



Networks, Cycles and Urban Metabolism. Mapping Critical Environment: Giugliano in Campania (Naples) as a Case Study

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ABSTRACT

The waste areas in Giugliano intercept the continuity of infrastructure networks and the reticular dimension of ecological connections, returning a porous structure that crosses the urbanized areas. This condition inevitably overlaps the processes of land consumption still in progress. The process aimed to map this critical condition was based on the interaction of some analytical-specialist readings from different sources using multiple GIS tools. The process results are represented in a system of integrated maps that provide data relating to the crisis of five life cycles (ecosystems, production cycle, waste cycle, infrastructure and urban fabrics). These dynamics give us a heritage of socially, ecologically and economically disadvantaged landscapes with immense potential for adaptation, reuse and recycling projects. The research has revealed a distinctive geography of place, even at a larger scale, where materials and relationships constitute the structure of the territory. The contribution presented was intended to recount a process of knowledge and planning for an emblematic territory such as Giugliano in Campania, in which the role of mapping critical landscapes that become potential materials for a project of adaptation, reuse and recycling is central. To overcome the current critical situation, it is essential to recover the environmental frames still capable of narrating the territory and use them as a strategic resource for the creation of new urban landscapes and for a Strategic Plan focused on regeneration.

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1. Introduction: The Landscape of Giugliano as an Interpretive Device

The Domitio-Flegreo Coastal Plain plays an important role as a connecting link between the conurbation north of the Metropolitan City of Naples and the dispersed city (Indovina, 1990) to the south of Caserta. The city of Giugliano in Campania is strategically located right in the center of this vast territorial nexus. The municipality is home to 123.697 inhabitants and covers an area of 94.62 square kilometers. It is the second-largest municipality in the Province of Naples in terms of population size and

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the third largest in the Campania region, following Naples and Salerno. Nationally, it is the most populous non-capital municipality after Cesena in Emilia-Romagna.

From a morphological perspective, the Coastal Plain slopes gently towards the extensive coastal strip from east to west, where significant archaeological and natural heritage sites are concentrated, and sporadic low-density settlement expansion has occurred. In contrast, the eastern quadrant features a highly urbanized and infrastructural territory, characterized by distinct environmental and functional diversities. In between lies the vast plain, marked by the strong grid pattern of historical agricultural design.

Within the area of the city of Giugliano, three major urban areas can be distinguished, each with distinct landscape and settlement characteristics: (1) the consolidated urban center, (2) the extensive central agricultural plain, and (3) the coastal strip corresponding to the Licola Mare fraction:

1. The first area, the consolidated urban center, is one of the most densely populated portions of the northern peripheral expansion of Naples, characterized by a fragmented fusion of urban centers from different municipalities. These centers predominantly serve residential purposes with limited urban features, face significant problems of insufficient internal infrastructure and service provision and exhibit a strong dependence on the regional capital. In this context, the settlement of Giugliano, in line with the typical urban growth process of rural nuclei in the province of Naples, is structured around its historic urban center, which is based on certain strong traces of Roman centuriation. The settlement has experienced recent expansions along the main communication routes radiating from it towards Naples, Caserta, Acerra and Casoria, Quarto, and the coastal areas, incorporating some important former administrative fractions.
2. The second identified area is part of the agricultural plain of Aversa, to the east of the populous fractions of Qualiano and Villaricca. It corresponds to an extensive, fertile, sparsely inhabited agricultural plain punctuated by farmsteads, rural buildings, and single-family residential structures. It is crisscrossed by a dense network of drainage channels and artificial canals inherited from ancient and recent water reclamation and regulation processes. This network extends up to the coastline, traversing a significant portion of the Giugliano territory and guiding the layout of its agricultural patterns (farm roads, inter-farm roads, cadastral plots, boundaries). After reaching certain artificial watercourses and the Regi Lagni, this network flows north of the Lago Patria coastline, while to the south, after intersecting the main drains of the "Canale di Quarto" and the "Alveo dei Camaldoli", it reaches the sea between the Varcaturo estuary and the Lido di Licola, at the center of the Domitio coast. This landscape is characterized by sequences of cultivated fields (orchards, tomatoes, legumes, artichokes, beets, and other fresh produce) and intensive greenhouse production (strawberries, kiwis, early crops), representing fertility, productivity, and intensity in agricultural production cycles, which are now at risk due to the pervasiveness of water and soil pollution processes.
3. The third area, the Domitio coastal strip, although smaller in size compared to the previous ones, is characterized by its distinctive natural and historical-settlement features. Morphologically, it is defined by the presence of dune systems and the historical water patterns that have shaped it. Within this area, the main archaeological resources are concentrated, such as the remains of the ancient Roman city of Liternum near the southern shore of Lake Patria, as well as the historic-architectural resources, consisting of a significant number of farmsteads scattered throughout the territory. From a naturalistic perspective, the coastal area is primarily characterized by a low, sandy coastline, where surviving sections of the coastal dune coexist with extensive pine forests and dense Mediterranean scrubland, albeit suffering from progressive soil erosion, abandonment, and frequent fires. This area has experienced widespread residential expansion with villa and apartment subdivisions, creating isolated and single-function settlements, such as Varcaturo, during the 1980s and 1990s. Over time, these settlements have been subject to real estate dynamics and social transformations that tend to exacerbate phenomena of

degradation. The northern sector of this area is characterized by the presence of the natural water body of Lake Patria, with its interesting ecosystem now compromised by significant water pollution and the presence of low-density residential development occupying a large part of the south-eastern shoreline.

By crossing and observing this vast area today, one can notice that it is the result of a long process of alteration and stratification, which experienced a rapid, diffuse, and confused development on the territory in the second half of the 20th century, lacking any political and design strategic vision. This process has inevitably led to the growth of new and dramatic inequalities, giving rise to new forms of social injustice that increasingly overlap with spatial injustice (Secchi, 2013). The consequences of these dynamics dangerously intertwine with the outcomes of the waste cycle crisis, land consumption, disposal and abandonment of tourist-accommodation properties, etc., resulting in a sudden and structural change in the urban metabolism of these places. They have moved away from the images of Campania Felix and are now represented in the media through the stigma of the "Land of Fires".

The reflections presented in this contribution were developed during the preparation process of the Preliminary Urban Plan (PUC) of the City of Giugliano in Campania. This process necessitated a multiscale approach, attempting to bring together the multiplicity of information and resources present in such a stratified and complex landscape, one that encompasses many of the issues that can be found in cities today. The complexity of these territories requires a transformation in the approach to knowledge for those who observe them, in which the landscape plays a central role as an interpretive device. This involves intersecting various modes of investigation, such as field visits and direct experiences, engaging with the communities that inhabit these places without prejudice, as well as collecting data through digital platforms provided by specialized studies, systematized within a GIS environment and processed using other digital tools (Terracciano, 2017). For these reasons, this study is part of a much broader spatial planning context, with the ambition to contribute to the ongoing debate in the field. These reflections can have a tangible impact on spatial planning processes in other urban settings. Through a multidisciplinary approach and in-depth case study analysis, this research offers new perspectives and practical solutions to contemporary urban and environmental challenges.

