designated priority areas for reforestation and naturalization, existing forested zones, and key infrastructural gates.

Similarly, the PAT of San Michele al Tagliamento and Concordia Sagittaria prepare specific actions for core areas and ecological corridors, integrating them with the disciplines for areas of naturalistic connection (buffer zones), biotopes, buffer strips and resurgence areas, but also stepping stones, secondary corridors, gates and barriers. The municipality of Concordia Sagittaria also identifies areas for the establishment of parks and nature reserves of municipal interest.

The objective of the PATs is to preserve widespread environmental quality, recognizing that simply designating isolated portions of the territory for strict but fragmented protection is insufficient. To ensure ecological continuity, they have established a system based on both area-based and network elements, as described above. Ecological corridors and stepping stones are designed as sufficiently large and naturally connected areas — whether continuous linear features, scattered patches, or discontinuous segments — that are essential for the migration, distribution, and genetic exchange of plant and animal species. These elements serve an ecological protection function by mitigating the impacts of human activities and maintaining landscape connectivity.

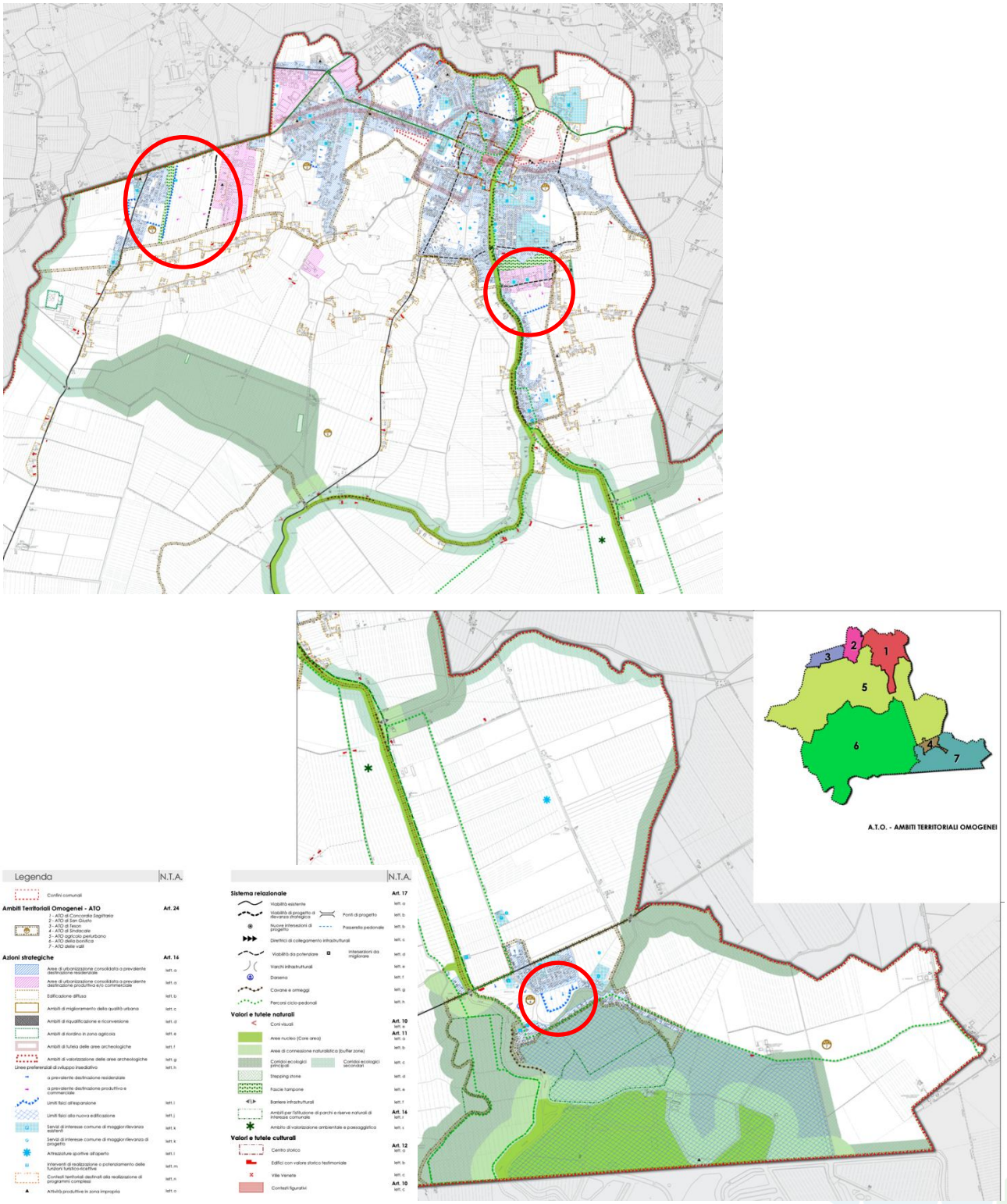

Figure 4 Transformation map with main unsuitable projects in the Municipality of Concordia Sagittaria

