

Highway Natural Borderscapes. The Landscape Potential of Infrastructural Residual Spaces in the Case of Milan Ring Roads

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1. Introduction

1.1 Highways and landscapes. The case of the Milan Ring Roads system

With the exponential growth of private mobility in the last century, the landscape and the motorway matrix have become one of the characterizing elements of major contemporary cities and territories.¹ Despite the promise of diminishing travel time, intermodality, and economic progress, the massive presence of these large infrastructural bodies initially pushed concerns about the landscape and its interference into the background. It is not uncommon to find, along the motorway edges, destructured fringe areas, and parts of peri-urban territory made up of small and medium-sized agglomerations, where the open spaces and architectural objects are very heterogeneous, without significant spatial relationships.² Such a condition strongly alters the rules of the pre-existing morphological system to the point of determining its total cancellation and replacement. The consequence is a new structure devoid of any landscape and ecosystem value, with existing, or at risk, conditions of degradation and compromise.³

This research takes the metropolitan city of Milan as the territorial area of reference, strongly characterized by its Roman-founded radio-centric system – and even more reinforced by the presence of three large infrastructures for mobility, the three Milanese ring roads, which constitute a large metropolitan ring.

The three ring roads – A50 west ring road, A51 east ring road, A52 north ring road – as well as the southern axis of the A7 Milan-Genoa, are managed by the company Milano Serravalle Milano Tangenziali,⁴ currently involved in a co-funded PNRR research project.⁵ It aims to investigate what opportunities the motorway ring can allow for urban and landscape regeneration. Can the Ring Road system be configured as a backbone for ecologic networks and environmental sustainability? How can we rethink, and what is the current trend, in the sensitive relationship between infrastructural landscape and landscape urbanism?

1 Fabrizio Berlingeri, *Intersections and Ambiguity. Urban Infrastructural Figures of the European Metropolis* (ListLab, 2018), 26-27.

2 Luca Di Grazia and Silvia Goldoni, "Entrare a Milano : Dall'anello Delle Mura a Quello Delle Tangenziali," MSc dissertation, Politecnico di Milano, 2000, 15.

3 Martín Arboleda, "In the Nature of the Non-City: Expanded Infrastructural Networks and the Political Ecology of Planetary Urbanisation," *Antipode* 48, 2 (6 March 2016): 233-51

4 Milano Serravalle - Milano Tangenziali S.p.A. is an Italian company that operates in the concession management sector of motorway sections. It is based in *Assago* and is the concessionaire until 2028 of the A7 from *Milano* to *Serravalle Scrivia*, and of the three ring roads of the Lombard capital (West, East, North).

5 The National Recovery and Resilience Plan, or PNRR is the plan approved in 2021 by Italy to relaunch its economy after the COVID-19 pandemic, in order to allow the country's green and digital development.



Fig. 1: Properties of Milano Serravalle Milano Tangenziali and Urban Regeneration Areas – Chierichetti Nicolò (2024)

In the necessary territorial reconnaissance operation, one fundamental source is GIS data repositories.⁶ Adopting such spatial tools enables the visualization and condition of information deriving from geographical data – including a large basin to refer to protected areas, sites of community importance, and areas of special protection interfered with and adjacent to the network. Such preconditions consequentially allow an exhaustive overlap with the Milano Serravalle network in discussing the relationship between these two macro-domains. (Fig. 1)

Concerning the Milanese example, the territory crossed is indeed characterized by high urbanization, for which we recognize continuous urbanization towards the northern part of the Monza Brianza province and penetrative conurbations in the southern parts, a symptom of the city's constant growth along mobility infrastructures. Yet, it also presents a heterogeneous co-presence of protected areas and supra-municipal and metropolitan interest parks. An example is the Southern Milan Agricultural Park, which intercepts the eastern and western ring roads, the Milanese section of the A7, and the Lombard Park of the Ticino Valley.⁷ In many sections of these systems, the green infrastructure is configured as a buffer between the urbanized area and the infrastructure itself.⁸ In contrast, in others, such as along the northern ring road, it is part of the park system from north Milan to unite and form an integrated system that constitutes a continuous and homogeneous territorial unicum while safeguarding each park authority's differences and peculiar characteristics.

The critical mass due to the presence of massive mobility infrastructures indeed recalls the need to address the theme of the greenery project, which is now considered a mere negative of the mobility space.⁹ Landscape in relation to the physicality of such infrastructures implicitly plays a crucial role as either a technical device – in a regulative and mitigation perspective – as well as a landscaping opportunity of the crossed territories, both seen from the static nature of the outside and the rapidity of the inside.¹⁰

6 A Geographic Information System (GIS), also called territorial information system, is a computerized system that allows the acquisition, recording, analysis, visualization, return, sharing and presentation of spatialized information.

7 The South Milan agricultural park is a protected natural area in Lombardy that encloses a large arched area between the neighborhoods south of Milan and around 60 municipalities of the metropolitan city of Milan.

8 Marcel Smets and Kelly Shannon, *The Landscape of Contemporary Infrastructure* (NAI publishers, 2010), 140-54.

9 Alberto Ferlegna, Marco Biraghi, and Benno Albrecht, eds., *L'architettura Del Mondo. Infrastrutture, Mobilità, Nuovi Paesaggi* (Milano: Editrice Compositori, 2012).

10 Sylvia Crowe, *The Landscape of Roads* (London: Architectural Press, 1960).

There is the need to highlight the enormous relevance of the greenery project – as a tool not only for urban planning compensation in quantitative terms, or mitigation concerning regulatory requirements – but also in its potential active role in promoting greater integration with the urban fabric is therefore critical. The motorway landscape, thus, represents an enormous spatial legacy and an estate that is currently undervalued but could instead constitute an excellent asset for the territories. Therefore, by noting the different urban patterns crossed, this contribution aims to explore which opportunities can emerge with a conscious design of the open border space, and which planning episodes are already part of the strategic asset of the motorway concessionaires operating in the Milan area, by concentrating on the case of the *Milano Serravalle Milano Tangenziali* in its management of the city's ring roads.

The Impact of Milan Ring Roads on Biodiversity

The Italian panorama across compensation and mitigation

The interventions relating to the creation of extensive mobility infrastructures certainly present themselves as massive interferences, firstly, due to the very legal nature with which the programming and planning phase takes place. The primary administrative tool that comes into play is expropriation for public utility, as defined by law no. 2359 of June 25, 1865,¹¹ which allows a public state authority to expropriate land owned by private individuals to build infrastructures or works of public interest.¹² Throughout the twentieth century, this urban planning device was primarily applied to agricultural and countryside land to retrieve profitable land for constructing infrastructures, thus leading to a progressive denaturalization of the urban and extra-urban landscape.¹³

With the advent of greater sensitivity to the issues of landscape and environmental sustainability, various protection tools for natural ecosystems and biodiversity have been created, with the attempt to highlight the systemic qualities of non-anthropogenic landscapes and to move away from a purely compensatory logic of the greenery project as the unfortunate outcome of what was Ministerial Decree no. 1444 of 1968.¹⁴ The approach, defined by the decree, still provides an urban planning standard as the specific minimum size of green areas and parks per inhabitant, but with a purely quantitative and not qualitative logic. This principle generated a pathological attitude to consider the green buffers as a mere compensative and neutral surface to conform to the imposed requirements. On the other hand, the Ministry of Environment played an essential role in the attempt to shift towards a more virtuous approach by defining more sensitive values in dealing with the natural capital, such as the definition of ecological networks and wider protected areas as an effort to stop the widespread pure speculative approach.