2. The context: Ecological-environmental and social impairment

The territory of the municipality of Giugliano is completely contained within the Site of National Interest (SIN) "Litorale Domitio Flegreo e Agro Aversano", established by Ministerial Decree of 10 January 2000 according to Law 426/98 and comprising 59 municipalities, to which a further 18 were added by two subsequent Decrees (Ministerial Decrees of 8 March 2001 and 31 January 2006), in the Provinces of Naples and Caserta.

As also reported by ARPAC, based on the provisional perimeter Decrees, within the perimeter of a SIN the surface area, regardless of the exceeding of the Contamination Threshold Concentrations (CSCs) in the individual areas, is potentially contaminated and as such, subject to the clean-up procedure. This site has identified about the danger of exposure to health and ecological risks about the extension and population density of the area and provides for sub-perimeter, characterization and reclamation procedures according to the laws in force (Title V "Remediation of Contaminated Sites" of the Fourth Part of Legislative Decree 152/06, art. 252). The spatial consequences of the previous economic crises are still clearly visible today, and here more than elsewhere they also intercept the crisis of the waste cycle and land consumption. For years, this area has not only been at the center of the state of emergency for the waste cycle crisis - declared in Campania on 11 February 1994, which lasted until 31 December 2009 and was led by no less than ten different extraordinary commissioners - but has also been the subject of illegal disposal operations of special waste, leading to the deep and widespread pollution of the territory. The data reported by studies are alarming: in the last 30 years, 13 million tonnes of waste have been disposed of in Giugliano, either legally or illegally.

This system of deep pollution is intertwined with widespread practices of abandoning waste that invades agricultural fields, road junctions, canals and infrastructure buffer zones and whose disposal has taken place and continues to take place through fires in various parts of the territory, producing large quantities of dioxin that spread through the air and surface waters to neighboring lands. In addition to these compromises to the environmental quality of the agricultural landscape, there are also unplanned urbanizations that contribute to the fragmentation of the agricultural matrix.

Following the entry into force of Ministerial Decree 11/01/2013 (Approval of the list of sites that do not meet the requirements of paragraphs 2 and 2-bis of Article 252 of Legislative Decree 3 April 2006, no. 152 and that is no longer included among the remediation sites of national interest, GU Serie Generale no. 60 of 12-03-2013), the "Litorale Domitio Flegreo and Agro Aversano", the "Bacino Idrografico del Fiume Sarno", the "Litorale Vesuviano and Pianura" areas were excluded from the list of SINs. Thus, the "Litorale Domitio Flegreo and Agro Aversano" site to which the municipality of Giugliano in Campania belongs has become a regional site and is therefore designated as a SIR (Site of Regional Interest) .

For the sub-perimeter sites within these ex-SINs, which have not yet been subjected to environmental investigations, the Campania Region has established the obligation to carry out preliminary investigations (Executive Decree no. 796 of 09/06/2014). With D.G.R. no. 417/2016 (Approval of the Technical Implementation Regulations (NTA) of the Regional Land Reclamation Plan) the "Guidelines for the preparation and execution of preliminary investigations" were defined, aimed at ascertaining the presence of pollution in the environmental matrices affected by an event that could contaminate them. As reported in the 2013 and 2019 Regional Remediation Plan, the criteria for carrying out preliminary investigations are differentiated according to the type of sites and the size of the areas to be investigated and concerns:

- Landfills.
- Disused or abandoned mining activities.
- Waste treatment plants; active and abandoned production activities; RIR industries.
- Hydrocarbon storage sites, active and abandoned fuel outlets.

The geographic location of the census of potentially contaminated CSPC sites in the former SIN allows the identification of a series of areas, defined as Vast Areas (AV), in which the existing data suggest that the environmental situation is particularly compromised due to multiple polluted and/or potentially polluted sites. Within the 2013 and subsequent 2019 Remediation Plan, no. 7 Large Areas, including one in the territory of Giugliano in Campania: Area Vasta Masseria del Pozzo-Schiavi, for which, as for each vast area, within the 2019 Land Reclamation Plan, a sheet was drawn up in which the identification data of the site, the cartography with its location, the description of the component sites of the area, a summary of the available past investigations, the current state of the activities and the interventions to be implemented are reported, from which the simultaneous presence of two or more waste disposal sites, for which the various investigations carried out over time have highlighted contamination situations, can be inferred.

«The territory of the municipality of Giugliano is affected by 113 potentially contaminated sites covering a total of 6.75 km², which represents approximately 8% of the Giugliano territory. The most impactful potentially contaminated sites from an area viewpoint are the quarries and landfills in the area. Among the contaminated sites at Loc. San Giuseppiello, Masseria del Pozzo - Schiavi dumps, the former Resit dump (Quarry Z, Quarry X) and Novambiente S.r.l., remediation work has been started but has not been completed. Of the entire potentially contaminated area, the only site with advanced reclamation works is the one in the San Giuseppiello area». In addition to these contents, which mainly affect the areas of the large agricultural plain and those of the coastal strip, there are also critical issues related to soil subsidence phenomena mainly present in some areas of the Historic Centre.

As several recent studies testify (Greenpeace, 2019), agriculture itself is not only a victim of this serious environmental situation, but is also partly responsible for it, not only because of the excessive use of synthetic chemicals, not entirely absorbed in the vegetative cycle, contributes to the contamination of air, water and soil, but also because the actions aimed at improving the usable agricultural species have in many cases forced the dynamics of regeneration of natural resources.

As regards the surface and underground water systems in the municipality, they too are characterized by a rather evident level of pollution. For the surface water system, the main critical issues are related to the Quarto canal, the Camaldoli bed and Lake Patria. For the Quarto canal and the Camaldoli bed, the presence of sewage and wastewater spills are proven, while for Lake Patria, the level of pollution is defined by the poor state of the waters in the classification for transitional waters that emerged from the surveys conducted by ARPAC. Moreover, the criticality of surface waters is not only related to their quality but also to flooding phenomena that characterize the Camaldoli riverbed in some places. This criticality is evident in the hydraulic risk tables contained in the "Piano Stralcio per l'Assetto Idrogeologico" of the former Central Campania Basin Authority, now merged into the Southern Apennines District Basin Authority.

The critical issues related to the groundwater system emerged through various measurement and monitoring campaigns of well water, which found exceedances of the permitted levels of certain pollutants, especially in the vicinity of landfills in the area. To summarise, the entire system of groundwater and surface water, of the soils directly exposed to polluting factors and those in any case affected by the transport of these factors through run-off, emunition and water absorption, to be affected by this general impairment process.