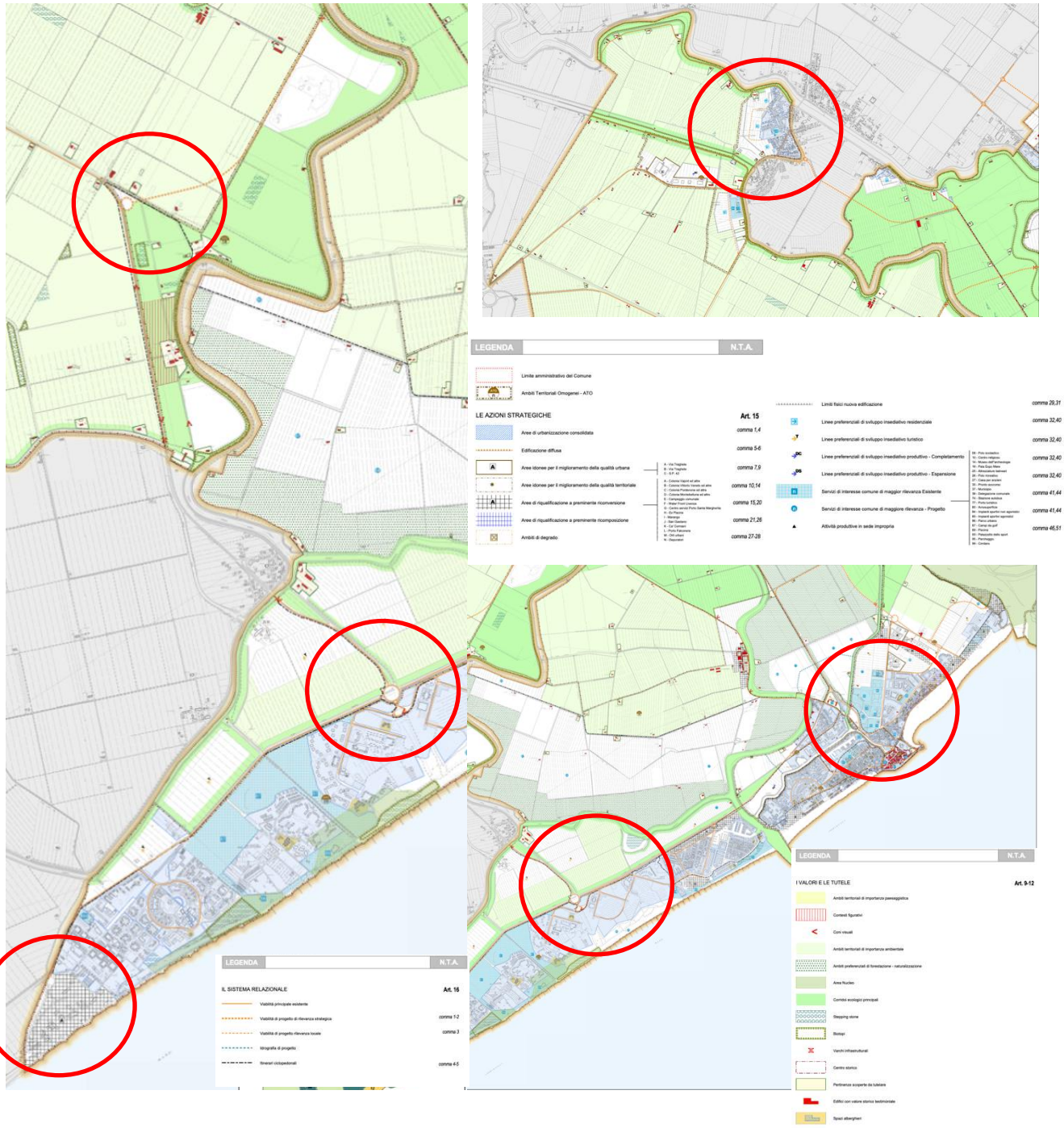

Figure 5 Transformation map with main unsuitable projects in the Municipality of Caorle

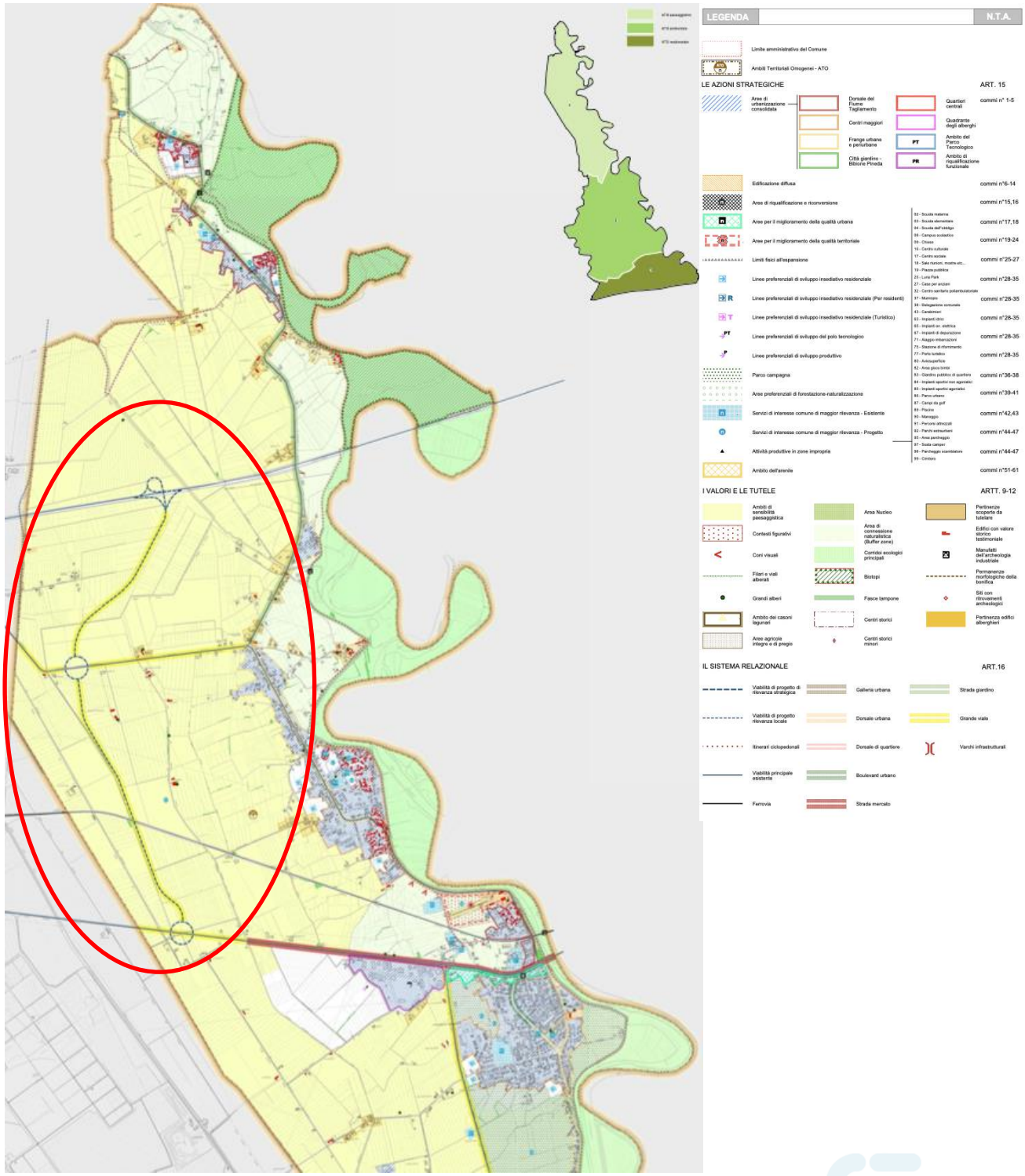

Figure 6 Transformation map with main unsuitable projects in the Municipality of San Michele al Tagliamento