Green infrastructures, ecologic corridors, and territorial systems

While this safeguarding worked better in the more rural settlements, establishing an ecological network in the province of Milan finds its main obstacle in the high anthropization of the territory, leading to the reduction and fragmentation of natural areas. On a large scale, the course of the *Villoresi* canal, despite the clear intersections produced by the numerous road routes, constitutes the only element of ecological continuity and, at the same time, the potential connection along the West-East axis from the *Ticino* corridor to that of the *Adda*.

11 Repubblica Italiana, "Espropriazioni per causa pubblica" [Expropriation for Public Utility], Law 2359 of June 26, 1865.

12 Chiara Bresciani, *Urbanistica e Mobilità: Regole e Innovazione* (Roma: Aracne, 2007), 145.

13 Alessandra De Cesaris, "Infrastrutture e Paesaggio Urbano," *L'industria Delle Costruzioni. Rivista Tecnica Dell'ANCE* 408 (August 2009): 4-19.

14 Repubblica Italiana, "Rapporti massimi tra gli spazi destinati agli insediamenti residenziali e produttivi e spazi pubblici o riservati alle attività collettive, al verde pubblico o a parcheggi" [Maximum ratios between spaces intended for residential and productive settlements and public spaces or spaces reserved for collective activities, public green areas or car parks], No. 1444 of April 2, 1968.

At a territorial scale, there are some landscape protection tools at a strategic level, which also constitute the main elements of impact assessment for the construction of new territorial infrastructures and their impact on the environment. We recall the Regional Ecological Network (RER) and the Territorial Coordination Plan of the Province of Milan (PTCP) as regional and metropolitan tools to regulate wider natural and green infrastructures regarding the more localized intermediate scales. These tools are then linked to a series of national regulatory and evaluation tools for the monitoring and approval of interventions, both at the strategic level of urban planning and at the implementation level.

The Territorial Coordination Plan of the Province of Milan¹⁵ (PTCP), to mend the ecological fragmentation of the territory, has identified an environmental network made up of a system of territorial areas (*ganglia*) and territorial connection bands (ecological corridors). The gates aim to preserve the continuity of the ecological corridor, preserve ecological continuity with the reconstitution of natural-shaped vegetation communities, and improve the landscape quality of the territory. The safeguarding of the overall continuity of the green and agricultural areas, with a prevalence of empty spaces over total spaces, is also the basis of the *Dorsale Verde Nord* project,¹⁶ promoted by the Province of Milan, which aims to relate and bring the different presences into a system of landscape-environmental value.

The PTCP also qualifies the extra-urban areas for agricultural use, corresponding to the scope of the Local Park of Supra-municipal Interest (PLIS) of *Balossa*, characterized by the presence of relict vegetation elements, as areas in which it is necessary to conserve the agricultural landscape as well as activate interventions of ecological consolidation to strengthen the supporting structure of the provincial ecological network. As regards the environmental landscape and soil protection system of the PTCP, the elements involved in the road project, as previously described, are the areas of landscape relevance and bands of river landscape relevance, the historical-architectural elements, the itineraries of landscape interest, the waterways, and finally rows, shrubs, and hedges.

Although direct references to infrastructural works are scarce, the text also contains some passages relating to indications that can directly influence the infrastructural project, on the one hand, constraining and guiding the route design choices, on the other proving decisive in the definition of environmental mitigation and compensation actions that will accompany the road work. Still regarding the PTCP of the Province of Milan, but concerning the Ecological Network Project and its evolution with the integration with the Metropolitan Territorial Plan (PTM), the elements involved in the road project are represented by actual ecological corridors - in particular, the secondary ecological corridors and the main connection lines with the greenery, the peri-urban areas on which to activate ecological consolidation, the gates and the infrastructural barriers.

"Linear infrastructures, such as roads and railways, have been forcibly inserted into various gaps. In the cases of higher-level infrastructures, the indispensable condition for ecological permeability is that ecological defragmentation works (faunal passages) are provided for, as art requires. Sixty-four of the Technical Implementation Regulations also use the detailed indications in the Directory of Landscape-Environmental Mitigation and Compensation Measures."¹⁷

The Regional Ecological Network (RER) of the Lombardy Region also aims to recognize the priority areas for biodiversity and the actions necessary to promote ecosystem rebalancing and ecological reconstruction programs. Complementary to the regional network, we also find the definition of the Natura 2000¹⁸ Network as an instrument of European policy for biodiversity

15 The province territorial coordination plan, in acronym PTCP, is an urban plan that plans the territory. It can be defined as the first level of territorial planning. The territorial planning used in this urban planning tool is that of major choices, strategic choices regarding road infrastructures, areas of environmental interest to be safeguarded and urban development hypotheses.

16 The *Dorsale Verde Nord* project is based on a reconstruction of the continuity of the ecological networks of the plain north of the Milanese capital and represents a recognizable and continuous sign from the *Ticino* Park to the *Adda* Park.