In addition to these crisis conditions of the water and soil system, there is also a particularly critical condition of erosion for the coastal strip, which is extremely anthropized due to the uninterrupted presence of bathing facilities and residential structures (Marina di Licola), which have contributed considerably over time to make the dune and back-dune ecosystem and the connected wetlands extremely fragile. The study of the evolutionary trend of the coastal sector, carried out within the framework of the "Piano Stralcio per la Difesa delle Coste" PSDC of the former North-Western Campania Basin Authority 2008 and the Coastal Erosion Plan of the Liri Garigliano and Volturno River Basin Authority, testifies to the evolutionary dynamics of the coastline and its progressive and inexorable erosion.

In this framework, the levels of vulnerability of urban areas due to the impacts of climate change (intense rains, heat waves, sea storms, etc.) remain to be investigated. Among the main factors that certainly need to be pointed out and analysed are the limited permeability of urban soils, due to the prevalence of asphalt surfaces over permeable ones, the lack of maintenance of current drainage and rainwater collection systems, as well as the meager and fragmented presence of green areas, and the poor quality of the construction materials used. An effective knowledge of the characteristics of the vulnerability of urban settlements to the various hazard factors induced or increased by climate change is indispensable not only to assess effective measures to guarantee their safety, but also to orientate choices in terms of regeneration and improvement of living conditions in urban contexts.

For these reasons, risk prevention and mitigation strategies must be based not only on the knowledge of the single factors of impairment, vulnerability and danger of natural and anthropic origin, but also on their reciprocal and possible interactions (See all the analysis papers of the Giugliano Environmental System: Water, geomorphology and natural and anthropised landforms; Water and evolutionary dynamics in land design; Land consumption and dynamics of vegetation cover; Urban metabolism and waste areas; Aggregate risks.

3. Material and Methods: methodology and objectives of the case study

This contribution aims to show the outcomes of the narrative of the Giuglianese landscape features. This work has been a complex process, characterized by a multi-scalar dimension, the outcome of the interaction and multi-disciplinary convergence between different areas of knowledge that have made it possible to construct an up-to-date picture of the territorial structure, the vegetal landscapes, the evolutionary dynamics of land use and consumption, the areas of environmental criticality and, more generally, the outcomes of urban metabolism and the more or less virtuous functioning of the city itself.

3.1. Tools

In planning processes, one must deal with the management of an imposing and heterogeneous mass of data to be superimposed and intersected to identify areas suitable or not suitable for a particular type of resource management and to understand where to implement certain plan choices. This method made a big breakthrough in the 1970s, when landscape architect and planner Ian L. McHarg developed a suitability analysis using a thematic overlay mapping technique he called Overlay Mapping (McHarg, 1969). Although this operation allows for the measurement, mapping, monitoring and modeling of land, as well as having the capacity to generate new data as a product of existing layers - particularly with the advent of GIS, which ushered in the era of computer-aided mapping - the maps and mappings obtained are very often inaccurate or incapable of capturing significant data streams leading to imperfect or false conclusions (Bailey, 1988). The overabundance of information, using super-clear and dense maps, in the superimposition of measurable and integrable thematic maps, however, generates problems for which the excess of certainty generates a simplification of the map, up to the construction of passive cartographies produced automatically by remote sensing, which however lack a critical reading, so that in the absence of a selection, these maps end up returning a selective and incomplete view of reality (Monmonier, 1991).

It is from this awareness that this research has endeavoured to build a methodology that involves a constant interaction between the virtual database in a GIS environment and the physical space of places. A continuous oscillation between the technical control of the data and the verification in the field, through visits and dialogue with the local communities. This method allowed us to organise and control all the information bases useful for the development of the research work, starting from the open-data portals to the incorporation of the geographic information layers by the competent bodies in the area, up to those of the specialised studies drawn up expressly for the Urban Plan of Giugliano. This procedure allowed us to combine different techniques and languages within a process of construction and manipulation of data, at different levels and scales, to bring out a drawing with a dry and essential language, capable of highlighting the characterised materials and latent questions of this territory that finally find form within evocative figures. The drawn figures tell some of the stories and dynamics of the landscapes of the Litorale Domitio-Flegreo and the Giuglianese area. These narratives convey not only the processes of territorial transformation from an environmental and morphological point of view but also and above all the socio-economic changes that have led to the crisis of certain cycles of life, such as that of production, waste, infrastructure and urban fabric. These dynamics are investigated in the form of layers of the GIS database, which constitutes a container of information in constant relation to each other, whose convergences and dissonances proactively suggest an opportunity to rethink these places.

3.2. Method

The knowledge process for the construction of the Environmental System of Giugliano (Figure 1) was based on the interaction of several analytical-specialist readings from different sources such as:

- The studies that supported the drafting process of the PUC: (1) the Geological Study, (2) the Agricultural-Forestry Study and (3) the Environmental Study "Main environmental criticalities of

the municipal territory of Giugliano in Campania, (4) the Municipal Census of abandoned (art. 30 L.R. 54/85), closed and active quarries (2018).

- The information coming from some digital databases: (5) the DEM Digital Elevation Model from NASA's Shuttle Radar Topography Mission SRTM (2014), (6) the Nature Map of the Campania Region: Habitat Map at the scale 1:25.000 (2009), (7) the Corine Land Cover in Campania updated by ARPAC Campania in agreement with ISPRA (2018) , (8) the Geoportal of the Regione Campania, (9) the CTR Regional Technical Map of Campania (2017), etc..
- The forecasts of supra-municipal and sector plans: (10) the PSAI-RI Piano Stralcio per l'Assetto Idrogeologico dell'Autorità di Bacino Campania Centrale (2015), (11) the PRB Regional Reclamation Plan (2013, 2017, 2019), (12) the PSdC Coastal Defence Stralcio Plan of the former North West Campania Basin Authority (2008), the (13) Piano di Tutela delle Acque Ciclo 2015-2021, (14) the Domitio Coast Master Plan by the Campania Region, (15) the Piano Regionale per la Gestione dei Rifiuti Urbani PRGRU (2016), (16) the Water Protection Plan (2017), (17) the Characterization Plan of the Giugliano Wide Area (2014), etc.
- Several sector studies such as: (18) the studies drawn up for Polluted, Contaminated and Potentially Contaminated Sites by ARPAC in SIN and ex-SIN sites, (19) the Italian Atlas of Environmental Conflicts¹⁸, (20) the Municipal Census of Abandoned Quarries (art. 30 L.R. 54/85), (21) the Studies of the General Reclamation Consortium of the Lower Volturno Basin, etc.
- The field surveys and virtual surveys through the Google Earth and Google Maps platforms, including the platforms: (22) Google Maps Digital Landfill Map, (23) the "Terra Dei Fuochi" Geoportal, etc.

The collection, elaboration and systemization of these data in a GIS environment have resulted in some interpretative readings contained in some of the Preliminary Drafts of the PUC of Giugliano which we will illustrate below, namely: Water, geomorphology and natural and anthropised landforms, Water and evolutionary dynamics in the design of the territory, Soil consumption and dynamics of vegetation cover, Urban metabolism and waste areas, Aggregate risks.

