

# The Possible Role of Brownfields Sites in a Circular Way in the Example of the “Isola Bergamasca”

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## 1 ABSTRACT

The circular economy looks at systems as a set of components designed to never leave the game, but to reinvent itself a role when the one previously assumed runs out.

In other words, we look at systems as sets in which someone's waste becomes a resource for someone else.

To achieve these objectives, a strong innovative capacity is required and it is necessary to focus on the production of components with a controlled life cycle.

In the circular model, matter is constantly reused, no waste products are present, resources do not decay, but are seen as capable of regenerating. In a context of circularity, the world of research and the world of business meet in a system of relationships guaranteed by territorial political institutions to build opportunities for growth and development.

Territorial planning is certainly one of the activities supported by the circular economy with a view to guaranteeing the real vocation of a territory, safeguarding its natural areas and privileging the choice of areas those already compromised or, in any case, affected by pre-existing interventions.

The concept of circular economy applied to land management appears to be of great use in putting into practice the legislative dictates aimed at containing soil consumption and promoting urban regeneration.

In the definition of uses of the areas, in order to control their evolutionary process, it is necessary to take into account the numerous databases available by crossing specific data, making use of the potential offered by IT tools.

The discussion on the need to restart the world of construction is very topical, but at the same time it is essential to work for interventions to protect the environment and guarantee better quality of life.

In terms of circular economy, it is spontaneous to think interventions in areas that have already been compromised, as suggested by the Law 31/2014 of the Lombardy Region. It is then necessary to verify that the areas chosen are actually suitable to accommodate the proposed transformations.

We have all the information to act correctly; the municipal planning, in its plan documents, has collected them diligently, it is a matter of actually taking into account the information and where it is necessary to intervene on areas that require consumption of new soil or burdened by constraints of different nature, it is necessary to foresee pilot interventions capable of presenting themselves as a manifesto of good practices.

The research work has set itself the objective of identifying the areas of transformation and the brownfield sites within a territorial area chosen as case study, which in the specific case was identified in the so-called Bergamo Island to guide the development of the territory towards an integrated model with characteristics of circularity. L'Isola Bergamasca is made up of a territory that brings together 21 municipalities in the Province of Bergamo. Altogether it has about 120,000 inhabitants. The area is called "Island" because it is enclosed by two rivers, precisely to the east the Brembo river and to the west the Adda river, while to the north it is delimited by Mount Canto. The Adda also marks the border between the provinces of Bergamo and Milan and the provinces of Monza-Brianza and Lecco.

Keywords: Brownfields, Circular economy, Land planning, Urban planning, Regeneration

## 2 INTRODUCTION

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### 3 DESCRIPTION OF THE AREA

The "Isola Bergamasca" brings together 21 municipalities in the Province of Bergamo; these are: Ambivere, Bonate Sopra, Bonate Sotto, Bottanuco, Brembate, Brembate di Sopra, Calusco d'Adda, Capriate San Gervasio, Carvico, Chignolo d'Isola, Filago, Madone, Mapello, Medolago, Ponte San Pietro, Presezzo, Solza, Suisio, Sotto il Monte Giovanni XXIII, Terno d'Isola e Villa d'Adda. In order to represent and coordinate territorial policies, the administrations of these municipalities in 1964 established, in the form of free association, the inter-municipal body of the Community of the Isle of the Bergamo land. Overall, this territory has about 121,000 inhabitants in the year 2017.

The triangular shaped territory of the Island extends for about 90 km<sup>2</sup>; wedged between the river Adda and the river Brembo. The confluence of the latter in the first determines the vertex facing south, while the base facing north is represented by the pre-Alpine belt that separates the plain from the mountainous area. The territory is mainly flat with altitudes ranging from 280 m s.l.m. of Carvico at 150 m a.s.l. of the southern part. The weak reliefs present to the north have their maximum elevation in the 710 m a.s.l. of Mount Canto. In the past, between Carvico and Calusco d'Adda, there was also Mount Giglio, today practically disappeared following the extraction activity, of which it was object, aimed at the production of cement.

In addition to the two large rivers that characterize the island, the territory is crossed by small streams and streams, whose waters are initially collected by the Dordo torrent, coming from the Val S. Martino and finally poured into the Brembo river near Marne, hamlet of Filago. A peculiarity characterizes the Island: built-up areas are arranged mainly on the perimeter of the triangle that identifies it, making a green heart emerge. It is a singular condition in Italy, dictated by the particular morphological conditions, which recalls in a much smaller form the green heart of the Dutch Randstad.

The river Adda represents the western limit that defines the Island. It is a river rich of water, at an alpine regime, which flows in a deep furrow dug in the high plain.

In the southern part of the Island, in the municipality of Capriate San Gervasio, the river Adda laps an important worker village of the late nineteenth century (1875), the village of Crespi d'Adda, now a

UNESCO heritage site. Throughout history, the river has represented an important commercial communication route both towards Bergamo and, above all, towards Milan. It has been navigable since Roman times; in the Middle Ages Leonardo lived not far from here and dedicated many studies to the Adda; these studies in the following centuries contributed to inspire the construction of navigation channels. The river water feeds several hydroelectric plants, in particular the Semenza plant in the municipality of Calusco d'Adda.