17 Città Metropolitana di Milano, "Piano Territoriale Metropolitano. Allegati alle norme di attuazione."

18 Natura 2000 is a network of sites of community interest (SCI) and special protection areas (SPAs) created

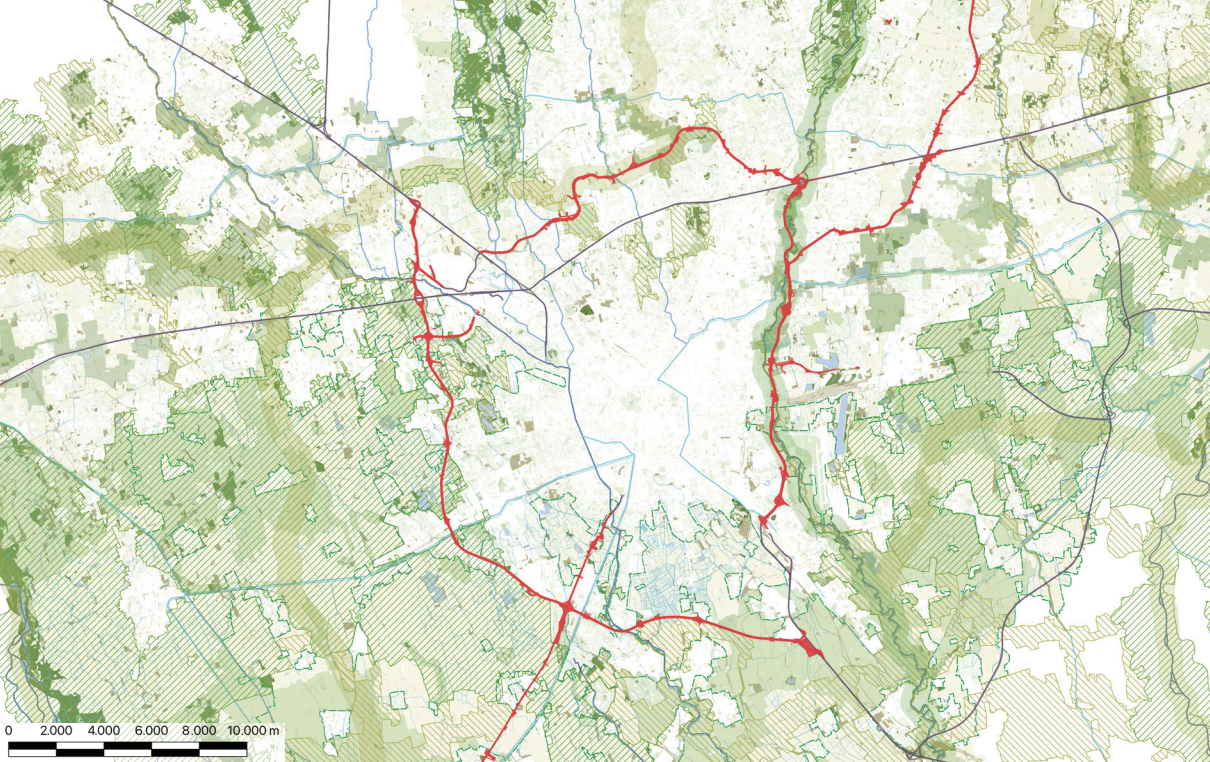


Fig. 2: Ecologic Networks and Green Infrastructures. Metropolitan City of Milan – Chierichetti Nicolò (2024)

conservation.¹⁹ The contribution poses as a fundamental reflection that each site provides both a qualitative and quantitative contribution in terms of habitats and species to be protected at a European level. It is, therefore, necessary to guarantee the maintenance, and possibly restoration, in a satisfactory state of conservation of these habitats and species.

Milano Serravalle Milano Tangenziali, for example, is committed to promoting the biodiversity of ecosystems, sustainably developing new projects, and protecting and promoting the development and growth of natural heritage. To this end, all works subject to Environmental Impact Assessment are accompanied by the Environmental Impact Study, which always includes a section relating to fauna, flora, and ecosystems with greater or lesser relevance depending on the case. For interventions planned on the network that fall within Natura 2000 sites or in the immediate vicinity, an Impact Assessment is also required to establish whether implementing the projects negatively affects the natural ecosystems and the flora, fauna, or hosted habitats. (Fig. 2)

Challenges and Opportunities. Towards Future Directions

Landscape urbanism and mobility infrastructures

Mobility infrastructures in most countries are crowned with intermediate spaces that, even if not anthropized, do not respond to the natural landscape. The condition of these buffer areas is what in literature has been defined as third landscapes,²⁰ as a dimension of the in-between, or terrain-vague²¹ as spaces of uncertainty, or again the French *paysages de la friche*. These definitions have in common the sense of abandonment of the places, spaces of mediation between one reality and another, but where the potential is left undefined and undervalued. Such vagueness reflects the concept of “borderscape,” as a conceptual framework that draws upon the

by the European Union for the protection and conservation of habitats and animal and plant species identified as priorities by the Member States of the European Union.

19 Ministero dell'Ambiente e della Sicurezza Energetica, “Rete Natura 2000,” 2023.

20 Gilles Clement, *Manifesto Del Terzo Paesaggio* (Macerata: Quodlibet, 2004).

21 Ignasi Solà-Morales Rubió, “Terrain Vague,” in *Anyplace* (Cambridge: MIT Press, 1995), 118-23.

terms “border” and “landscape.” It has emerged as a concept in geography, cultural studies, and border studies to examine the dynamic and multifaceted nature of borders.²² In this approach, the concept is used to illustrate the fluidity and complexity of borderlands, challenging the traditional perception of borders as mere buffer zones. Instead, it is proposed that borders should be understood as competence spaces with intrinsic value.

The greenery project about the motorway landscape not only represents an element of landscape mediation and decorative filter but is also configured as a precious resource from an environmental, ecological, and mitigation point of view. The vegetation along the road infrastructures, consisting of shrubs and trees, performs numerous functions – biological filter, consolidation, anti-erosion, windbreak, anti-noise, ecological, and aesthetic.

The best-known ecosystem function of vegetation is undoubtedly that of a biological filter for air quality, favoring the reduction of the dispersion of pollutants with the interception of suspended substances.²³ such as dust and fumes and the return of oxygen; for instance, the European Environment agency is sensitively active on monitoring, and returning through open-access reports, quantitative measures on pollutants-absorption action in relation to the tree canopy cover.²⁴

Furthermore, the consolidation with patches of shrubs and hedges along the motorway routes allows the consolidation of the slopes with the support given by the roots, as well as performing an anti-erosive function with the hedges, which slows down the flow of water by gravity, limiting surface water erosion. Tree and shrub roots can increase soil shear strength by 30-50% due to the mechanical reinforcement they provide.²⁵ Moreover, the vegetation developing in elevation acts as a windbreak element and a filter, which reduces the speed of the windy masses and the damage due to mechanical action. Bands of vegetation of varying widths, alongside infrastructures such as roads and motorways, also represent an efficient anti-noise device for mitigating noise pollution and shielding the infrastructure. Dense vegetation belts, for instance, can reduce noise levels up to 5-10 decibels in distances of up to 50 meters from the noise source, with an optimal reduction with a 15-meters green buffer depth.²⁶

In this sense, the Ministry of Public Works circular on road trees no. 8321 of 1966²⁷ expresses, in addition to the obligations regarding alignments and distances, the objectives that should guide the redevelopment of road infrastructures towards greater satisfaction of road users:

“It is necessary to equip the road with all the suitable requirements aimed at facilitating its use and enjoyment, also through the formation of a real road landscape that enriches its content and integrates its values. To this end, tree insertions and, therefore, respect for existing trees, woods, and flora must be considered essential within the more general framework of the public protection of the country’s cultural and environmental assets and their conservation for the enjoyment of the community.”²⁸

22 Chiara Brambilla, “Exploring the Critical Potential of the Borderscapes Concept,” *Geopolitics* 20, 1 (2015): 14-34.

23 The European Environment Agency states that “An air pollutant consisting of small particles with an aerodynamic diameter less than or equal to a nominal 10 micrometer. Their small size allows them to make their way to the air passages deep within the lungs where they may be deposited and result in adverse health effects.”

24 “For example, trees can absorb, on average for each year, 9-13 g of pollutants for each square meter of leaf area, resulting in dense tree canopies to absorb around 90-130 kg each year [...] A single tree of *Carpinus Betulus* can absorb up to 0.21 tons/year of CO₂, a *Populus Alba* 6.01 tons/year – and with, respectively, 1.099 and 0.295 grams/day of PM₁₀” (Milano Serravalle Milano Tangenziali, “Interventi Di Sistemazione a Verde Progetto Esecutivo (A50, A51, A52). Relazione Generale”).

25 Ibid.

26 Ibid.

27 Repubblica Italiana, “Alberature stradali. Istruzioni per la salvaguardia del patrimonio arboreo in rapporto alla sicurezza della circolazione stradale” [Street trees. Instructions for the protection of the tree heritage in relation to road traffic safety], Law No. 8321, 1966.

28 Ibid.

For the vegetation to carry out its functions efficiently, it is necessary to guarantee constant maintenance, especially of the tree species, through pruning or cutting the plants and carefully monitoring their health. This also prevents sick or unstable species from creating obstacles to road traffic in adverse weather conditions, affecting road safety.