The realization of these analytical-interpretative maps constituted the starting point for the definition of an updated framework of Strategic Objectives and Project Actions that find their spatial precipitate in the Strategic Synthesis Framework and the Strategic Projects (Figure 8), aimed at defining the guidelines for a more overall requalification of Giugliano.

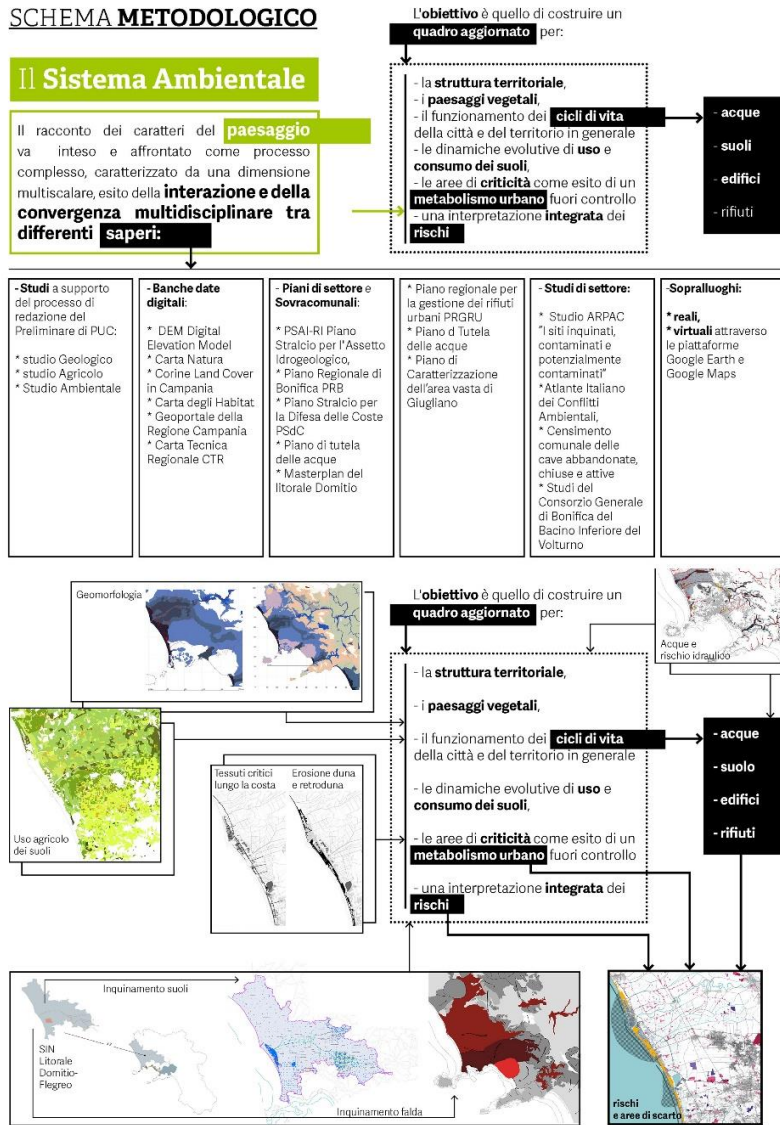


Figure 1. Methodological outline of the interactions between the objectives, sources and characteristics of the Giugliano Environmental System (Developed by Author, 2022)

4. Results: integrated maps with an analytical-interpretive character

This mapping process has returned a geography of places, endowed with a strong recognisability even at a vast scale, in which the materials that compose them and the relationships that exist between them constitute the structure of the territory itself and are of fundamental importance not only for its own understanding but also and above all for understanding the relationships that exist between the hydro-geomorphological and vegetation aspects, between the consolidated and recently expanded urban settlements and the agricultural contexts and coastal areas. In addition, the reading of the evolutionary dynamics and persistent features that have qualified the environmental structure over time provide an important opportunity to understand the criticality and vulnerability factors of the environmental and landscape systems in Giugliano, which are represented in the following maps.

4.1. Water, geomorphology and natural and man-made landforms

For the construction of this map, we started with the codification of some of the emblematic features of the Giugliano landscape, through the synergic use of different multidisciplinary knowledge that made it possible to update the territorial structure of the water network, geomorphology and landforms. These materials are superimposed on the dynamics of soil loss due to anthropogenic action and the identification of environmental criticalities such as hydraulic risk, the mapping of quarries and mining areas, landfills and storage sites, the survey of unstable and potentially unstable areas, geological and subsoil instabilities, and the study of soils saturated with water or potentially saturated due to the rise in the water table in the back dune areas where the soil level, in some places, is below sea level. and building matter" and where the net sphere must be superimposed on the natural and urban spheres.



Figure 2. Water, geomorphology and natural and anthropized landforms (Developed by Author, 2022)

4.2. Water and evolutionary dynamics in the design of the territory

The development of this map starts from an in-depth study of the cartographies and historical texts that have dealt with the evolution of water and its role in the territorial design of the Domitio-Flegreo coastline. Over the centuries, this great plain south of the Volturno River has seen a multiplicity of uses and different economies that have shaped and profoundly modified its landscape. In particular, the imposing work of land reclamation of the Regi Lagni, the largest hydraulic infrastructure in Campania

completed between the end of 1592 and 1616 under the direction of Giulio Cesare Fontana, made the typical alluvial lands of this area particularly fertile, thus dedicating them to agriculture. The post-reclamation landscape took the form of a complex system of canals that crossed the historic wetlands down to the sea, while at the same time building an articulated network of connecting tracks that encouraged the repopulation of the plain. The large number of farms and farmhouses present flanked the historic urbanization of the centers that had sprung up along the Roman centuriazioni, thus initiating an epochal change that transformed the nature of social and economic relations in these places. This great water machine, which has been capable of governing territorial development since the 17th century, has, however, in the last hundred years progressively become, in the media dimension, the skeleton of a territory sadly subjected to a widespread condition of degradation, abandonment and pollution. To superimpose the different layers of the water network, it was decided to photograph the territory in four different periods to highlight the territorial transformations following the manipulation and regimentation of water, in particular, reference is made to the "Map of the Naples environs" (1818) by the Royal Topographical Office, to the "Carta Idrografica e delle Bonifiche" (1889) edited by the Istituto Geografico Militare IGM, a mapping of the water network from the "Carta d'Italia" (1950) edited by the IGM, finally a restitution of the current state using the work edited by the Autorità di Bacino della Campania Centrale updated to 2017, in which the criticality of the areas subject to hydraulic risk is also highlighted.