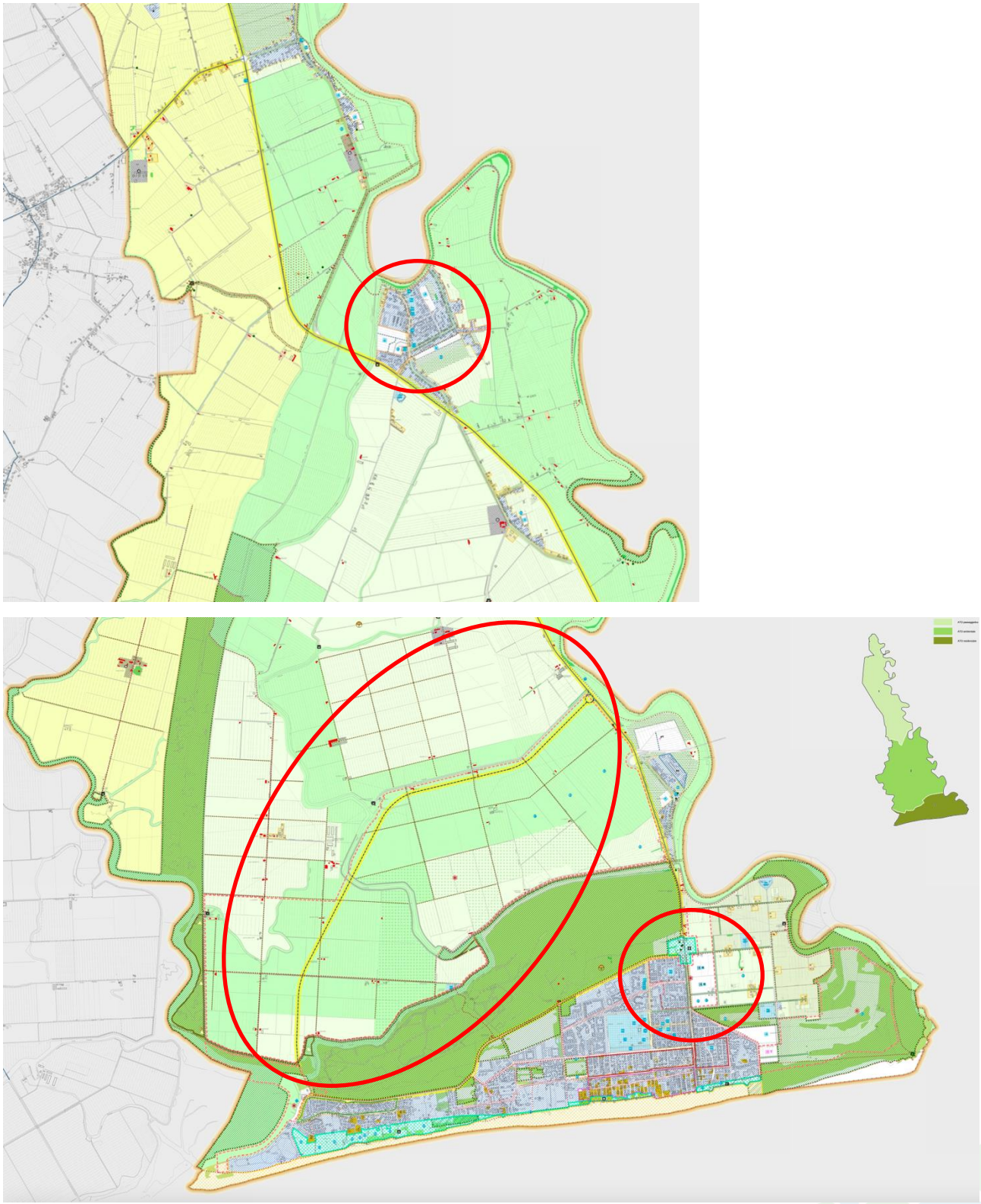

Figure 7 Transformation map with main unsuitable projects in the Municipality of San Michele al Tagliamento

The PAT divides the municipal area into planning units known as “Homogeneous Territorial Areas” (ATOs). Within each ATO, the plan defines the residential, commercial, and industrial development zones, as well as the related public services such as parking areas, schools, sports facilities, public parks, and other amenities.

As highlighted in the previous images, several inappropriate developments have been identified — primarily new built-up areas — which risk interfering with the connectivity of key remaining corridors and ecological areas. In addition, various new infrastructure projects may further compromise the territorial continuity.

For the Municipality of Concordia Sagittaria, 3 main interfering developments were highlighted:

- the ATO 3 di Teson, close to a main commercial development line,
- the commercial development zone close to Case Furlanis,
- the ATO in Sindacale with a main residential development.

For the Municipality of Caorle, both new settlements and road developments were identified as possible threats to the connectivity in the pilot area, including:

- the new road connections between the Provincial roads 54 and 59,
- the reconversion area of Colonia Vajont,
- the service area in Chiggiato,
- the residential development zone in San Giorgio di Livenza.

For the Municipality of Eraclea, the bypass road around Bibione represents one of the main threats to connectivity together with the new connection between the highway E70 and the State Road no. 14. Similarly, the settlement developments in Cesarolo and Bibione can represent a significant issue to tackle in terms of connectivity.

5 Choice of Locations for major developments/renewable energy facilities

The chapter addresses general criteria for unsuitable locations for the project types considered, adding specific criteria for unsuitable locations in the pilot area. During the development of the project, some areas were identified to be subjected to conservation and restoration measures of ecological connectivity. The identification of these areas involved the following steps (described in the previous chapters):

- the recognition of the updated information bases available from the administrations and bodies owning the data,
- the inventory of green and blue infrastructures (components and functions) at the level of the pilot area,
- the analysis of the naturalistic value of the geographical and environmental components of the territory, through the detailed analysis of the available information,
- the identification and characterisation of green and blue infrastructures with connecting functions and the ecosystem services they provide,
- the identification of the barriers to connectivity to be solved.

About the definition of the actions for the conservation and restoration of ecological connectivity, an abacus will be prepared, which will be developed in the next phases of defining the contents of the necessary actions. The manual presents a wide range of interventions suitable for different local situations. Each action has the potential to improve the ecological functionality of green and blue infrastructure, supporting biodiversity and ecosystem resilience. The priority areas subject to conservation measures, at the end of the participatory process, were the following:

1. Venetian Coastal Corridor (Poseidon project): Improvement of the naturalness of the waterway, permanent naturalistic arrangement of the areas now identified for the temporary storage of sludge and other possible areas in the CBVO feasibility study,
2. Cavrato Corridor (spillway of the Tagliamento river): Management of the agricultural part affected by the spillway to avoid erosion and sediment transport in the lagoon, improving the quality of habitats (cover crops, agri-environmental measures),
3. Areas with widespread connection and Natura 2000 completion areas: Reduction of pressures deriving from intensive agricultural activities, experimenting with conservation agriculture measures,
4. Fishing Valleys: Increase and/or widening of the keys in order to increase the flow of the tides, strengthen the connections between the different wetlands and improve the ecological continuity and the action of water exchange due to the tides. Agree on management criteria for the keys with the tenants of the Valleys.