Destructive landscapes

Among the main critical issues to consider in the motorway landscape project, primarily of the infrastructure itself, is the risky outcome of impoverishment and loss of any form of landscape identity, sometimes even resulting in minimal habitability conditions. The fragmentation, standardization, and trivialization of the landscape of open spaces, aggravated by the recent trend towards densification,²⁹ constitute one of the main risks in the delicate relationship with infrastructures. The trend of migration towards the city and the expansion of the urban environment produces an increasing erosion of the natural land devoted to agricultural and environmental domains.

During the twentieth century, extensive infrastructure construction operations favored the widespread exclusion, fragmentation, and deskilling of peri-urban agricultural areas, with consequent insufficiency and lack of architectural-spatial and functional quality of spaces for public use.

A second critical issue, which also concerns the last decades, refers to the diffusion of mono-functional zoning areas, the legacy of the modernist season,³⁰ without any connection or reference to places with the formation of new urban centralities and without any logic of continuity with the pre-existing ones. This is the case of numerous motorway junctions designed and built without actually taking into account landscape sensitivity or their strategic functionality, destroying the continuity of ecological corridors. Instead, this approach saturated some agricultural land with tertiary macro-containers – dedicated as distribution centers of large-scale trade and as logistics hubs – and almost always with the poor architectural and environmental quality typical of production and logistics facilities themselves.

Despite this attempt to simplify the critical issues that emerge in the infrastructure-landscape relationship, numerous other elements of complexity should be considered in their long-term effect. It is not uncommon to find uses and reuses, often improper, of the building heritage and the open space close to the infrastructures with a widespread conflict in the use of the land – as well as, on the other hand, the presence of underused and abandoned areas. In cases where the landscape is dedicated to agricultural cultivation, the widespread and invasive presence of network infrastructures is striking, both for mobility and for the transport of energy and the works aimed at its production. Very often, agricultural expanses are superimposed by punctual technical infrastructures that constitute this double-overlapped landscape: the agricultural on one side, and that of the technical networks on the other. For example, the agricultural landscape of the northern Italian region is frequently characterized by a high density of telecommunications infrastructures, including radio and television transmission towers. This has resulted in significant perceptual challenges in certain areas and has had a substantial impact on the health of the local population and its landscapes.

Design Strategies for Promoting Spontaneous Biodiversity

When the relevance of landscape is considered as a self-referential entity, a ring road creates an inevitable caesura in the territory, preventing relationships between the different parts of the urban fabric and the outskirts of the city. Therefore, the mitigation interventions envisaged in the project must be directed at the mending of the territory through interventions on the green-

29 Gianluca Ferriero, "Intrastructures. Scenari Di Densificazione Urbana per La Mobilità in Transizione," PhD Dissertation, Politecnico di Milano, 2018.

30 David Harvey, *La Crisi Della Modernità* (Milano: Il Saggiatore, 2010).

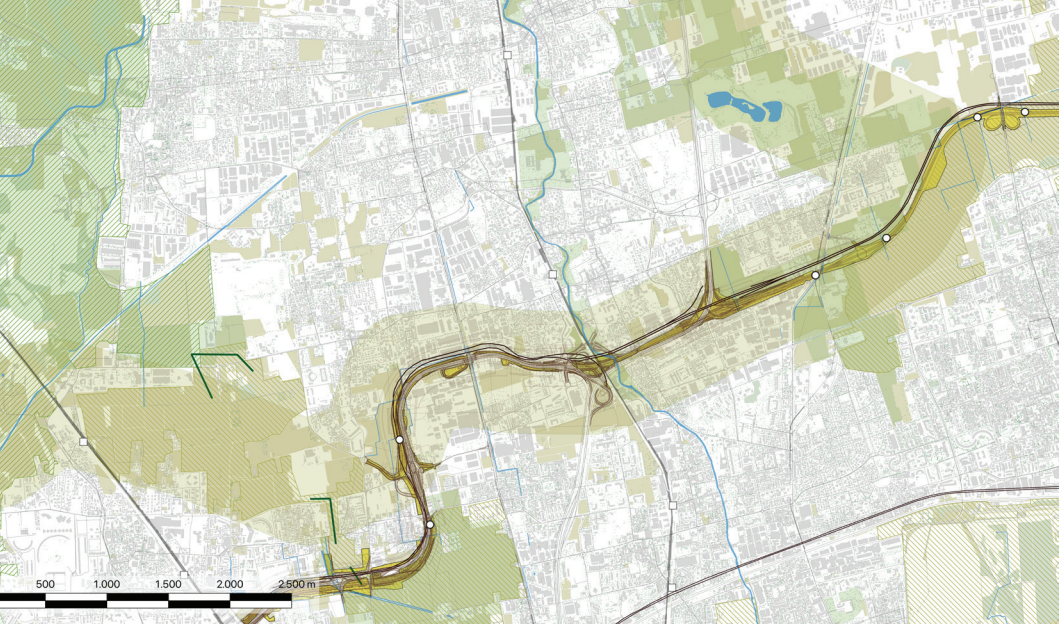


Fig. 3: Green strategic networks in the Rho-Monza section of North Ring Road – Chierichetti Nicolò (2024)

ery, by establishing a relationship with the surrounding landscape and with its historical and environmental values. The motorway concessionaire that operates on the system of the three Milanese ring roads, *Milano Serravalle Milano Tangenziali*, is active and sensitive to the issues of environmental sustainability both with regards to the necessary compensation and mitigation interventions in the case of new works and redevelopment projects of its areas of property not directly occupied by physical infrastructure. Taking the Milanese case as a reference, the intention is to propose different project-approaches sensitive to the landscape and the environment of the motorway matrix – with examples of environmental monitoring, reforestation, and reappropriation of public space.

Rho-Monza environmental monitoring

Of the three ring roads that make up the urban motorway ring of the Metropolitan City of Milan, the A52 North ring road is the one that responds to a more consolidated urban fabric in the close relationship of continuity with the province of *Monza and Brianza* to the north. The stretch of interest is characterized by a landscape covered mainly by roads, warehouses, factories, and houses – with agricultural areas now becoming marginal and closed off between the urbanized areas and the road network. The considerable presence of plants and infrastructure, such as pylons and power lines, shows the plain's intense anthropic transformation.

The environmental characteristics of the plain area north of Milan result from urban sprawling, i.e., disorderly land consumption with deleterious effects on nature and the landscape. This macro-area represents one of the most fragmented sectors in ecological terms on a regional scale due to extreme urbanization and anthropization.³¹ (Fig. 3)

These phenomena produce the fractionation of primary habitats. If they are intense, they lead to a fragmented system between an anthropic matrix, fragments of the natural environment (patches) with different shape-extension and degrees of isolation, and marginal environments (edge habitat). A context of this type does not present natural solid features. Still, in terms of biodiversity and faunal richness, it must be said that urban environments can host even complex animal populations. Many species of birds and mammals can live in the urban ecosystem despite urbanization; this can be active when the species colonize the city from external environments or passive when the city has surrounded the original habitat and progressively isolated

31 Giuseppe Bogliani, Valentina Bergero, Mattia Brambilla, Fabio Casale, Riccardo Falco, Paolo Siccardi, and Matteo G. Crovetto, "Rete Ecologica Regionale" (Milano, 2009).

from neighboring extra-urban habitats. Anthropization leads to the disappearance of species typical of pre-existing environments³² and the increase of generalist ones adapted to living even within small and fragmented territories.