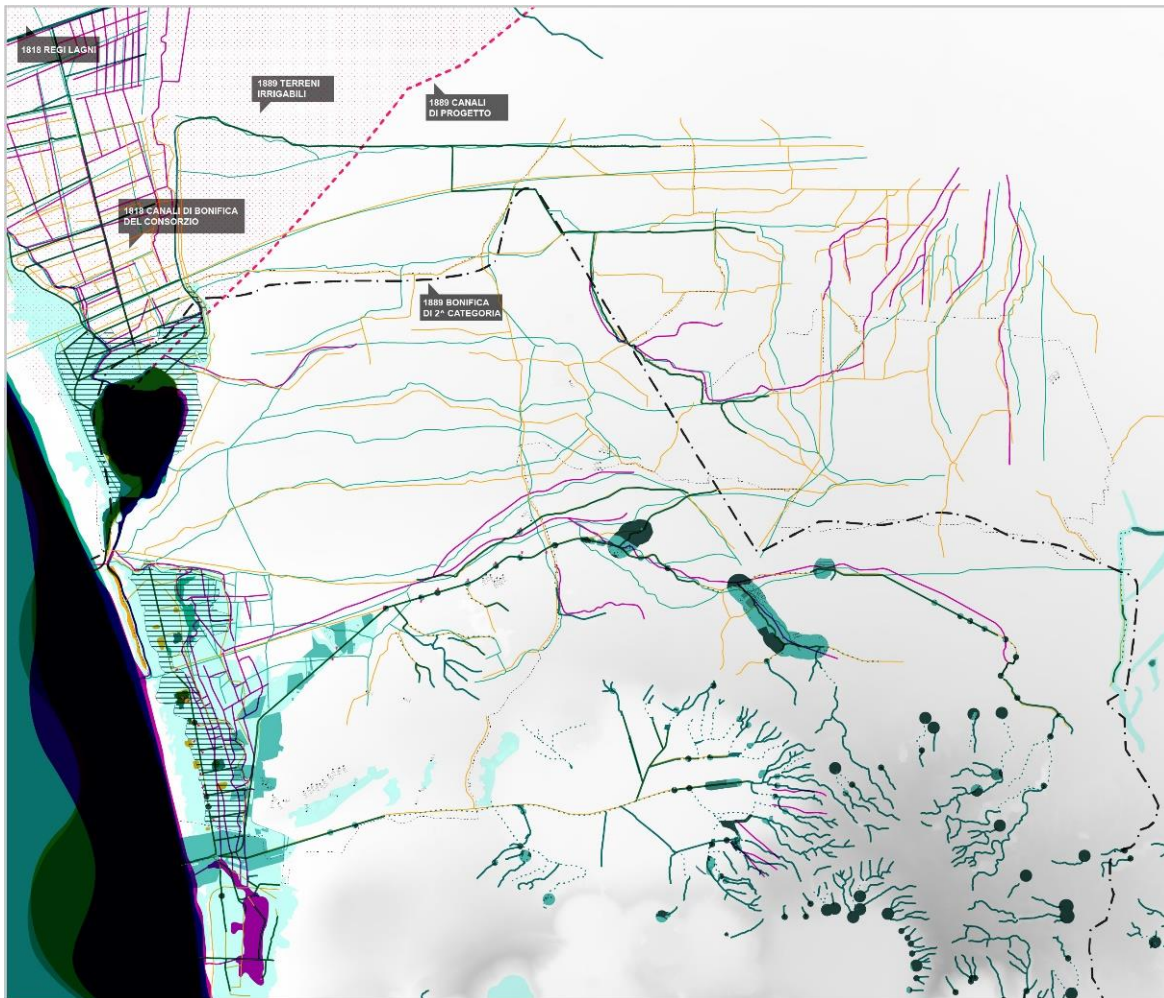


Figure 3. Water and evolutionary dynamics in land use design (Developed by Author, 2022)

4.3. Soil consumption and land cover dynamics

From this map emerges a territorial structure of fundamental importance not only for its own comprehension but also and above all for understanding the relationships that exist between the hydro-geomorphological and vegetation aspects, between the consolidated and recently expanded urban settlements and the agricultural contexts and coastal areas. In addition, the reading of the evolutionary dynamics and persistent features that have qualified the environmental structure over time provide an important opportunity to understand the criticality and vulnerability factors of the environmental and landscape systems in Giugliano. In this drawing, we can recognize the "Rural landscape matrices" composed of agricultural soils in particular arable land and orchards, the "Linear coastal landscapes" with beaches and the dune and back-dune vegetation system, and the "Urban ecological constellation" where the minute system of green pores, green spaces of historical and ornamental value, designed gardens, greenery and street furniture, outdoor and permeable recreational and sports facilities, and even the mapping of tree rows emerge. Superimposed on these landscapes characterized by the green system are drawn the "Landscapes of waste and compromise", i.e. an archipelago of materials in which the largely rural areas and consolidated urban nuclei fade towards an incessant and pervasive settlement dispersion, which generates discontinuities between the environmental networks with which it inexorably seeks to overlap. An image that we can reconstruct by broadening the horizon of our observation within a necessarily metropolitan dimension, in which the forms that these structures take on the territory transcend administrative limits. Specifically, the system of compromised and polluted soils, quarries and mining areas, landfills, specialized production and trade enclosures, areas that intensively exploit agricultural soils, and abandoned and degraded areas are restored.



Figure 4. Soil consumption and land cover dynamics (Developed by Author, 2022)

4.4. Urban Metabolism and waste areas

This map depicts the pervasiveness of pollution and the multiplicity of contamination factors, ecological degradation, the pervasiveness of land consumption and the consequent hydro-geomorphological fragility, the scarcity and vulnerability of water resources, the lack of adequate management of the waste cycle and, more generally, the spread of waste produced by partially or totally abandoned industrial supply chains, the seismic vulnerability of the built heritage and its energy inefficiency, are just some of the factors that are stressing Giugliano and, more generally, all the cities in the world at this historical stage, dangerously intercepting also the risks arising from climate change. In addition to the environmental issue, there are also the visible effects of the economic crisis and traditional development models, along with the social crisis expressed above all by the absence of fair access to resources and the right to the city. These dynamics hand us a legacy of landscapes that are socially, ecologically and economically disadvantaged but which return an immense capital of opportunities for adaptation, reuse and recycling. The areas of waste and abandonment in the Giugliano context also intercept the continuity of infrastructure networks and the reticular dimension of ecological connections, restoring a porous structure that crosses with the urbanized areas, inevitably overlapping with the processes of soil consumption still underway. In this sense, what we want to return with these readings is a geography of places that do not only configure a traditional critical porosity made up of disused areas and buildings, brownfields and residual spaces, but rather to broaden and specify a taxonomy capable of involving further urban and landscape materials affected by the exhaustion of economic, productive and ecosystemic life cycles to return more effectively not only the complex dimension of waste areas but also and above all the mechanisms and outcomes of an urban metabolism out of control. The outcomes of this process can be seen in this paper and can be mainly traced back to the crisis of five life cycles: (1) compromised ecosystems, (2) crisis of productive cycles, (3) critical tissue, (4) compromised infrastructure and (4) waste cycle.