5.1 General criteria for unsuitable locations

The general criteria for unsuitable sites are compiled in the following table. They are based on the corresponding chapters of the report D1.3.1.

Table 6 General criteria for unsuitable sites (D1.3.1)

	Unsuitable locations
Hydropower	• protected areas (e.g. Natura 2000 areas, nature reserves, …) • natural or semi-natural rivers
Windpower	• protected areas (e.g. Natura 2000 areas, nature reserves, core areas of national parks and biosphere reserves) • European bird protection areas with occurrences of wind energy-sensitive bird species • designated bird migration routes • density centers of collision-sensitive bird species • old natural or semi-natural forests • forested ridgelines because of high collision rates of birds and bats • areas with high perceived scenic quality (landscape quality)
Solar power	• protected areas (e.g. Nature 2000 areas, nature reserves, water protection areas) • areas of high nature conservation value • riparian buffer zones, floodplains • natural watercourses and lakes • soil with very high significance for natural soil functions • agricultural soil with high degree of productivity
Biomass (bioenergy plant)	• protected areas (e.g. Nature 2000 areas, nature reserves, core areas of biosphere reserves, water protection areas) • areas of high nature conservation value
High voltage transmission line	• European bird protection areas (Important Bird Areas (IBAs) or Special Protection Areas (SPAs)) • wetlands of international importance according to the Ramsar Convention • designated bird migration routes • near large bodies of water and reservoirs • protected areas specifically for landscape (UNESCO World Heritage Sites, Landscape conservation areas, priority areas for tourism) • other protected areas (e.g. Natura 2000 areas, nature reserves, core areas of national parks and biosphere reserves) • old natural or semi-natural forests • water protection areas of zones I and II (no construction of transmission poles in waterways or banks of waterways

	Unsuitable locations
Roads/ highways	• protected areas (e.g. Nature 2000 areas, nature reserves, core zones of national parks and biosphere reserves, water protection areas) • areas of high nature conservation value like old-growth forests or wet- and peatland • soil with very high significance for natural soil functions
Railways	• protected areas (e.g. Nature 2000 areas, nature reserves, core zones of national parks and biosphere reserves, water protection areas) • areas of high nature conservation value like old-growth forests or wet- and peatland
Urban /industrial development	• protected areas (e.g. Nature 2000 areas, nature reserves, core zones of national parks and biosphere reserves, water protection areas) • areas of high nature conservation value like old-growth forests or wet- and peatland • existing ecological corridors, especially in bottleneck areas

In 2021, 44.73% of the national territory was classified as high and very high fragmentation. The regions with the largest surface area with very high fragmentation are Veneto (40.44%), Lombardy (33.64%), Puglia (28.54%) and Campania (28.52%). This confirms the close correspondence between fragmentation and density of urbanization. The indicator used "Fragmentation of the natural territory and agriculture" (ISPRA 2021) measures the degree of fragmentation of the territory, mainly the result of the phenomena urban sprawl and infrastructure network development, which are responsible for the reducing effects of continuity of ecosystems, habitats and landscape units.

On 31 October 2023, Directive 2023/2413/EU of the European Parliament and of the Council of 18/10/2023, also known as the Renewable Energies Directive III, amending EU Directive 2018/2001 on the promotion of energy from renewable sources, known as the RED II Directive, was published in the Official Journal of the European Union (Gazzetta Ufficiale dell'Unione Europea, G.U.U.E).

The RED III Directive has been in force since 20 November, pursuant to Article 7, and must be transposed by the Member States no later than 21 May 2025. Needless to say, the energy transition towards a sustainable and decarbonised model is one of the most urgent challenges of our time.

In this context, the production of energy from renewable sources (RES) plays a fundamental role, as it allows to reduce greenhouse gas emissions and diversify energy supply sources. The most important figure of RED III is, in fact, the raising of the production targets of the share of energy from renewable sources to 42.5% by 2030. This deserves some clarification.

Exclusion zones in this context are areas where certain infrastructures are not allowed to be built or operated. Exclusion zones are the most common planning instrument to mitigate environmental impacts of human land-use, including the deployment of RE.

As can be seen from the table above, the unsuitable locations are often identical. They include mainly protected areas of various types: e.g. Nature 2000 areas, nature reserves,

core zones of national parks and biosphere reserves, water protection areas or the developed GBI network for connectivity (including priority areas for conservation and restoration). For the definition of exclusion zones, however, it is not sufficient to use only the boundaries of ecologically valuable areas. Many infrastructure projects have far-reaching effects (for example wind turbines or roads), so that positioning them directly next to an ecologically valuable area can affect the area in a negative way. As described in report D1.3.1 edge effects and barrier or fragmentation effects influence not only the habitats adjacent to an infrastructure, but also the ecosystems and living conditions of wildlife in wider areas (see report D1.3.1).

5.2 Development of specific criteria for unsuitable locations in the pilot area (exclusion zones)

The pilot area was chosen for its specific characteristics, starting from the set of activities that were concentrated downstream of the experience of the Wetland Contract (cf. Foreword of this report)

Nature conservation (Directive 92/43/EEC “Habitats” and Directive 2009/147/EC “Birds”), hydraulic safety (Directive 2007/60/EC known as “Floods”) and water quality (Directive 2000/60/EC), together with the quality of the river and lagoon environment and the territory of the sub-basin (biodiversity, ecological connections, ecosystem services, etc.) represent the priority objectives in the management of the Wetland System covered by the Contract.

Moreover a significant portion of wetlands in the area consists of traditional fishing valleys (Valliculture systems), which are semi-enclosed areas hydraulically connected to the lagoon. These are actively managed and monitored by operators to regulate water exchange and fish movement.

The question is: What distances must be kept ensuring that an ecologically valuable area is not adversely affected by a certain infrastructure? This distance depends on the type of area and species occurring in the area as well as the type of infrastructure. Two approaches were taken to answer this question:

- compilation of existing standards or guidelines for determining unsuitable areas for a certain type of infrastructure, and
- compilation of the maximum impact ranges of infrastructure projects used as a buffer around ecologically valuable area.

There are different buffers for different infrastructures in each country. Regarding the existing standards for our pilot area, we have adopted the relevant exclusion zones from the Regional plans. Other Italian regions use different distances.

The second approach is based on the maximum impact ranges of infrastructure projects. These impact ranges can then be used as a buffer around the ecologically valuable areas.

The following table lists the unsuitable areas that occur in the pilot area with the proposed buffers. The proposed buffers are based on an evaluation of buffers from various sources and on our expert opinion - if no values could be found.