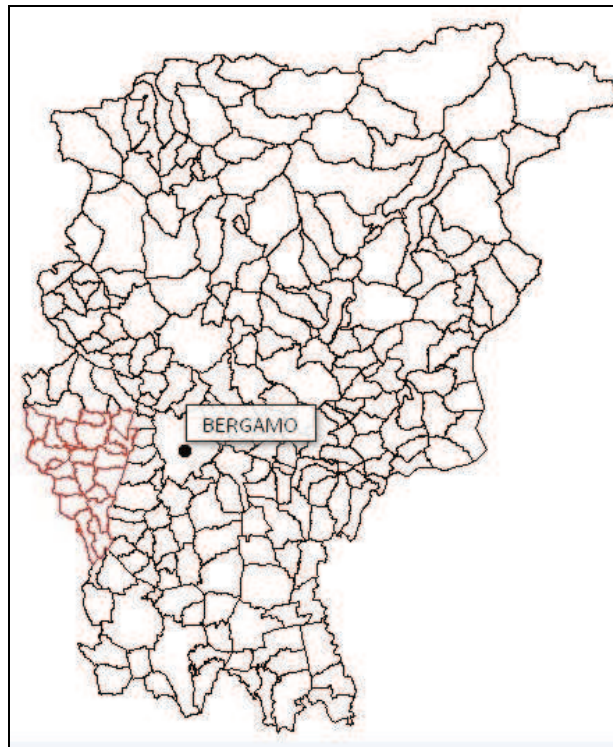


Figure 1 Colour red identifies the mosaic of the municipalities that make up the Bergamo Island, drawing by Vanessa Verdi

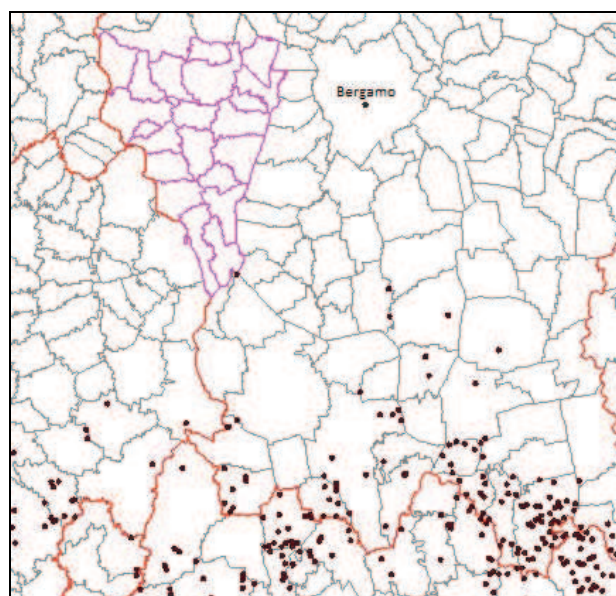


Figure 2 The dotting indicates the characteristic sources of the low plain, whose concentration identifies what is called the sources line, a line that precisely marks the passage between the two types of plain, drawing by Vanessa Verdi

The river Brembo, that represents the eastern limit, instead has an irregular regime. Unlike the river Adda it runs totally in the province of Bergamo. Along its course there are several industries too, including Legler, now dismantled, in the municipality of Ponte San Pietro. The Canto Mount represents an important element in the territory of the Island. It acts as a border towards the Valle San Martino, but at the same time the hilly area has for centuries been a link road with the same valley. In fact, the roads followed the line of the hills for a long time before to follow that of the plain. In front of the hilly system extends the portion of the plain

which is part of the wider Po plain. The Bergamo plain, apparently uniform, stands out for the "high" plain, dry and permeable, consisting of the debris of rivers, pebbles and gravel, and in the "low" plain, with a bottom consisting of sands and clays and above all rich in waters coming from sources.

The plain of the Island is high and dry; this condition has deeply influenced its history, especially since the advent of advances in agriculture, linked to irrigation, have effectively excluded the dry plains, destined to become poor plains. The natural face of the island was also characteristic and remained so for centuries: the plain was covered with forests of oak, elm, lime, maple and ash trees where the spaces of crops and human settlements barely made space their way.

Knowing and analyzing this aspect, as well as the other characteristics of the territory, is very important for a project as it allows you to understand the future evolutionary scenarios of a place and thus have a clear vision of the context in which you are operating.

### 3.1 Population

The analysis of the census data shows the tendency of the resident population to increase over the years. With reference to the data of the last population census (2011), a table representative of population density has been constructed.

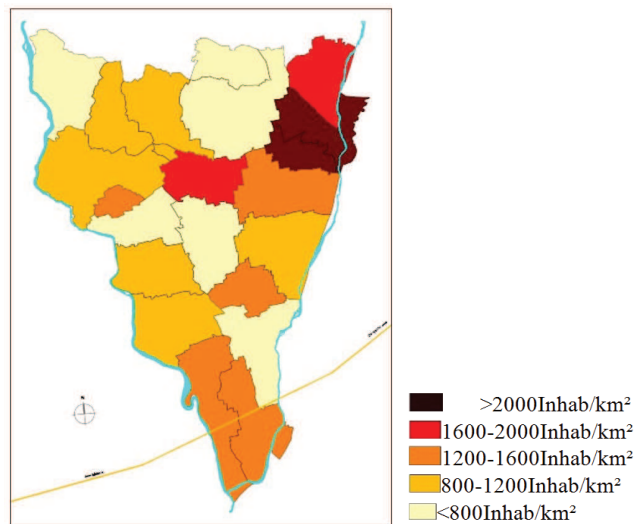


Figure 3 Distribution of population density, represented for the 21 municipalities of the Bergamo island, drawing by Vanessa Verdi