The project, therefore, set itself the objective of monitoring the different components of biodiversity to determine their level of naturalness and spatial distribution. The eight areas of the monitoring plan³³ in the *ante-operam* phase are the underground water environment, surface water environment, atmosphere, fauna, noise, soil, and vegetation. In the area of interest, some points of interest have been highlighted which present a slightly higher level of naturalness, considering the overall context. These micro areas also play a potential role as a refuge for fauna. They are characterized by a greater density of tree and shrub vegetation, which is also about the lowest level of anthropic disturbance.

The analyzed area is surrounded by protected areas, which can act as “biological reservoirs” from which animal species can radiate. The natural areas in question are the *Groane* Regional Park, the North Milan Park, the *Grugnotorto Villoresi* Park, and the *Balossa* Park; these constitute an ecological network that connects the areas of the highest natural value that have remained in the Northern Milanese context. The area of territory that is now crossed by the new SP46 provincial road, in the section from *Paderno Dugnano* to *Rho*, is located in the central-northern portion of the province of Milan, between the highly irrigated plain of the *Villoresi* Canal and the medium irrigated plain characterized by the presence of fountains. As mentioned, it is a highly urbanized territory that hosts a complex system of functions and uses of the land, which is heterogeneous and fragmented due to numerous communication routes. The areas not occupied by anthropogenic uses are included in the outermost urbanization area, near the municipal administrative limits, and have a modest landscape value in absolute terms, even if in the territorial context, they constitute the only areas susceptible of ecological potential. *Groane* Park and North Park protect the remaining significant natural presences, representing exceptional elements in an area with limited open spaces, poor functionality, and ecological continuity. The residual natural vegetation is identified almost exclusively near remaining canals and fountains, such as the *Fontanile Nuovo* and the *Fontanile Novello*. The rare elements of naturalness, such as active irrigation channels, natural watercourses, and arboreal plant associations, even if alien or degraded, are identified in the PTCP documents of the Province of Milan as areas of landscape or natural importance, as they consist of areas characterized by the presence of elements of ecological, landscape or agronomic interest.

Considering the advanced state of the works on the motorway carriageways and, at the same time, the absolute need for a design improvement to effectively mitigate the environmental, acoustic, and visual impact of the project on the population of the affected settlements, the project plans to exploit a large amount of vacant land, overturning the negative concept of waste and degradation areas to instead transform them into an opportunity to naturalize the entire settlement system, creating a green forestry infrastructure along the motorway axis which redevelops the landscape, implements biodiversity and creates visual mitigation and acoustics, as well as ensuring a reduction in air pollution through the absorption of pollutants and CO₂. A significant portion of the arboreal arrangements is planned immediately, with large trees in natural shapes, the formation of meadows, and rich undergrowth. At 23,639 sqm, it equals approximately 13% of all the areas involved. The new plantations are made with native species typical of the lowland forest, guaranteeing the best rooting and maintainability. The plantations already carried out have mostly been preserved and integrated into the new plantations to minimize waste and enhance the ability of the vegetation to respond to the project objectives.

In drafting the project, it was not always possible to reconsider the noise barriers, which determined a visual degradation of the landscape. Wherever possible, near the noise barriers the proj-

32 Michel Desvigne, “The Landscape as Precondition,” *Lotus International* 150 (2012): 20-26.

33 Milano Serravalle Milano Tangenziali, “Sistema Di Gestione Ambientale SGA - Analisi Ambientale Iniziale AAI” (Assago, 2023).

ect envisages the planting of a forest system, including linear ones, which visually mitigates the barrier and absorbs pollutants while at the same time guaranteeing the safety of vehicular traffic as the barrier guarantees protection between the forest and the roadway. It was also impossible to improve the wildlife corridors, which are of particular importance, given the indications of the territorial planning, except for birds. Consequently, the proposed interventions incorporate the original provisions issued by the competent territorial bodies, which emerged during the Services Conference,³⁴ and the committee proposals endorsed by all interested parties, including *Milano Serravalle*, which decided to make them the basis of this project integration. The work achieves a significant positive impact both on the environmental impact of the work during operation and on the capacity for integration between infrastructure and landscape, as well as in terms of environmental mitigation, with substantial parts of the intervention having immediate effect.

The works for the greenery project, therefore, include forestation activities and land movements which create a natural forest system of a particular landscape and environmental strength along the new motorway route, which is more necessary than ever to mitigate the considerable negative impact of this infrastructural work for the populations of the adjacent settlements.³⁵ The landscape insertion of the infrastructure is characterized by the intention of creating a natural green infrastructure parallel to the road infrastructure through the design of urban forestation strips as extensive as possible.³⁶ The project envisages widespread forestation, wherever possible, of the vacant land enclosed between the junctions and, above all, of the strips between the motorway route and the industrial, commercial, and residential settlements.³⁷ Where areas of sufficient size are available, in correspondence with the settlements, the project envisages further mitigating the impact of the motorway route with the creation of vegetated dunes, blocking or at least reducing the exposure of residential areas, the view of the infrastructure, and creating effective environmental mitigation. For the *Seveso* stream, while keeping the slopes free for maintenance purposes and to preserve the dimensions of the riverbed in consideration of the severe hydraulic problems of the stream, we proceeded with the same criterion as in the other areas; however, preparing hygrophilous woodland vegetation was considered.

The same forestation strategies were adopted regarding the presence of the railway route and maintaining the criteria already used for the motorway infrastructure. The environmental insertion interventions of the project route involve the creation of an ecological unit consisting of an urban forest, which is strengthened thanks to the additional areas in the town of *Paderno*. The plant species adopted in the typological composition are typical of the territorial context concerned, which is ensured by using local species of trees and shrubs. Persistent leafy or evergreen vegetation has been enhanced to some extent, with some cases of using conifers to improve the masking of the infrastructure in all seasons.

The project follows the Environmental Impact Assessment (EIA) Guidelines prepared by the Ministry of the Environment and Land Protection in 2001³⁸ regarding the objectives of proposing the revegetation of all available surfaces or revegetation on the roadside wherever possible.

All interventions are, therefore, mainly located in roadside buffer zones - equipped with the space necessary for their maintenance - or in areas closed off by road works, in smaller rem-

34 The services conference is an institution of Italian legislation for the simplification of the activity of the public administration of the Italian Republic. It aims to facilitate the acquisition by the P.A. of authorizations, deeds, licenses, permits and authorizations or other elements however denominated, by calling collegial meetings (so-called conferences) also aimed at issuing an administrative measure. It can be seen both as a procedural module for simplifying a procedure and as a tool for coordinating the interests involved, in order to weigh them and aggregate them.

35 Milano Serravalle Milano Tangenziali, "Interventi Di Sistemazione."

36 Techfam, "Forestami - Progetto Di Imboschimento Comune Di Milano. Area Cantalupa" (Milano, 2020).

37 Odile Decq, Dennis Lago, Joerg Reikittke, Luisa Calabrese, Francine Houben, and Paul Meurs, eds., *Mobility: A Room with a View* (NAI Publishers, 2003), 419-30.