Table 7 Compilation of unsuitable locations and their corresponding buffers in the pilot area Caorle Lagoon

	Infrastructure	**Distance to**	**Buffer (m)**	**Reference**
Urban /industrial development	Buildings	Riverbanks	4 to 10 metres for buildings, depending on the importance of the watercourse, 1-10 metres for other works (plantations)	R.D. 8 maggio 1904, n. 368, https://www.bonificaferrara.it/images/Allegati/Amministrazione_trasparente/Disposizioni_generali/Atti_generali/R.D.%2008-05-1904,%20%20n.%20368.pdf R.D. n. 523/1904 D.lgs. n. 152/2006
	Any change in land use as well as any construction work, except for ordinary and extraordinary maintenance, static consolidation and conservative restoration work that does not alter the state of the place and the external appearance of buildings) - land use changes are subject to a landscape permit or - are regulated by landscape plans (if existing)	Riverbanks	150 m	legge 8 agosto 1985, n. 431 (legge Galasso) + D.lgs. 42/2004

	Infrastructure	Distance to	Buffer (m)	Reference
	Any change in land use as well as any construction work, with the exception of ordinary and extraordinary maintenance, static consolidation and conservative restoration work that does not alter the state of the place and the external appearance of buildings) - land use changes are subject to a landscape permit or - are regulated by landscape plans (if existing)	shore of the sea and lakes	300 m	legge 8 agosto 1985, n. 431 (legge Galasso) + D.lgs. 42/2004
	Any change in land use as well as any construction work, with the exception of ordinary and extraordinary maintenance, static consolidation and conservative restoration work that does not alter the state of the place and the external appearance of buildings) - land use changes are subject to a landscape permit or - are regulated by landscape plans (if existing)		buffers zones of parks	D.Lgs. 42/04
	Risk management and Fire prevention	settlements	variable	D.lgs. 105/15 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2015;105~art27
	Risk management and Fire prevention	forests	variable	D.lgs. 105/15 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2015;105~art27

The pilot area was chosen for its specific characteristics, starting from the set of activities that were concentrated downstream of the experience of the Caorle System Wetland Contract for the preservation of natural capital (cf. Foreword of this report)

Nature conservation (Directive 92/43/EEC “Habitats” and Directive 2009/147/EC “Birds”), hydraulic safety (Directive 2007/60/EC known as “Floods”) and water quality (Directive 2000/60/EC), together with the quality of the river and lagoon environment and the territory

of the sub-basin (biodiversity, ecological connections, ecosystem services, etc.) represent the priority objectives in the management of the Wetland System covered by the Contract.

Moreover, a significant portion of wetlands in the area consists of traditional fishing valleys (Valliculture systems), which are semi-enclosed areas hydraulically connected to the lagoon. These are actively managed and monitored by operators to regulate water exchange and fish movement.

Primary and secondary ecological corridors have been defined and designed. Primary ecological corridors are mainly concentrated along the routes of major watercourses, as these provide natural routes of movement for many species. In particular, the primary corridors have been traced in the areas crossed by the Livenza, Tagliamento and Lèmene rivers. These rivers represent strategic axes for conservation, as they guarantee ecological continuity both at the local and regional and transnational levels.

In addition to the primary corridors, secondary ecological corridors have also been designed, which develop mainly in correspondence with canals and minor waterways. Among these, particular importance has been given to those canals that have more natural shapes, with wider and less artificial bends, able to offer refuges and habitats for wildlife. These secondary corridors are essential to create a capillary network of connections that allows the movement of species even on a smaller scale, promoting the resilience of the ecosystem.

The positive effect of rivers and canals is represented by buffers of different sizes, namely:

- Channels and channels (secondary ecological corridors): Buffer 50m
- Channelled rivers (primary ecological corridors): Buffer 100m
- Natural rivers (primary ecological corridors): Buffer 200m

About specific criteria for Renewable energy installations, with Resolution no. 335 of 4 April 2024, the Regional Council adopted the New Regional Energy Plan (NPER), the strategic planning document that defines the guidelines and coordination of programming for the promotion of renewable sources and energy saving in implementation of the provisions of European sector legislation, national and regional. Based on this document, regional energy policies will be adopted between now and 2030.

Impacting actions on biodiversity will be:

- Interventions to support the recovery of residue for energy purposes wood biomass, including maintenance;
- Interventions for the diffusion of soft mobility - extension and implementation, also for functional excerpts, of cycle routes part of the national and regional cycle network;
- Productive agricultural investments for the environment, climate and animal welfare: Construction of structures and plants for the production of renewable energy from

agro-forestry sources, renewables and wastewater from the company's activities; Transition 5.0 (Repower EU);

- Investments in networks and infrastructures - construction of networks electricity and gas;
- Incentives to support the creation of green businesses.

Article 20 of Legislative Decree No. 199 of 8 November 2021 provides for the definition and delimitation of areas suitable for the installation of renewable energy plants. To this end, in the same article - paragraph 1, it is provided that:

- by interministerial decree (decree of the Minister of Ecological Transition in agreement with the Minister of Culture, and the Minister of Agricultural, Food and Forestry Policies, subject to agreement within the Unified Conference) the general principles and criteria will be established, and the distribution of the installed power between regions and autonomous provinces (paragraphs 1 - 3);
- within the following 180 days from the entry into force of the implementing ministerial decrees, the Regions will have to identify, with their own laws, the suitable areas.

Pending the identification of suitable areas, based on the criteria and procedures established by ministerial decree Ministerial Decree 21/06/2024, those identified in art. 20 paragraph 8 of Legislative Decree 199/2021, listed below:

- Modification of existing systems - Art. 20 par. 8. lit. A),
- Sites subject to be reclaimed - Art. 20 co. 8. letter B),
- Quarries or Mines - Art. 20 par. 8. letter C),
- Sites and facilities of railways and highways management companies - Art. 20 par. 8. lit. (c-bis),
- Sites and facilities of airport management companies - Art. 20 par. 8. lit. C-bis 1),
- Agricultural Areas - Art. 20 par. 8. lit. C-b)1,
- Industrial plants or factories - Art. 20 par. 8. lit. C-b)2,
- Motorway Network - Art. 20 co. 8. lit. (C-ter)3,
- Other areas outside protected assets - Art. 20 par. 8. letter c-quarter.

For photovoltaic systems whose installation is envisaged in areas classified as agricultural by the urban plans in force, Law no. 101 of 12/07/2024 is in force from 14 July 2024 converting with amendments to Legislative Decree 63 of 15 May 2024 ("Agriculture Decree"), which limits the possibility of installing new photovoltaic systems with modules located on the ground only to some of the previous areas.