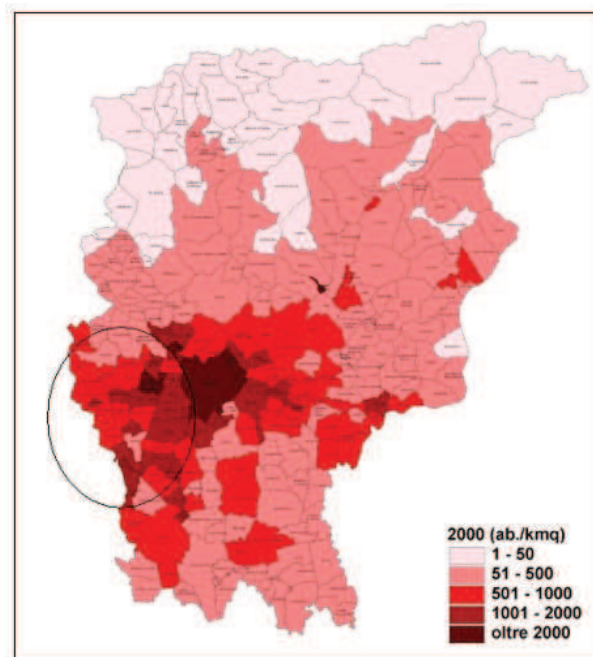


Figure 4 Source: PTCP of the Bergamo province; population density

This image highlights how the territory of the Island is characterized by a high density. In fact, as well as that of the entire Bergamo province, fragmented in numerous municipalities with limited extension compared to the national average of 37.3 km<sup>2</sup>, the population is distributed more or less homogeneously with densities higher than the provincial average that is equal to 399.3 inhab / km<sup>2</sup>, with peaks at the municipalities closest to the city of Bergamo. An image extracted from the PTCP (Territorial Coordination Plan) of the province of Bergamo helps to understand this dynamic; it can be noted that even less populated municipalities within the island such as Villa d’Adda, Mapello, Ambivere, Medolago, Chignolo d’Isola and Filago, have values far above the provincial average. The possible reasons can be traced both to the numerous industrial sites that have attracted a lot of manpower in the past and to the proximity to the cities of Milan and Bergamo, both easily accessible by highway and rail links.

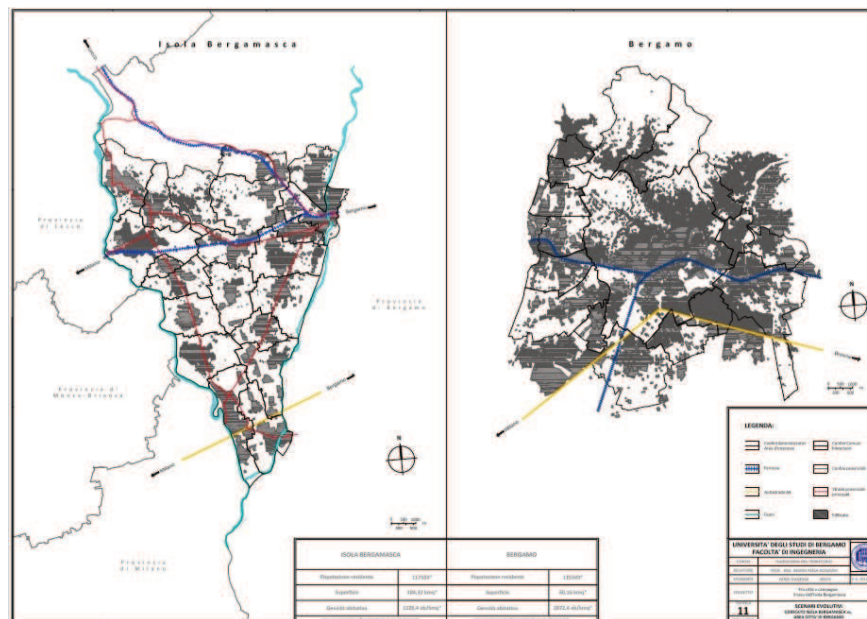


Figure 5 The table compares the territory of the Bergamasca Island with that of the Municipality of Bergamo considering the resident population (117,503 inhabitants against 115,349), the territorial extent (104.32 km<sup>2</sup> against 40.16 km<sup>2</sup>) and the consequent population density (1126,4 inhabited / km<sup>2</sup> against 2872.4 inhabited / km<sup>2</sup>), drawing by Vanessa Verdi

### 3.2 Mobility

As regards the mobility, it may be of interest to report some maps that help to frame the territory in its context. A map relating to the main road and rail connections, which serve the Island and two schemes depicting displacements to and from Bergamo and internal ones.

Commuting towards Bergamo is significant, which frames the Island as a satellite of the city. It was not possible to acquire the data for Milan. The internal displacement map underlines the inviolability of the green heart inside the Island.

## 4 PLANNING TOOLS

An important regulatory reference is the Lombardy Region Regional Law of November 28, 2014 n. 31 "Disposizioni per la riduzione del consumo di suolo e per la riqualificazione del suolo degradato". ("Provisions for the reduction of soil consumption and for the requalification of degraded soil").

The law provides that the instruments of the government of the territory direct their expansions towards areas already built, degraded and abandoned, already waterproofed, to be recovered or regenerated, with the aim of not compromising the environment, the landscape and the agricultural activity. It reiterates that soil is a non-renewable and common good of fundamental importance for environmental balance, health protection, agricultural production aimed at food and defense against hydrogeological instability. Among the objectives of environmental protection there is also that of reaching zero land occupation by 2050.

Main planning tools to which we referred is the following:

Regional Land Plan (PTR) Lombardy Region. Orients, directs and prescribes the choices of territorial and urban planning (government of the territory) formulated by municipalities, provinces, mountain

communities, park management bodies and any other competent body. It expresses the criteria and the technical guidelines to be applied in the instruments of the government of the territory to contain the expansion on new ground.