38 "Valutazione Impatto Ambientale" [Environmental Impact Assessment Procedure], Ministry of Environment and Land Protection, 2001.

nants of land – challenging to return to their initial function – or in areas occupied in *ante-operam* from road sections – to be dismantled during the design phase (*reliquati stradali*) – or in the land closest to the planned infrastructure and intended, according to the provisions of the urban planning instruments in force, for greenery or public services, subject to agreement with the Municipality concerned.

Urban forestry

Another type of intervention on the motorway landscape relates to forestation and reforestation operations. The objective of the intervention project is the protection of the metropolitan habitat through interventions to reduce the environmental impact of infrastructures and anthropic activities, with an active action aimed at rebalancing the landscape-environmental system on a territorial scale. The aim is to restore a unitary image of the route of the Milanese ring roads in dialogue and direct comparison with the surrounding landscape, capable of involvement in the renewal of even territories not directly managed by *Milano Serravalle Milano Tangenziali* through an integration and re-naturalization project. In the peri-urban context, forestation interventions in areas located along communication routes, in highly natural residual habitats, represent significant opportunities to activate environmental mitigation and rebalancing processes, capable of contributing to the implementation of policy coordination plans of the government for the environmental reorganization of the entire Milanese metropolitan area. It is, therefore, intended to create, along the motorway route, a system of environmental interventions aimed at mitigating the impact of the infrastructure, enriching the environmental value of the areas around the ring road, and reconnecting the areas of intervention with the territory while also serving as an amplifier of environmental values and characteristics of existing parks.

The intervention aims to mask, mitigate, and naturalize the elements by inserting masses of shrubs, hedges, and rows to punctuate and emphasize the sequences,³⁹ slopes, and trees' masses with a screen and filter function. These objectives were pursued by identifying repeatable typological schemes⁴⁰ along the route, identifying areas of intervention with similar characteristics, including portions of urbanized areas and inhabited centers, open areas, open areas with pre-existence of systems of shrub hedges and rows of trees, areas with the presence of wooded areas, tree and shrub patches, areas with watercourses and wetlands, junction and junction areas, and lawn sectors. The functions that project shrubs perform are biological filter, consolidation, anti-erosion, and consolidation functions.

Reliquati stradali. Sustainable mobility as urban and landscape regeneration

Considering the approach provided by the conspicuous environmental intervention for the construction of the *Rho-Monza* in the city of *Paderno Dugnano*, some of the publicly owned spaces that are not actively used but could constitute a green infrastructure are the residual spaces of the infrastructures. These spaces, the result of the planning system and the properties of the Italian territory, are also known as road relics, i.e., all those portions of territory that are part of the ownership of the local authority but not exploited for mobility.

Two research and design projects are currently active in this specific area within the concessionaire company *Milano Serravalle Milano Tangenziali*. The first is the ReMi-Se⁴¹ project, which aims to provide some preliminary indications on possible redevelopment interventions for ecological purposes, such as improving ecological functionality and masking landscape-environmental detractors with subsequent studies. The project is also developed in close relationship

39 Donald Appleyard, Kevin Lynch, and John Myer, *The View from the Road* (Cambridge: MIT Press, 1964).

40 Bernardo Secchi, *On Mobility. Infrastrutture per La Mobilità e Costruzione Del Territorio* (Marsilio, 2010).

41 Fondazione Lombardia per l'Ambiente (FLA), "Progetto ReMi-Se. Recupero e Miglioramento Ambientale Dei Reliquati Di Milano Serravalle" (Milan, 2024). The acronym stands for Reliquati Milano Serravalle, as Milano Serravalle's residual spaces.



Fig. 4: Selection of infrastructural residual spaces along Milan Ring Roads, orthoimages. Google Earth (2024)

with the *Piantalati*⁴² association, which collaborates with FNM⁴³ and the Lombardy Foundation for the Environment as part of FNM's broader FILI program.

The intervention shares the starting point and objectives with another doctoral research project that the company and the Polytechnic of Milan co-financed. The project "Sustainable Mobility as an Opportunity for Urban and Landscape Regeneration," active within the PhD in Architectural Urban and Interior Design of the Department of Architecture and Urban Studies (DAS-tU), starts from an initial analysis of the road relics owned by *Milano Serravalle*, to attempt to integrate these spaces into a broader strategic framework of the redevelopment of the Lombardy territory and landscape re-composition.

The areas can be preliminarily classified into two macro-categories. The first includes all the surfaces, as single areas or systems, in which it is possible to hypothesize interventions to improve the ecological functions and systematize a green infrastructure conceived as a whole; the second category instead includes all the areas, especially single ones, which due to their morphological and context configuration do not allow an immediate connection with the neighboring landscapes, as in the case of areas closed off by motorway junctions or by a consolidated built fabric. (Fig. 4)

The project's initial phase involves the return of all the areas available for transformation, which, therefore, include the property areas identified as motorway buffer zones and the residual or relict road spaces, in synergy with the regions identified by the urban planning instruments as areas for urban regeneration. The systematization of all these spaces that encounter the ring road infrastructure has made it possible to return a complete taxonomy of the potential regions grafted onto the Milanese ring road network in analytical sheets.

42 *Piantalati* is an initiative created by *Trenord*, concessionaire for the railway lines in the north of Milan, as part of the FILI urban regeneration project, which aims to propose planting and reforestation interventions on uncultivated green areas adjacent to stations and tracks.