The first sentence referred to in paragraph 1 of Article 5 of Law no. 101/2024 does not apply in the case of projects:

- that provide for photovoltaic systems with modules placed on the ground aimed at establishing a renewable energy community pursuant to Article 31 of Legislative Decree 63/2024
- implementing the other investment measures of the National Recovery and Resilience Plan
- necessary for the achievement of the objectives of the PNRR

The following table lists the unsuitable areas for renewable energy installations that occur in the pilot area with the proposed buffers. The proposed buffers are based on an evaluation of buffers from various sources and on our expert opinion - if no values could be found

Table 8 Compilation of unsuitable locations and their corresponding buffers in the pilot area Caorle Lagoon

	Infrastructure	Distance to	Buffer (m)	Reference
Hydropower	Rivers and water channels maintenance area (servitù)	settlements	variable	Report "Normativa statale per la realizzazione di impianti da fonti elettriche rinnovabili" https://documenti.camera.it/leg19/dossier/pdf/AP0055.pdf
	Flooding areas	artifacts	variable	Hydrogeologic plans ex L. 183/1989 https://www.gazzettaufficiale.it/eli/id/1989/05/25/089G0240/sg
	Safety distance	any activity inside rivers	variable	Managing authority decisions + state property administrations
	Protected areas regulations and plans	protected areas	variable	Protected areas managing authorities can exclude specific areas from installation or settle specific distances from the most sensitive areas
	Technical regulations	specific parts of dams/water channels	variable	Technical manuals from Public Works Ministry and Regional Authorities + Water infrastructure managing authorities
Windpower	wind power plants	protected areas	3000 meters (minimum)	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
	noise pollution	settlements	variable	https://www.bosettiegatti.eu/info/norme/statali/1995_0447.htm
	Technical regulations	specific parts of the infrastructure	variable	Technical manuals from Public Works Ministry and Regional Authorities
	Protected areas regulations and plans	protected areas	variable	Protected areas managing authorities can exclude specific areas from installation or settle specific distances from the most sensitive areas

	Infrastructure	Distance to	Buffer (m)	Reference
	aircrafts navigation protection	airports and take off/landing cones	variable	Risk plans ex L. 165/2004 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:2004-11-09;265
Solar power	solar power and biogas installations on agricultural areas	settlements	500 meters (minimum)	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
	solar power and biogas installations	motorways	300 meters (maximum)	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
	solar power plants	protected areas	500 meters (minimum)	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
	Protected areas regulations and plans	protected areas	variable	Protected areas managing authorities can exclude specific areas from installation or settle specific distances from the most sensitive areas
	Technical regulations	specific parts of the infrastructure	variable	technical manuals from Public Works Ministry and Regional Authorities
	Aircrafts navigation protection	airports and take off/landing cones	variable	Risk plans ex L. 165/2004 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:2004-11-09;265
Biomass (bioenergy plant)	Risk management and Fire prevention	settlements and lifelines	variable	D.M. 03/02/2016 + D. Min. Svil. Econ 17/04/2008
High voltage transmission line	Lines maintenance area (servitù)	settlements	variable	https://documenti.camera.it/leg19/dossier/pdf/AP0055.pdf
	Risk management and Fire prevention	settlements	variable	D.lgs. 105/15 + Lettera Circolare Min. Int. VV.F. n.3300 del 06/03/2019
	aircrafts navigation protection	airports and take off/landing cones	variable	Risk plans ex L. 165/2004 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:2004-11-09;265
	Protected areas regulations and plans	protected areas	variable	Protected areas managing authorities can exclude specific areas from installation or settle specific distances from the most sensitive areas

	Infrastructure	Distance to	Buffer (m)	Reference
Roads/ highways	Maintenance area and expansion zone	settlements	variable depending on the road level (10 to 60 m)	https://www.bosettiegatti.eu/info/norme/statali/1992_0495.htm
Railways	Maintenance area and expansion zone	settlements	30 m (minimum)	https://www.bosettiegatti.eu/info/norme/statali/1980_0753.pdf

5.3 Mapping the land use conflicts for renewable energy production

On the basis of the Ecological Network projects existing in the regional planning tools, of the metropolitan city of Venice and of the municipalities, the analyses carried out at different scales, the representation of the state IVB and the orientations drawn from the analyses themselves and from the stakeholders, the design of the core areas of the IVB Network was obtained, which, for the most part, overlap with those already identified in the existing policy framework.

However, habitat enhancement areas have been added to these, located in areas of lower quality within the core areas, important for their "location value" more than for the current quality of the Habitat.

Since the effectiveness of the core areas also depends on the degree of "hostility" of the surrounding matrix, to ensure an improvement in the ecological functionality of these areas, large buffer zones have been proposed where experiments for conservation agriculture practices will have to be promoted.

These practices should be aimed at reducing agricultural pressures, in particular chemical load and water pumping which, for many kilometers from the coastal strip, act as accelerators of the ascent of the saline wedge, to improve the ecological permeability of the surrounding areas, facilitating exchanges between areas of high naturalness and providing temporary refuge for animal and plant species.

Primary and secondary ecological corridors have been defined and designed. Primary ecological corridors are mainly concentrated along the routes of major watercourses, as these provide natural routes of movement for many species.

In particular, the primary corridors have been traced in the areas crossed by the Livenza, Tagliamento and Lèmene rivers. These rivers represent strategic axes for conservation, as they guarantee ecological continuity both locally and regionally.

In addition to the primary corridors, secondary ecological corridors have also been designed, which develop mainly in correspondence with canals and minor waterways. Among these,

particular importance has been given to those canals that have more natural shapes, with wider and less artificial bends, able to offer refuges and habitats for wildlife.

These secondary corridors are essential to create a capillary network of connections that allows the movement of species even on a smaller scale, promoting the resilience of ecosystems.

The priority areas identified within the pilot area include the following habitat types:

- Rivers
- Canals and waterways
- Vegetation dominated by reeds/rushes
- Salt marshes or mudflats
- Salt marshes
- Humid lacunal environments
- Fishing valleys
- Beaches and dunes

In all these areas, renewable energy plants should be avoided.

6 Possible mitigation and compensation measures

The analysis of potential infrastructural and settlement interventions in the Caorle Lagoon requires particular attention, given the ecological fragility and the importance of the natural connectivity of this area. The Caorle Lagoon, located along the Adriatic coast of Veneto, represents an ecosystem of great ecological value, characterized by wetlands, canals, salt marshes and maritime habitats that host a vast biodiversity.

1. Development of road and transport infrastructures

New roads or road extensions: The construction of new roads or the widening of existing ones in the vicinity of the lagoon could fragment sensitive habitats, disrupt ecological corridors and compromise the mobility of local wildlife. Interventions of this type can also alter the hydraulic regime of the area, with impacts on wetlands and waterways.