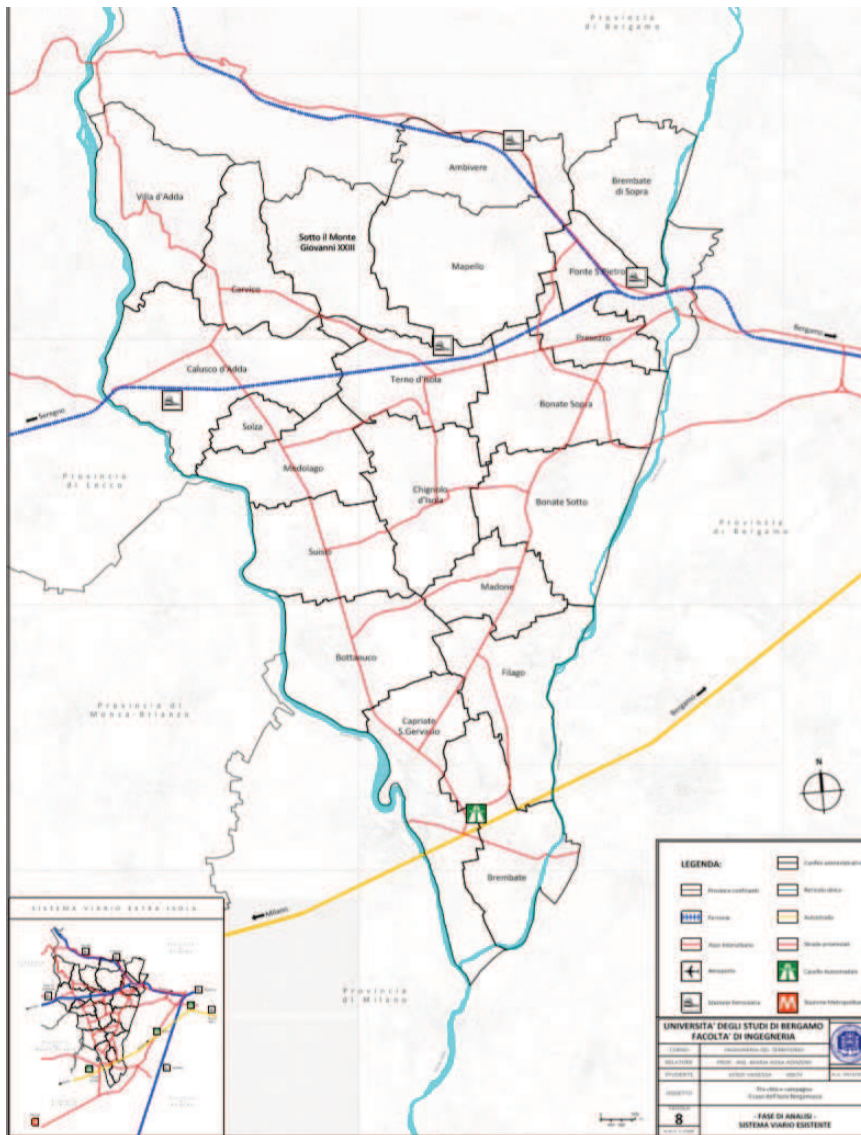


Figure 6 Main roads and rails insisting on the Bergamasca Island, drawing by Vanessa Verdi

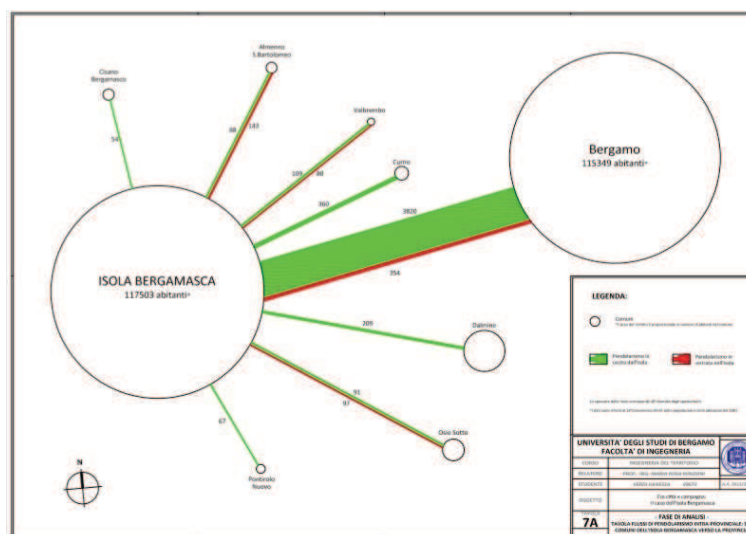


Figure 7 Commuter flows going from the municipalities of the island to the province of Bergamo and back, drawing by Vanessa Verdi

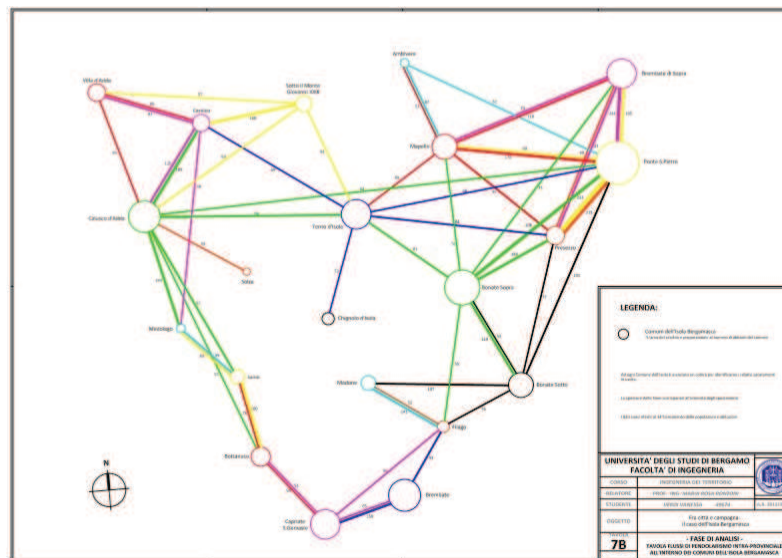


Figure 8 Commuter flows within the Bergamo area, drawing by Vanessa Verdi

P.A.I., Piano di Assetto Idrogeologico, (Hydrogeological Structure Plan), is the cognitive, regulatory and technical-operational tool through which the actions, interventions and rules of use relating to the defense against the hydrogeological risk of the territory are planned and programmed. It is a real territorial planning tool that must be the starting point for the anthropization of the environment. It was introduced by a law in 1998. The P.A.I. is configured as the territorial planning tool through which the Basin Authority aims to determine a territorial structure that ensures conditions of balance and compatibility between the hydrogeological dynamics and the growing anthropization of the territory in order to obtain both the safety of the existing settlements and infrastructures and the compatible development of future activities. The P.A.I. pursues the improvement of the hydrogeological structure of the basin through structural interventions (preventive and for risk reduction) and regulatory provisions for the correct management of the territory, the prevention of new risk situations, the application of safeguard measures in cases of ascertained risk.