43 FNMGroup is the main integrated group in sustainable mobility in Lombardy – motorway and railway concessionaire.

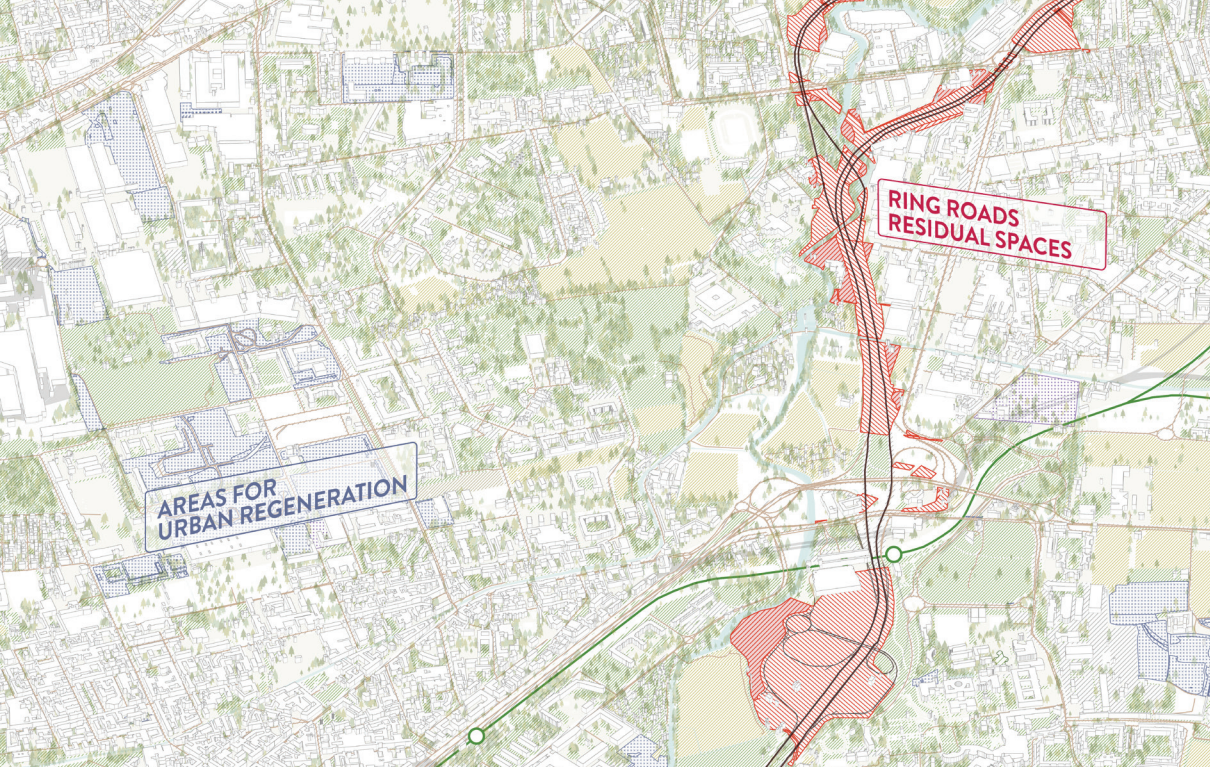


Fig. 5: Highways' Urban Voids as Urban Regeneration Spaces. The node of Cascina Gobba in A50 and A51 Milan Ring Roads – Chierichetti Nicolò (2024)

It is also important to underline how this potential green infrastructure does not only have a relationship with the physicality of the roadway but also with various heterogeneous systems that characterize the contemporary city. In this sense, it is essential to intersect the road system with the existing ecological network and other infrastructures and mobility networks and their relative contributions to interference and articulation of space. (Fig. 5)

The construction of a possible taxonomy of the residual spaces close to the infrastructure was configured through the definition of some possible indicators to evaluate the different characterizing components of these spaces and try to reconstruct families of landscapes comparable to each other and experienced as a continuous system. In addition to some more sectoral investigations, such as those referring to transits and the interconnection of these spaces with the ordinary road system, the road relics were meticulously classified according to the criteria of territorial extension, spatial distribution, relationship with the infrastructure, consistency of the land, current use of the space, and relationship with other identified surfaces. The overall vision of this cognitive framework has therefore made it possible, on the one hand, to systematize, in informative terms, a heritage currently fragmented along the Milan Ring Roads network - and on the other, to allow us to identify some landscapes and typological systems on which we can propose design experiments to enhance the landscape.

The attempt to be the subject of the next phase of design experimentation will be to propose a design atlas of possible strategic interventions for valorizing and mending fragmented spaces, starting from the definition and choice of the most representative situations. It is important to underline how the objective of these design probes will not only refer to the quantitative prescriptions of compensations and mitigations regulated by law but will respond to a possible re-appropriation of land as the restitution of an environmental and ecological heritage that responds to a network and a broader system, and not to a superimposed function due to industrial development and private mobility. In the long term, but with the need to start its definition now, it is essential to prepare which interventions - reparative, regenerative, and valorization - can be implemented to redevelop the relationship of the urban fabric with the infrastructures and vice versa. (Fig. 6)

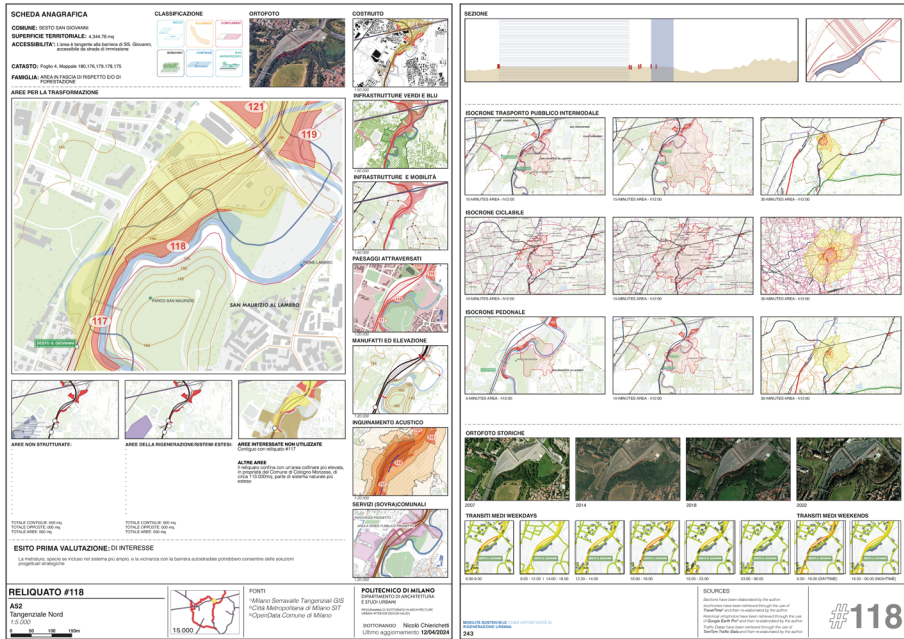


Fig. 6: Analysis card on an Infrastructural Residual Space. The node of Sesto San Giovanni – Chierichetti Nicolò (2024)

Conclusions. Call for Action for Sustainable Highway Landscapes

Although the projects presented are still in the start-up phase or are in progress, some of these experiments may present some best practices and guidelines to consider in designing new infrastructures and the redevelopment processes of already consolidated ones.

First of all, the adoption of defragmentation measures is now fundamental, aimed at stemming the subdivision of habitats into non-communicating areas and, in general, interference with the dynamism of fauna – such as the extension of viaducts – with the construction, for example, of overpasses (ecological bridges) for macrofauna and interventions to mend ecosystems and environmental corridors, where possible. The revegetation of available surfaces, for example in the shape of *reliquati stradali* as the Italian motorways' residual spaces, is another of the primary objectives that contemporary infrastructures must keep in mind in dealing with such borderscapes: this, therefore, includes all the surfaces that are part of the infrastructure project and which constitute the physical separation of entire portions of territory or interruption of the continuity of habitats, networks ecological and ecosystems (such as trench slopes, embankments, release areas, construction site areas, and tracks, etc.), both for functional reasons (anti-erosion and stabilization in general), and for ecological reasons of reconstitution or ex novo formation of habitats, and for significant critical landscape issues. In such cases, i.e., for the surfaces of the slopes (both in embankments and trenches), it is advisable to include the filling of topsoil, the formation of herbaceous cover, and the planting of shrub and tree species compatible with the local micro station conditions. In the distribution of plant elements, it will also be necessary to avoid interference with the functions of the project infrastructure, such as interference with the roadway due to abnormal vegetation development and inappropriate attraction of fauna with edible species placed too close to the road.

Where, however, forestation of a continuous area is not possible, and therefore where the intervention can be limited to road-side reforestation of the relevant regions along the road fronts, the minimum intervention is that of “buffer” vegetation bands with “filter” functions to mitigate visual intrusion, atmospheric and light pollution and encourage the definition of linear green infrastructure. It is also essential to prefer areas external to the road surfaces to avoid the ecological trap and road-kill effects.⁴⁴ Instead, one must prefer contiguous and open regions consistent with the agricultural systems. All mitigation and compensation interventions must, in principle, avoid excessive acquisitions of land, foreseeing their localization mainly in the road buffer zones - accompanied by the space necessary for their maintenance - in the areas closed off by road works, in the remnants of smaller dimensions - challenging to return to their initial function - in the occupied regions before construction by road sections and to be dismantled during the planning phase, in the lands closest to the planned infrastructure and intended, according to the provisions of the urban planning instruments in force, to green areas or public services, subject to agreement with the Municipalities concerned.