Maritime transport infrastructure: The construction of marinas or the expansion of navigable waterways can lead to greater erosion of the banks, alter the flow of lagoon waters and disturb the nesting areas of birds. In addition, the increase in boat traffic can increase the risk of pollution and the introduction of alien species.

2. Urbanization and residential development interventions

Urban expansion: The expansion of residential settlements along the coast or in the immediate vicinity of the lagoon can pose a significant threat to ecological connectivity. Overbuilding and the reduction of green areas compromise the continuity of natural habitats and reduce the ability of species to move between different areas.

Projects for vacation homes and tourist resorts: The increase in tourist facilities along the lagoon areas, such as hotels and residences, can lead to increasing anthropogenic pressure, with the loss of riparian vegetation and the increase in vehicular traffic, damaging coastal habitats and ecological corridors present.

3. Reclamation and drainage interventions

Canalization and drainage work: The construction of new canals or the intensification of drainage works can change the dynamics of lagoon waters, causing a decrease in wetlands, which are essential for the ecological connectivity of the area. These interventions can also alter salinity and water quality, negatively impacting aquatic habitats.

Land levelling and remediation interventions: Transforming wetlands into agricultural land through remediation can reduce the surface area of valuable habitats and disrupt links between different biotopes. This type of intervention is particularly harmful to species that depend on wetlands for their survival.

4. Development of tourism infrastructure

Camping areas and tourist villages: The construction of accommodation facilities in or near the lagoon can cause the degradation of natural areas due to the expansion of parking lots,

paths, and access infrastructures. This can compromise bird nesting areas and rare species habitats, altering connectivity between natural areas.

Cycling and tourist trails: Although less impactful than other infrastructures, the construction of cycling and walking routes must be carefully planned to avoid fragmentation of ecological focus areas and minimise disturbance to sensitive species.

5. Expansion of production activities

Intensive aquaculture: The development of aquaculture and mussel farming facilities in the lagoon can interfere with conservation areas, occupying spaces intended for wildlife and changing the physicochemical characteristics of the water. The introduction of non-native species or the administration of artificial nutrients can alter the ecological balance of the area.

Industrial and manufacturing activities: The establishment of new industrial areas in the vicinity of the lagoon, even if not directly on site, can pose a threat through water pollution, increased traffic and emissions. This type of intervention can compromise the quality of air and water, which are essential for maintaining the balance of habitats.

6. Coastal protection interventions

Breakwater barriers and dams: The construction of artificial barriers for the protection of coasts from erosion can alter the sedimentary dynamics of the lagoon and negatively affect the flora and fauna of the intertidal areas. This type of intervention can also prevent the natural exchange between the lagoon and the sea, reducing the variety of habitats present.

Beach renaissance projects: If not designed in an environmentally friendly way, they can alter the transition zones between the marine and lagoon environment, disturbing the delicate balance of coastal habitats and the nesting areas of bird species.

7. Development of renewable energy

Wind and photovoltaic plants: The construction of wind farms or large-scale photovoltaic plants in the vicinity of the lagoon can have landscape and direct impacts on wildlife, especially migratory birds. The installation of structures of this type must be carefully evaluated to avoid the alteration of migration corridors and the fragmentation of habitats.

Biomass energy plants: The use of agricultural areas close to the lagoon for biomass production could lead to the conversion of natural habitats into monocultures, with a negative impact on biodiversity and ecological connectivity.

The impact of these interventions varies according to their location, scale and how they are carried out. However, it is clear that inadequately planned interventions can significantly alter the ecological balance of the Caorle Lagoon, compromising its function as an ecological corridor. To minimize the damage, it would be advisable to:

- carefully plan infrastructure interventions, favouring solutions that maintain ecological connectivity, such as underpasses for fauna or "green corridors" between urbanized areas.

- promote the renaturalization of degraded areas, promoting the recovery of wetlands and the conservation of the most sensitive areas.
- Assess the environmental impact of each project through in-depth studies and promote the involvement of local communities in the management and conservation of the lagoon.
- promote low-impact tourism activities and sustainable tourism, which enhances the ecological peculiarities of the lagoon, without threatening biodiversity and connectivity.

This integrated approach can ensure a balance between economic development and conservation, keeping the Caorle Lagoon a precious natural heritage for future generations.

To mitigate the potential impacts of infrastructural and settlement interventions on the areas of conservation and restoration of connectivity in the Caorle Lagoon, it is essential to adopt a strategic approach that balances the needs of economic development with environmental protection. The criteria and mitigation measures proposed below aim to reduce the negative effects on sensitive habitats, while improving the resilience and ecological connectivity of the lagoon.

7 Conclusions

The main vulnerability agents present in the pilot area and on wetlands, found by reading the local territory concern the aspects described below.

Pressures on the water system

Hydrological effects of climate change on the lagoon

Climate change will also have impacts on the ecosystems of river mouths and lagoons. The high variability of precipitation will produce a winter increase in nutrients and pollutants in the lagoons of northern Italy. The increase in the frequency of floods could destroy the banks and aggravate the erosion phenomenon, leading to loss of biodiversity. These lagoons will be subject to the spread of non-indigenous species.

To this must be added, as a result, the effects of climate change on rivers, in particular the reduction in flow rates caused by the drastic reduction of glaciers, less rainfall and increased evaporation.

- Pressures on the deep and surface water system: agglomerations, discharges (civil and industrial) and purifiers, waste management plants, polluting loads of agro-livestock origin,
- Changing quality of transition water and saline wedge rise,
- Blocking of the natural dynamics of wetlands and consequent dependence on careful water management.

Intensive farming

The main critical issues that emerged are the following: all negatively affect the provision of regulation and support ES:

- ecosystem trivialization and nitrates,
- Strong artificialization of watercourses,
- pumping of the aquifers that recalls the saline wedge,
- fertilization, agricultural practices rather than on the spontaneous regeneration of soils on continuous fertilization, to the detriment of soil biodiversity, water and CO2 capture.

Tourist pressure

This is a growing pressure that concerns the coastal strip. The main aspects are as follows:

- apparent exceeding of the tourist load-bearing capacity of the coast,
- increase in the uncontrolled abandonment of waste (especially plastic),
- Intense disturbances to habitats especially in late spring and summer.

The pilot area is currently subject to various protection activities, but there are several potential threats to connectivity. These include infrastructure developments that fragment the territory, such as disposal plants and road infrastructures, and the planned settlm,ent and related service system expansion. Other direct pressures on habitat, such as human-induced activities and effects leading to the degradation of habitat connectivity functions in corridors, include agricultural and fishing practices, water pollution, and changes in watercourse structure. Forest sectors present in the area also face pressures, including anthropogenic and natural activities, tourist pressure, and sea level rise and salty water intrusion.