PTCP, Piano Territoriale di Coordinamento Provinciale (Provincial Territorial Coordination Plan): coordinates the activities of the municipalities in compliance with the indications of the PTR. It recognizes the need to divide the provincial territory into ambits; in particular, the Bergamasca Island is divided into two ambits: one comprising the municipalities of the foothills and one the municipalities in the flat belt.

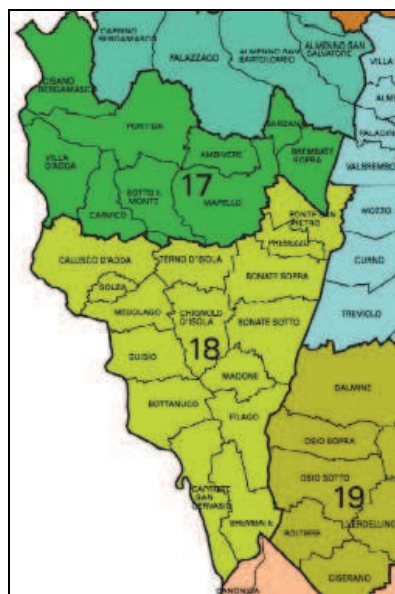


Figure 9 Source: PTCP Bergamo, Extract from Table E5.1, perimeter of the ambits

In order to limit the consumption of soil, the PTCP favors the recovery and enhancement actions of the existing, also ensuring the presence of greenery and mitigation spaces in the event of the construction of new

buildings and infrastructure. It also incorporates the provisions of the PTR as regards the territory of the island.

An observatory is foreseen which periodically monitors the level of soil consumption in relation to built-up and unused spaces using measurement and detection methods. There is also a land use map, it constitutes a necessary and binding prerequisite for the realization of public and private building interventions that also involve a partial consumption of soil and is an integral part of any general or partial variation of the PGT.

In addition, regional funding and simplification measures are envisaged for municipalities operating in the direction of urban regeneration.

PGT, Piano di Governo del Territorio (Land Government Plan). The planning tool in force, in the Lombardy Region, on an urban scale. At municipal level, the Land Government Plan, PGT, provides for the consumption of soil only in cases where the Plan Document demonstrates the technical and economic unsustainability of requalifying already built-up areas or recovering brownfields areas. The municipal instruments of the territory government cannot order new expansion forecasts until the transformation forecasts in force on the date of entry into force of the law have been fully implemented.

For the Island area, all the PGTs of the 21 municipalities that make it up were analyzed and for these were drawn up cards, which systematically report the objectives of the plan, identify the transformation areas, the agricultural areas, the Adda Nord Regional Park and the PLIS (Local Park of supra-municipal interest), where present, in addition to the main indications relating to the mobility system. By way of example, two of these cards are reported, relating to the municipalities of Bottanuco and Brembate:

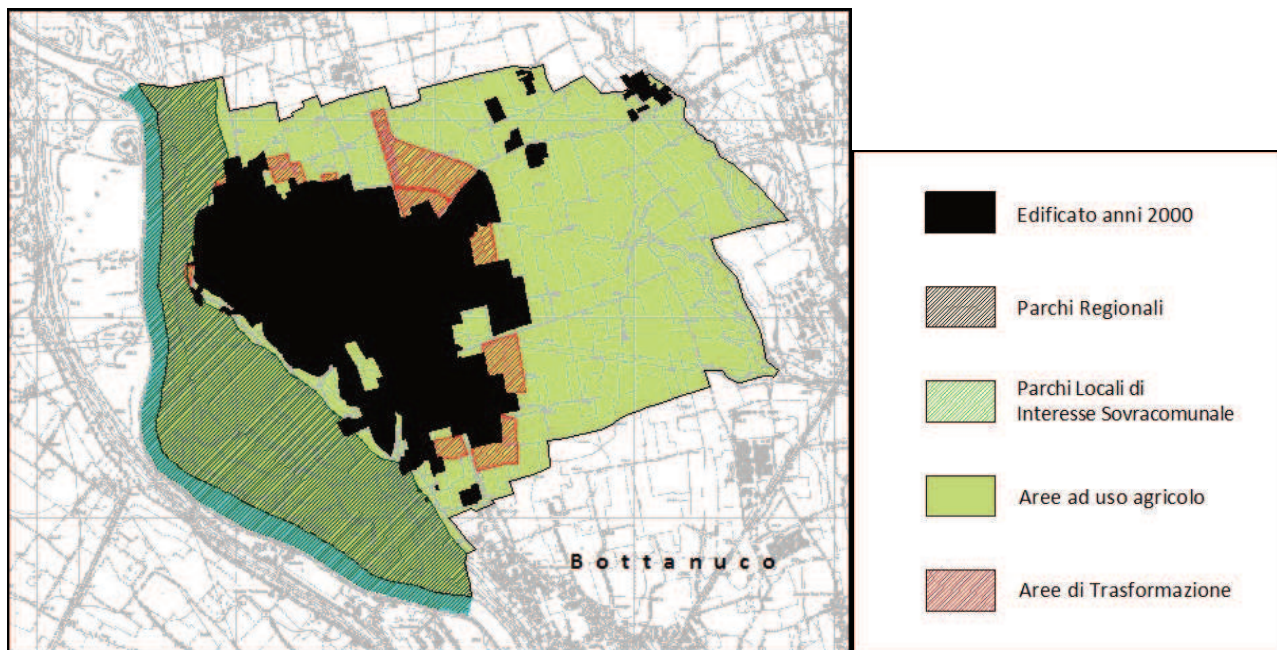


Figure 10 Municipality Bottanuco, drawing by Vanessa Verdi

Targets: minimize land use.