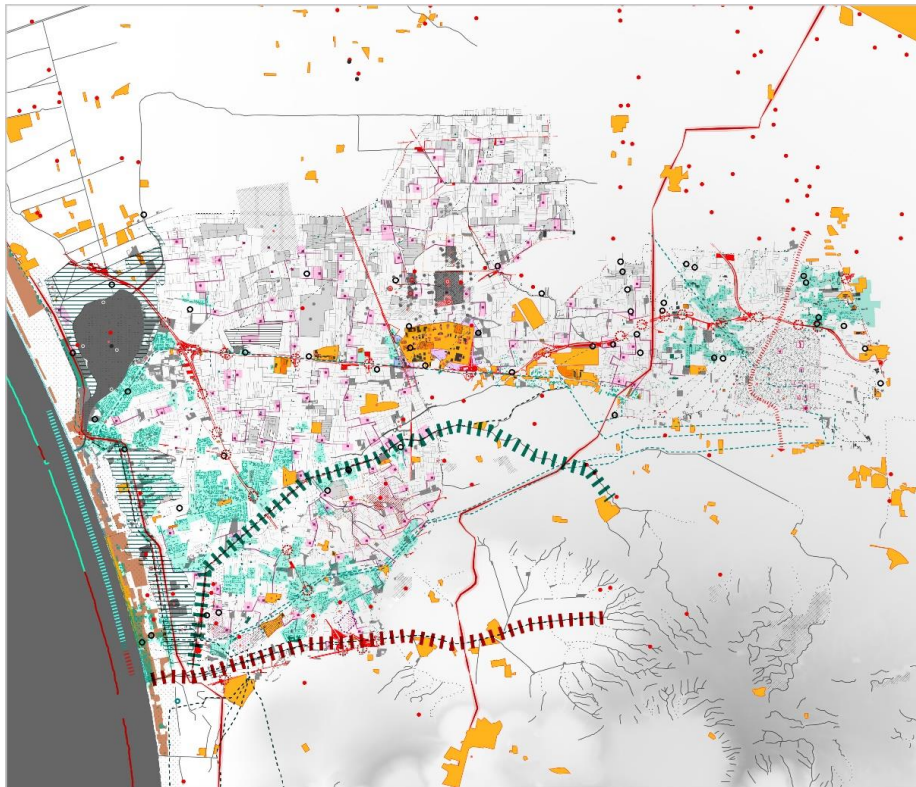


Figure 5. Urban metabolism and waste areas (Developed by Author, 2022)

4.5. Aggregate risks

The investigations, studies and interpretative readings represented above give us for Giugliano a territory characterized by a multi-hazard dimension, affected by a multiplicity of hazard factors that have undermined and continue to make vulnerable a very complex territorial system. Although anthropic hazard factors constitute a threat that is sometimes less evident than natural hazard factors, they risk profoundly compromising not only the existence but also the possible use of the natural and anthropic resource heritage by future generations (Magnaghi, 2015). In the case of Giugliano, the greatest evidence is represented by the risks linked to waste flows that have constituted, over time, one of the main causes of long-term changes to landscapes, even with very significant impacts of alterations to natural resources and damage to the health of inhabitants. In addition, ineffective land-use controls have led to the development of vast residential settlements in high-risk areas.

This map is the result of the relationships and overlaps between two large families of hazards, viz: those deriving from (1) geological vulnerability factors, such as hydraulic vulnerability and hydraulic crisis points, areas subject to subsidence risk, landslide vulnerability, unstable soils, geological and subsurface instabilities, coastal strip vulnerability and seismic vulnerability and those arising from (2) anthropogenic vulnerability factors, such as impaired waters, marine coastal water quality, well water quality, mapping of sewage treatment plants and fugitive canals, mapping of risks from land consumption and fragmentation of ecosystems, in particular peri-urban sprawl and greenhouse areas, mapping of waste cycle management, highlighting landfills, storage sites and illegal disposal practices. For these reasons, risk prevention and mitigation strategies must be based not only on knowledge of individual natural and anthropogenic hazard factors but also on their mutual and possible interactions.

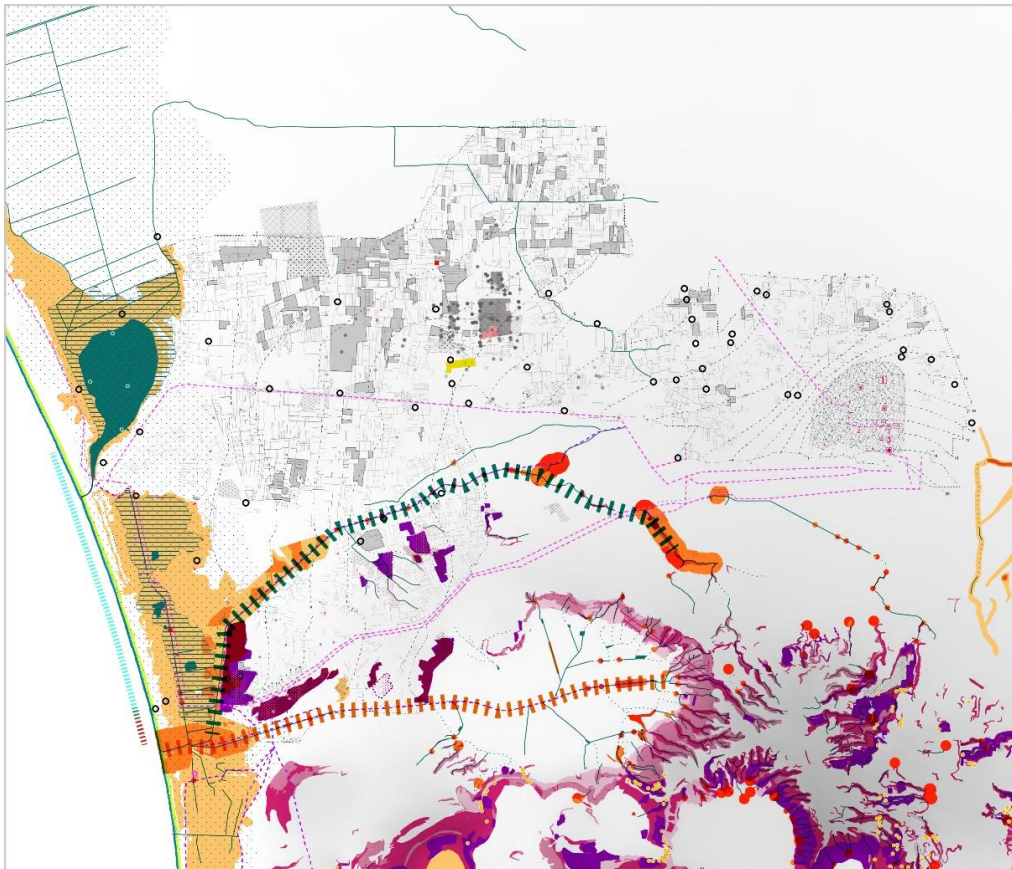


Figure 6. Aggregate risks (Developed by Author, 2022)