In terms of landscape redevelopment guidelines, it is also worth underlining the importance of having synergy with the definition of a transparent morphological system, for example, with the conservation and redesign of open spaces – according to a systemic and multifunctional organization – as a contribution to the construction of a local level green network capable of giving continuity to the larger scale green network, and in particular:

- by conserving, protecting, and enhancing the elements of the natural system and assigning them a structuring role;
- redeveloping the water system as an integral component of landscape;
- attributing a high environmental and landscape quality to existing and planned public green areas;
- strengthening the spatial organization of the agricultural landscape, especially in cases where this is still strongly interconnected with the sizeable rural space, preserving and encouraging traditional cultivation arrangements, and promoting specific programs for agriculture in peri-urban areas.

Secondly, by strengthening the design of urban regeneration proposals with the redevelopment of the urban fabric, and in particular:

- preserving and enhancing a structuring value to the pre-existing landscape features – therefore encouraging an integrated approach – to have morphological and architectural design proposals that acknowledge a subordinate order toward the landscape;
- defining spatial relationship hierarchies between the different polarities, new and pre-existing, when dealing with re-constructing ecological networks and greater parks;
- preserving the “distant views” as indispensable spatial values and taking care of the architectural interfaces towards the open landscape;
- orienting mitigation interventions toward achieving environmental sustainability objectives;
- with the recovery and valorization of degraded, underused, and abandoned areas for landscape, fruition, and ecological purposes.

Therefore, now more than ever, it is necessary to carefully plan the new development master-plans for a clear and robust definition of the landscape system in terms of fostering correlation with the historical territorial and agricultural pre-existences, with specific attention to the areas of transformation and the complete valorization of landscape quality. Therefore, the role given to the landscape of the motorway must go beyond the marginality attributed to it up until now and must instead take on a structuring and significant value as an integral part of the qualitative elements of the open space, overcoming its current understanding as either a border of the open landscape, or a border of the more traditionally experienceable spaces of the city.

44 Roadkill refers to wild animals that have been killed by collision with motor vehicles.

BIBLIOGRAPHY

- Appleyard, Donald, Kevin Lynch, and John Myer. *The View from the Road*. Cambridge: MIT Press, 1964.
- Arboleda, Martín. 'In the Nature of the Non-City: Expanded Infrastructural Networks and the Political Ecology of Planetary Urbanisation'. *Antipode* 48, no. 2 (6 March 2016): 233–51. <https://doi.org/10.1111/anti.12175>.
- Berlingeri, Fabrizia. *INTERSECTIONS AND AMBIGUITY. Urban Infrastructural Figures of the European Metropolis*. ListLab, 2018.
- Bogliani, Giuseppe, Valentina Bergero, Mattia Brambilla, Fabio Casale, Riccardo Falco, Paolo Siccardi, and Matteo G. Crovetto. 'Rete Ecologica Regionale [Regional Ecologic Network]'. Milano, 2009.
- Brambilla, Chiara. 'Exploring the Critical Potential of the Borderscapes Concept'. *Geopolitics* 20, no. 1 (2015): 14–34. <https://doi.org/10.1080/14650045.2014.884561>
- Bresciani, Chiara. *Urbanistica e Mobilità: Regole e Innovazione*. Roma: Aracne, 2007.
- Cesaris, Alessandra De. 'Infrastrutture e Paesaggio Urbano'. *L'industria Delle Costruzioni. Rivista Tecnica Dell'ANCE*, no. 408 (August 2009): 4–19.
- Città Metropolitana di Milano. Piano Territoriale Metropolitan. Allegati alle norme di attuazione, Pub. L. No. Art. 46 comma 1 (2020).
- Crowe, Sylvia. *The Landscape of Roads*. London: Architectural Press, 1960.
- Decq, Odile, Dennis Lago, Joerg Rekitke, Luisa Calabrese, Francine Houben, and Paul Meurs, eds. *Mobility: A Room with a View*. NAI Publishers, 2003.
- Desvigne, Michel. 'The Landscape as Precondition'. *Lotus International*, no. 150 (2012): 20–26.
- Ferlegna, Alberto, Marco Biraghi, and Benno Albrecht, eds. *L'architettura Del Mondo. Infrastrutture, Mobilità, Nuovi Paesaggi*. Milano: Editrice Compositori, 2012.
- Ferriero, Gianluca. 'Intrastructures. Scenari Di Densificazione Urbana per La Mobilità in Transizione'. Doctoral Dissertation, Politecnico di Milano, 2018.
- Fondazione Lombardia per l'Ambiente (FLA). 'Progetto ReMI-Se. Recupero e Miglioramento Ambientale Dei Reliquati Di Milano Serravalle.' Milan, 2024.
- Gilles, Clement. *Manifesto Del Terzo Paesaggio*. Macerata: Quodlibet, 2004.
- Grazia, Luca Di, and Silvia Goldoni. 'Entrare a Milano : Dall'anello Delle Mura a Quello Delle Tangenziali'. Master of Science dissertation, Politecnico di Milano, 2000.
- Harvey, David. *La Crisi Della Modernità*. Milano: Il Saggiatore, 2010.
- Milano Serravalle Milano Tangenziali. 'Interventi Di Sistemazione a Verde Progetto Esecutivo (A50,A51,A52). Relazione Generale'. Assago, 2013.
- — —. 'Sistema Di Gestione Ambientale SGA - Analisi Ambientale Iniziale AAI'. Assago, 2023.
- Ministero dell'Ambiente e della Sicurezza Energetica. Rete Natura 2000 (2023).
- Repubblica Italiana. Alberature stradali. Istruzioni per la salvaguardia del patrimonio arboreo in rapporto alla sicurezza della circolazione stradale [Street trees. Instructions for the protection of the tree heritage in relation to road traffic safety], Pub. L. No. 8321 (1966).
- — —. Espropriazioni per causa pubblica [Expropriation for Public Utility], , Pub. L. No. 2359 (1865).
- — —. Rapporti massimi tra gli spazi destinati agli insediamenti residenziali e produttivi e spazi pubblici o riservati alle attività collettive, al verde pubblico o a parcheggi [Maximum ratios between spaces intended for residential and productive settlements and public spaces or spaces reserved for collective activities, public green areas or car parks], Pub. L. No. 1444 (1968).
- Secchi, Bernardo. *On Mobility. Infrastrutture per La Mobilità e Costruzione Del Territorio*. Marsilio, 2010.
- Smets, Marcel, and Kelly Shannon. *The Landscape of Contemporary Infrastructure*. NAI publishers, 2010.
- Solà-Morales Rubió, Ignasi. 'Terrain Vague'. In *Anyplace*, 118–23. Cambridge: MIT Press, 1995.
- Techfem. 'Forestami - Progetto Di Imboschimento Comune Di Milano. Area Cantalupa'. Milano, 2020.

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