Transformation areas: North of the inhabited center, areas intended for industria are planned to complete the production auction on the Riviera that runs through the Municipality. The remaining areas are instead intended for residential expansion.

Regional Park Adda Nord: the plan provides for the enhancement of the area by proposing the expansion of the territorial perimeter to join the valley in the east of the Municipality and the development of connections between the agricultural and inhabited areas. Particular attention is paid to the redevelopment of the "quarries" area, which occupies a considerable area of the territory, this both from an environmental point of view and as regards services.

Mobility: critical issues are reported regarding the works envisaged in the PTCP such as: the construction of the East Railway Gutter for freight transport which falls south of the territory with a new crossing on the Adda River, the construction of the foothills speedway which does not provide for interconnections with the local road network and would constitute a mere crossing of the Municipality with its environmental and



landscape impact. The construction of a new provincial street parallel to the existing one is envisaged, which would allow the redevelopment of the latter to be planted with trees.

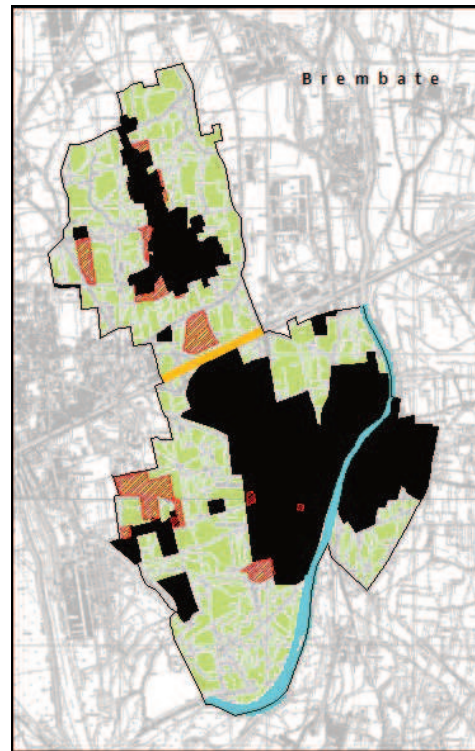


Figure 11 Municipality Brembate, drawing by Vanessa Verdi

**Targets:** priority is given to actions aimed at redeveloping the appearance of the municipal area, especially with regard to the quality and use of "green" as well as safeguarding the environment.

**Transformation areas:** they are provided in the internal part of the Municipality and are all residential. New industrial sites are planned in areas close to the A4 motorway.

**Agricultural areas:** agricultural areas of protection and safeguard are envisaged in which all forms of construction are prohibited, agricultural areas around the settlements and strategic agricultural areas within which to encourage agricultural activities.

**Quarries Plan:** the PGT acknowledges the prescriptions imposed at provincial level and hypothesizes recovery scenarios.

**Mobility:** the document incorporates what is indicated at regional and provincial level regarding the construction of the Pedemontana motorway and the related link with Bre.Be.Mi and, as in the case of other interested municipalities, highlights its critical issues regarding the environmental impact and landscaping.

## 5 TARGETS

The research work has set itself the objective of identifying the areas of transformation and abandoned areas within a territorial area chosen as studies case, which in the specific case has been identified in the so-called "Isola Bergamasca" to address the territorial development towards an integrated model with circular characteristics.

It was divided into the following phases:

Analysis of municipal planning tools and identification of data to be acquired to activate a circularity process. Data relating to the transformation areas provided for in the Land Government Plans of the 21 municipalities making up the Bergamo Island were collected.

Identification of the transformation areas for the functions they will host: residential, commercial or productive.

Identification of brownfield sites in the municipalities covered by the study.

Superimposition of the hydrogeological risk map to the mapping of transformation and brownfield areas. Balance sheet of areas (transformation and brownfields).

Starting from the PGTs of the municipalities of the Bergamasca Island, the transformation areas for residential and production use have been identified.

At the same time, a classification was made of the brownfields areas on the Island.

This research was carried out by consulting the databases of the Lombardy Region, that of the research laboratory of the University of Bergamo Diathesis and the data available from the municipalities as well as a direct analysis conducted on the site.

Unfortunately, none of the databases identified were found to be complete and often the data collected were not comparable. The information collected was represented on a map.

It was also considered appropriate to proceed with the verification of the possible hydrogeological risk. In this regard, the areas at risk have been identified. The reference was the IFFI Project which documents landslides and hydrogeological instability. Evaluation forms have been created for each municipality, which take into consideration the areas of transformation and the brownfields areas in order to verify whether all or even only a part of the planned volumes could have been built in the disused area. For each municipality located on the Island of Bergamo, a scheme has been produced that documents the dimension of the possible areas in play. The case of Ponte San Pietro is shown as an example.

Municipality	AD1 m <sup>2</sup>	ATR1 m <sup>2</sup>	ATR2 m <sup>2</sup>	ATR3 m <sup>2</sup>	ATR4 m <sup>2</sup>	ATR6 m <sup>2</sup>	ATR7 m <sup>2</sup>	ATR8 m <sup>2</sup>	ATR9 m <sup>2</sup>	ATRR m <sup>2</sup>	TOT m <sup>2</sup>
Ponte San Pietro	+155.000	-4.150	-11.643	-2.841	-5.787	-21.429	-14.643	-8.127	-10.100	-17.977	+58.303

AD is brownfield area - ATR are transformations area

As for the areas subject to flooding, with regard to the Adda river, it is noted that only the southern part of the Bergamasca Island, which falls in the municipality of Capriate San Gervasio, is affected by the overflow of the river. The industrial village of Crespi d'Adda, now a brownfield area, insists on this site. This type of flooding is classified with a low hazard level defined as a rare scenario. If we consider the level of risk instead, this area is classified at risk one, (in the risk scale corresponds to a moderate risk) and risk two (in the risk scale corresponds to an average risk). It means that the return time with which this scenario occurs is 500 years and the level of risk can cause marginal social and economic damage to environmental and cultural goods. On the other side of the island, the Brembo river overflows affecting urbanized areas in a small portion in the municipalities of Brembate Sopra, Brembate and Filago. In all these cases, the type of scenario is rare and the risk category is classified as moderate.