Indirect pressures, such as income needs, lack of knowledge, and lack of enforcement, also contribute to the occurrence of direct pressures. Changes in the morphology of the territory due to natural evolution of the lagoon system and river mouths, as well as hydraulic safety and related interventions, could make their balances more fragile and cause the loss of consolidated landscapes.

8 Glossary

Table 9: Main glossary for the Caorle Lagoon

Connectivity" (structural and functional)	**"Connectivity comprises two components, structural and functional connectivity. It expresses how landscapes are configurated, allowing species to move. Structural connectivity, equal to habitat continuity, is measured by analysing landscape structure, independent of any attributes of organisms. […]. Functional connectivity is the response of the organism to the landscape elements other than its habitats (i.e. the non-habitat matrix). This definition is often used in the context of landscape ecology. A high degree of connectivity is generally linked to low fragmentation." (EUROPEAN COMMISSION - Technical information on Green Infrastructure (GI), 6.5.2013, Glossary)** **(Definition of connectivity see also Deliverable 1.1.1, chapter 8)**
GBI – Green and blue infrastructure	Green infrastructure (GI) is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings." (EUROPEAN COMMISSION - Green Infrastructure (GI) - Enhancing Europe's Natural Capital, 6.5.2013) (Definition of connectivity see also Deliverable 1.1.1, chapter 6)
Hydropower (dams, weirs, run-off-river power plant)	power derived from the energy of falling water or fast running water to generate electricity Hydropower generation including development and use of associated infrastructure (e.g. building dams or weirs, changes of hydrological functioning rivers or chemical and thermal properties of water due to operation of dams and weirs).
Hydroelectric dam	a barrier that stops or restricts the flow of water; used to create energy in the water flow that can be captured by a turbine to generate electricity
Pressures and Threats	Definition by the European Environment Agency 2020 (State of nature in the EU - Results from reporting under the nature directives 2013-2018): *"Pressures are considered to be factors that have affected habitats and species within the current reporting period, while threats are factors that are anticipated to be likely to have an impact during the subsequent two reporting periods."*
Solar PV panel	an arrangement of PV materials that absorbs and converts sunlight into electricity
Transmission lines	power lines used to move electricity from a generating site (e.g., a power plant) to an electrical substation, which often transforms the voltage from high to low before reaching consumers
Wind farm	a group of wind turbines used to produce electricity

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10 ANNEXES

Annex 1 Mitigation/compensation (see D1.3.1)

	Mitigation / Compensation
Hydropower	• Upstream and downstream fish passage facilities (fish ladders, bypasses) to allow migration • intelligent turbine design or turbine shutdown on a fixed schedule decreasing turbine related mortality • ecologically effective minimum flow of water • bed-load management • morphological enhancement measures: ➢ improvement of the riverbank structure (unsealing the riverbank) ➢ introduction of gravel banks ➢ introduction of disturbance elements (stones, deadwood) • New hydropower technologies with less environmental impacts
Windpower	• turbine design optimization • switch off systems at times of increased bird/bat activity to prevent/avoid collisions (Automatic anti-collision systems) • unattractive design of the environment at the base of the mast and in surrounding fields for wind energy-sensitive birds (red kites)
Solar power	• landscape-oriented design of the facility, visual integration into the environment: suitable arrangement of the solar panels (e.g. “Solar biotope network”) • sufficiently large (wide) open spaces between the rows of solar panels (sunlit strips at least 3 m wide between the rows) • elevation of the solar panels (panel distance to the ground at least 0.8 m) • no fencing or at least permeable for small and medium-sized mammals (15 cm distance between the fence and the ground), migration corridors as crossing aids for large-scale facilities • development and maintenance of extensively used, species- and flower-rich grassland in the solar park ➢ using seeds from local species or locally obtained mown material ➢ no fertilization, no use of pesticides ➢ up to 2 mowing intervals (use of insect-friendly mower, cutting height 10 cm) with removal of mowed material or/and site-adapted grazing • no mulching
Biomass (bioenergy plant)	• -
High voltage transmission line	• bundling of linear infrastructure, appropriate route alignment • appropriate design of the pylons to reduce fragmentation including spanning above the forest canopy • marking transmission lines to reduce bird collision risk • ecological rights-of-way vegetation management creating and connecting new habitats

	Mitigation / Compensation
Roads/ highways	• appropriate route alignment • traffic management measures: reducing traffic volume or speed • fencing combined with wildlife passages • wildlife passages as overpasses (e.g. green bridge, fauna overpass, multiuse overpass) or as underpasses (e.g. viaduct, fauna underpass, multiuse underpass, small fauna underpass, adapted culverts, fish passage, amphibian passage) reducing the barrier effect and providing a safe crossing • embankments to mitigate noise and provide new habitats for endangered flora species • adapting infrastructure verges • mechanical methods for vegetation control or grazing as alternative methods to the use of chemical substances in the management of green areas • adapting road lighting for mitigating light pollution • noise screens, placing the road between cuttings or earthen mounds, silent pavements for mitigating noise • runoff water management: Retention ponds
Railways	• appropriate route alignment • fencing combined with wildlife passages • wildlife passages as overpasses (e.g. green bridge, fauna overpass, multiuse overpass) or as underpasses (e.g. viaduct, fauna underpass, multiuse underpass, small fauna underpass, adapted culverts, fish passage, amphibian passage) reducing the barrier effect and providing a safe crossing • embankments/ earthworks to mitigate noise and provide new habitats for endangered species • adapting infrastructure verges • mechanical methods for vegetation control or grazing as alternative methods to the use of chemical substances in the management of green areas • noise screens, placing the road between cuttings or earthen mounds, rail noise absorbers for mitigating noise • runoff water management: Retention ponds
Urban /industrial development	• appropriate location of new urban/industrial development (avoid areas of high nature conservation value including ecological corridors) • preservation of large, undissected open spaces, safeguarding inner-urban trees (particularly large/mature trees) • minimizing the road infrastructure associated with urban/industrial development, keeping vehicle speeds low • reducing use of fertilizers and pesticides in maintenance of public and private green • minimizing artificial lighting • good pet ownership to reduce domestic animal damages to wildlife • runoff water management: minimize water runoff into streams • Integration of connectivity elements in zoning plans / optimising connectivity planning and interfaces between regional concepts and municipal planning

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Mainstreaming ecological connectivity in spatial planning systems of the Alpine Space

Project partners:

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GBI-network: Land use conflicts for RE production and other threats in Caorle Lagoon

Authors
Gioia Gibelli, Alessandra Pandolfi, Elena Moncalvo (Studio Gibelli),
Claudio Chiapparini (Regione Veneto)

Layout
RV, Elena Moncalvo

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