5. Discussion: the role of blue and green infrastructure in Giugliano as prospects for sustainable development

It is from a reading of the historical territory of Giugliano and the succession of settlement processes according to several significant temporal scans, that the degree of permanence and persistence that the networks of environmental infrastructures retain to this day as a load-bearing structure capable of innervating the entire dimension, while profoundly modifying itself through the urban, peri-urban and natural contexts, can be deduced. This founding, structuring dimension, endowed with enormous potential in terms of regeneration and rethinking for the multiplicity of Giugliano's landscapes, is conveyed through the synthesis framework contained in the blue and green infrastructures (Figure 7) which, crossing transversally all the analysis papers of the Environmental System, constitutes its inevitable outcome. To overcome the current critical scenario, it appears necessary to recover the life cycle of those environmental frames still capable of narrating the territory, revealing themselves as a strategic resource for the new landscapes of town planning and for the elaboration of a Municipal Urban Plan that proposes their regeneration. The historical landscape of the hydraulic reclamation devices becomes inescapable for the construction of landscape networks at different scales that can have the strength to propose new figures and new narratives for the Giugliano of the future, but also to redesign the territory incrementally, crossing the city along the environmental and infrastructural networks and building a generation of multiform and multifunctional spaces within which to place a qualified, updated and dynamic offer of welfare places, passing from a perspective of regulatory resistance to soil consumption to a strategy of production of new soil.

Through blue and green infrastructures, it is indeed possible to imagine working on a double level:

- A first level could concern the great territorial fixed capital consisting of the hydrographic network, the great agricultural plain and areas of naturalness, characterized by phenomena of environmental compromise and alteration, opening it up to new life cycles and focusing on resilient and adaptive systems capable of responding, at different scales, to changing context conditions. These are performance and structuring systemic interventions that inevitably overflow the municipal dimension and therefore also require new forms of inter-municipal cooperation (e.g. for the reclamation of the Regi Lagni and contaminated agricultural soils, the nourishment of the coastal strip, etc.) capable of defining new territorial development figures, linked to the coordinated action of institutional subjects and priority and long-term redevelopment and investment objectives.
- A second level could concern micro-interventions also linked to temporary practices in land use to give immediate answers to extremely fragmented territorial situations with two important purposes: the ecological one, to reconnect natural resources in support of large-scale interventions (e.g. the creation of river filter belts, phyto-purification areas, punctual biological reclamation interventions, etc.) and the social one, because micro-interventions are not only a way to improve the quality of life of the population, but also to improve the quality of life of the population) and the social one, because micro-interventions can be rapidly activated in confrontation with actors operating on the territory and involving a multitude of private subjects (farmers, small leisure entrepreneurs, dispersion inhabitants, occasional users of leisure spaces, niche tourists, etc.) and unusual geography of public subjects to implement and guarantee continuous maintenance of the interventions and the landscape itself.

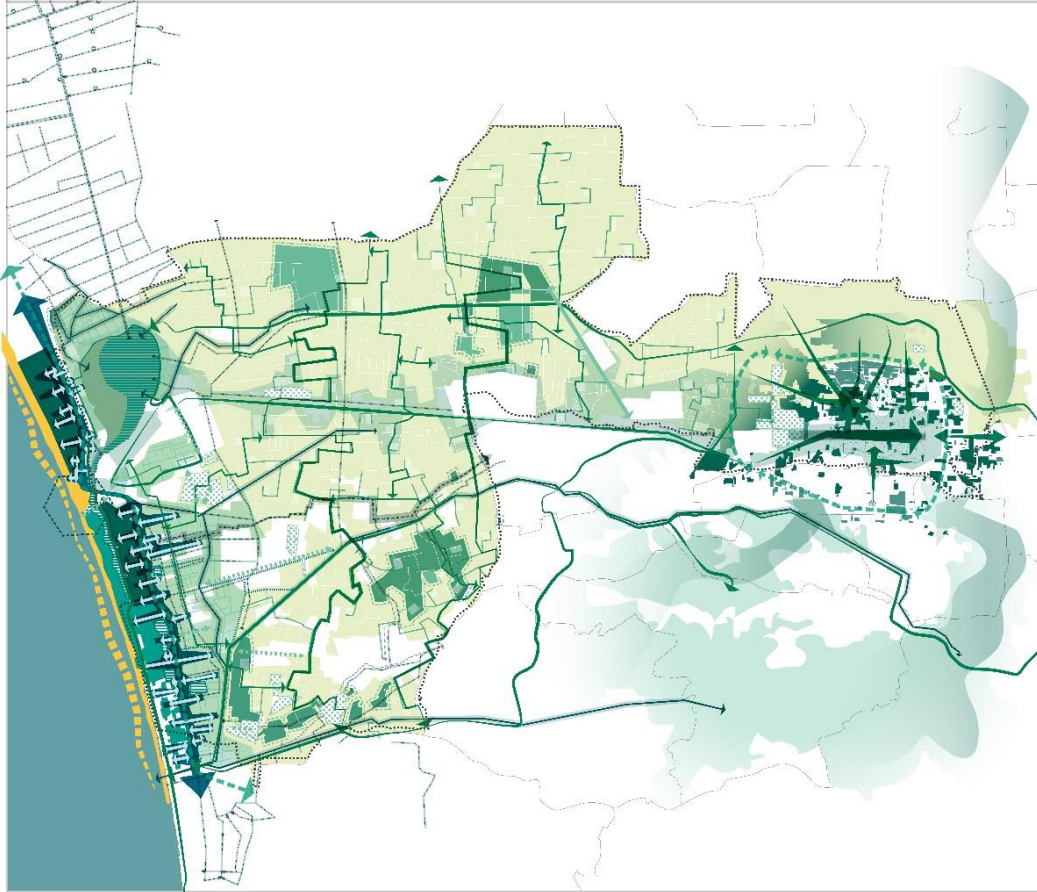


Figure 7. Blue and green infrastructures (Developed by Author, 2022)

6. Conclusions: Waste landscapes as a potential heritage for a reuse and recycling project

Taking into account this complex condition and the extreme fragmentation of this territory, starting from the synthesis of the fundamental cognitive-interpretive representations described up to now, considering the dimension of risks and the role played by blue and green infrastructures in this territory several urban and environmental regeneration perspectives have been outlined to try to hold these materials together while awaiting regeneration and redesigning, defining actions to stitch together pieces of territory, promoting public and alternative mobility to road transport and orienting risk mitigation to favour a polycentric network of services for greater social inclusion and interaction. The main strategic guidelines are outlined by referring to the co-presence and interaction of different declinations of the city's future the virtuous adaptation to the multiple conditions of natural and anthropic risk, also as an opportunity to qualify the coastal landscape for sustainable tourism; the consolidation of the agrifood production heritage of the vast Giugliano countryside and of a food chain linked to the growth of agro-biodiversity the prospect of hard and soft infrastructures aimed at consolidating sustainable urban mobility at the service of the entire urbanised territory, in close connection and integration with the rail and road network of the metropolitan area, also supported by new digital and energy networks; finally, the concrete start of a concentrated and widespread process of urban and environmental regeneration, to be accompanied by an economy based on recycling and a new urban metabolism, as well as a profound renewal of the building cycle centred on the regeneration of the existing city.