Considering also the smaller waterways it can be concluded that the flooding scenarios of rivers and streams in the urbanized territory of the Bergamasca Island are considered rare, with a return time ranging from 200 to 500 years, and at moderate risk. As regards landslides in the Bergamo area, all the areas concerned are far from inhabited and urbanized areas while areas subject to hydrogeological constraints are present in the context of Mount Canto in the municipalities of Ambivere, Carvico, Mapello, Sotto il Monte Giovanni XXIII and Villa d'Adda. Su questa parte del territorio esiste solo un'area di trasformazione ad uso residenziale con consumo di nuova terra nel comune di Sotto il Monte Giovanni XXIII. È soggetto al rispetto della presenza del vincolo idrogeologico.

## 6 METHODOLOGICAL APPROACH

First, a comparison was made between the past and the current situation to analyze the development of the settlement.

Starting from research on historical maps, comparing the urbanization of the mid-nineteenth century (1842-1843) and the current state, an attempt was made to understand how this evolved on the territory of the island and what the factors were that they determined this distribution. The comparison was possible thanks to the use of maps of the Austrian Land Registry, preserved in the Historical Archive of Bergamo, dating back to the years 1842-1843. The cadastral representations, in the original maps, are in scale 1: 2000 for the general territory and 1: 1000 for the built area, the buildings are marked by maps in pink, the churches are in red and the waterways in blue. The map relating to the Municipality of Ambivere is shown as an example, but the research was conducted for the 21 municipalities of the Island.

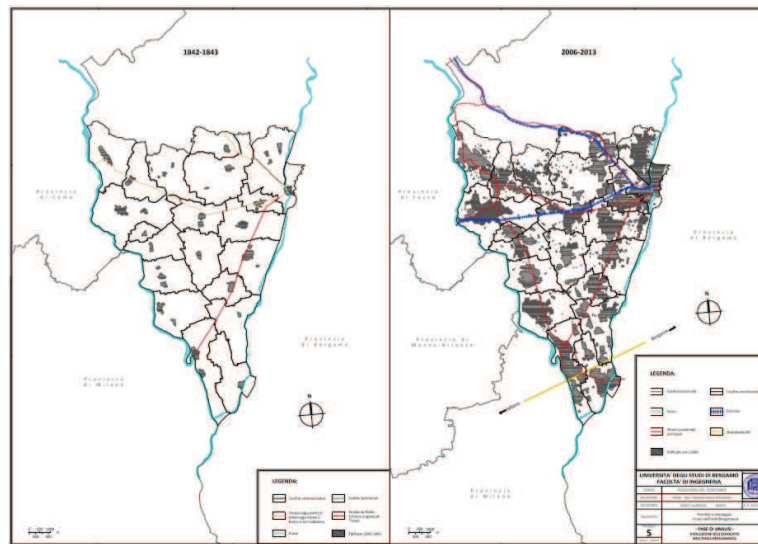


Figure 12 Comparison between the urbanized of the mid-nineteenth century (1842-1843) and the current state, drawing by Vanessa Verdi



Comune	Data mappa	Mappa
Ambivere 	1843	

Figure 13 Source: map of the Austrian Cadastre, Bergamo Historical Archive

### 6.1 Data collection and municipal planning tools analysis (PGT)

To identify the transformation areas and the brownfields areas in the territory of the Island, planning tools were consulted starting from the regional level expressed by the PTRs, going down to the provincial level with the PTCs, up to the local level with the PGTs.

The consultation of the tools at regional and provincial level was useful for understanding the guidelines expressed by the territorial planning, while the examination of the PGTs allowed to identify the areas of transformation envisaged in the municipal territories examined, on which it will be possible to intervene in line with what expressed by the Regional Law n.31 on the reduction of land consumption.

#### Intended use of transformation areas

The analysis of the PGTs of the 21 Municipalities of the Bergamasca Island has made it possible to map this territory by quantifying all the areas of transformation envisaged, divided into areas for production, commercial and residential. The most significant brownfields areas were also identified, in particular those that have the greatest impact in terms of extension.

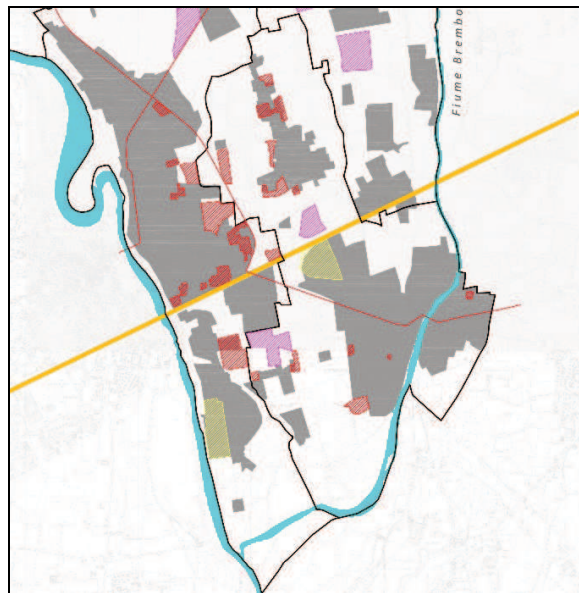


Figure 14 Drawing by Vanessa Verdi and Chiara Grigis

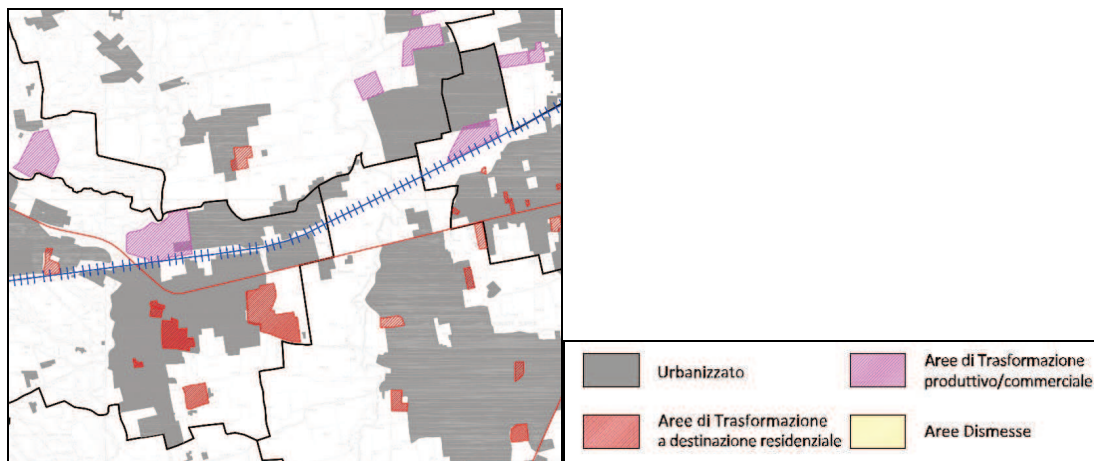


Figure 15 Drawing by Vanessa Verdi and Chiara Grigis

## 6.2 Balance between transformations areas and brownfields areas

It was decided to differentiate the transformation areas for industrial use from those for residential use by quantifying their respective dimensions. On a map all the information are reported. Together with the transformation areas, some brownfield sites are also reported in order to evaluate what contribution could derive from the re-use of these areas to contain soil consumption in compliance with the needs, as defined in the PGT and also in accordance with the provisions of the Law Regional no. 31 of 2014.

A further map was drawn which the map of the hydrogeological risk areas was superimposed on the map that shows the transformation areas to verify the real aptitude of the transformation areas identified to accommodate new buildings within it.

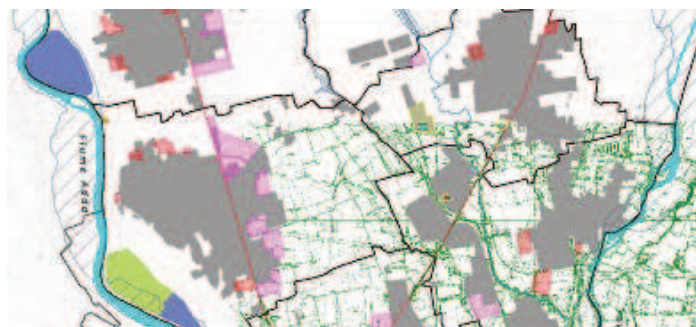
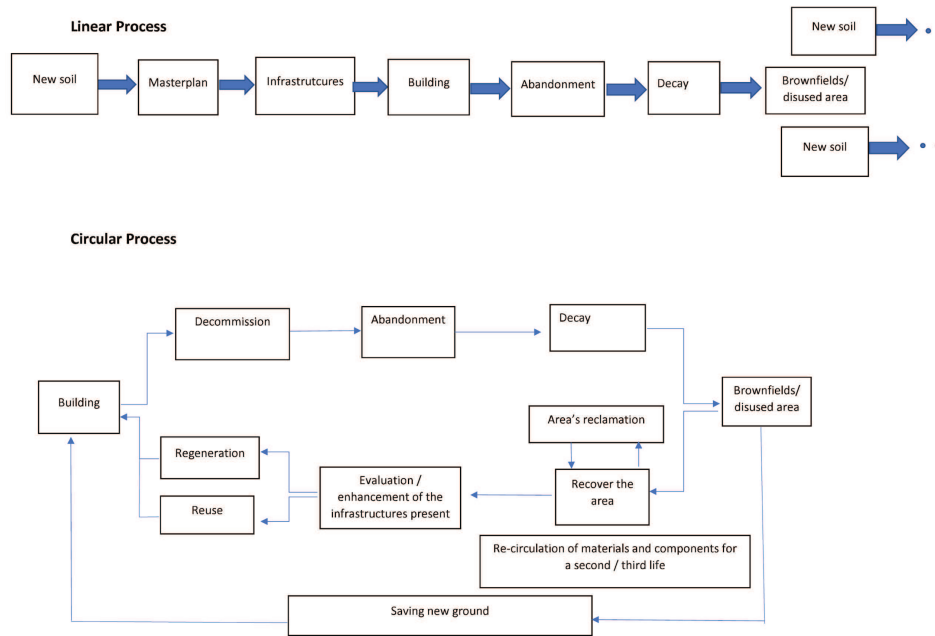


Figure 16 Balance between transformations areas and brownfields sites with superimposed hydrogeological risk areas, drawing by Vanessa Verdi and Chiara Grigis

## 7 THE CIRCULAR ECONOMY APPLIED TO LAND CONSUMPTION



Bringing abandoned areas back into play traces the principles of the circular economy. The above scheme aims to describe the process that must guide the recovery of the abandoned area with consequent saving of new soil.

## 8 CONCLUSION

The work is not finished, there is room for further additions and insights. It would be necessary to integrate the research by incorporating all the abandoned areas of the Island, not only the more substantial ones, it would then also be necessary to document the state of occupation of the accommodation, to have a sense of how effectively it can be absorbed by the existing. Finally, a reflection on how to intervene on the building up is also needed to redistribute the buildings where this is possible, this also to reconfigure areas not sufficiently structured. The work wants to be preparatory for a possible regeneration / redevelopment project of this territory aimed at giving greater quality to places and greater dignity for living.

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