Based on these considerations, a system of strategic objectives and project actions was developed and graphitized in an Overall Vision (Figure 8). The strategic perspective is also completed by the identification of four Guide Projects (Figure 8) that correlate the priority project actions within specific narrative schemes structured around great signs of nature, history and urban and territorial infrastructures.

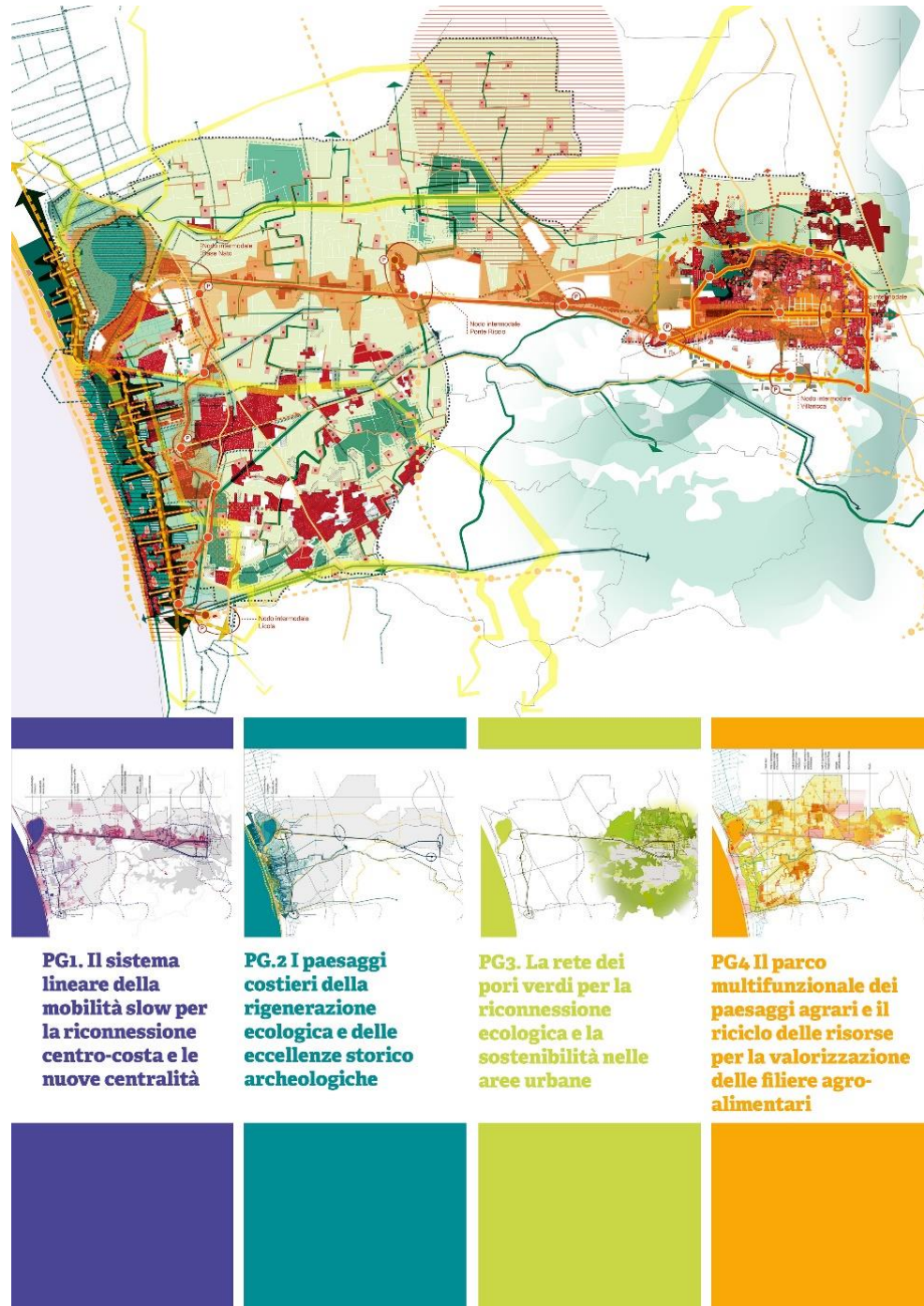


Figure 8. The Framework of Strategies and Thematic Strategic Projects (Developed by Author, 2022)

Overall, the contribution presented was intended to narrate a knowledge and planning process for an emblematic territory such as Giugliano in Campania, in which the role of mapping critical landscapes that become potential materials for a project of adaptation, reuse and recycling is central. The process aimed at mapping this critical condition was based on the interaction of several analytical-specialist readings from different sources, using multiple GIS and graphic post-production tools to be able to represent the complexity of these data and issues, which are often intangible or untraceable with conventional tools and methods. Of fundamental importance were the in-situ surveys that made it possible to recount these layered landscapes more closely, without any bias.

The results of this process are represented in a system of integrated maps providing data on the crisis of five life cycles (ecosystems, production cycle, waste cycle, infrastructures and urban fabric), which are fundamental for the construction of a vision of the future for the city of Giugliano in Campania represented in the Strategic Synthesis Framework of the Preliminary Municipal Urban Plan. Looking forward, it is critical to explore opportunities for regeneration of these landscapes and develop specific strategies for redevelopment. In addition, further insights and studies are desirable to better understand the interplay between these critical landscapes and urban planning, in a never-ending process that fosters continuous updating of both cognitive and strategic papers. This study is intended to provide a solid and integrable basis for future research aimed at promoting sustainability and resilience in urban areas undergoing continuous transformation, as well as a useful tool for local government.

In the presence of such complex and stratified places, it is necessary to rethink the methods of representation for this condition of complexity and uncertainty, to orient the project towards an open incremental process, with particular attention to the use of languages and communication, keeping in mind that to draw is to select, to select is to interpret, to interpret is to propose (Solà-Morales, 1979), in a collective path, maintaining the complexity and roughness of the territory (Poli, 2019). This is how some 'territorial figures' emerge, capable of capturing the shapes and dimensions of this territory, giving back evocations and conditions, represented in the Guiding Projects of the Preliminary Municipal Urban Plan. What emerges in these drawings is a series of landscape materials, new and sedimented, that merge with the practices and uses produced by different forms of interaction between environmental transformation and social re-appropriation, and that infuse a greater concreteness to the strategic dimension, producing a series of projects of open spaces for the community capable of meeting a need that has so far been largely unfulfilled.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statements

Studies involving animal subjects: No animal studies are presented in this manuscript.

Studies involving human subjects: No human studies are presented in this manuscript.

Inclusion of identifiable human data: No potentially identifiable human images or data is presented in this study.

Conflict of Interests

The author declares no conflict of interest.

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