THE IMPACT ON THE LANDSCAPE: LARGE INFRASTRUCTURE CONSTRUCTION SITES AS OPPORTUNITIES FOR TERRITORIAL COHESION

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1. Introduction

The research presented, still in development, is part of a project called Sew-Line, coordinated by the University of Padua, along with the University of Bergamo and the University of Rome La Sapienza [1]. The Sew-Line project aims to identify a holistic methodology for the design of large linear infrastructures in agricultural and peri-urban landscapes. Large infrastructures deeply influence landscape perception [2; 3], often appearing disconnected from the landscape, as if they had been placed there without establishing any relationship with it (ibid.).

The study in question concerns one of the case studies of the Sew-Line project: the high-speed/highcapacity line under construction between Verona and Montebello Vicentino[1]. The 44 km stretch between Verona Porta Vescovo and Montebello Vicentino, construction of which began in 2020, traverses an already critical landscape marked by the presence of other transport infrastructures such as the A4 motorway, the historic Milan-Venice railway line, and the Porcilana road. The landscape crossed, characterized by pronounced fragmentation, retains a clear agricultural vocation.

The initiated research focuses on the impact of construction sites on this type of landscape. Construction sites are a strongly impactful feature on landscape perception [4], configuring themselves as marginal, transitional spaces. Their activities have a significant impact from both environmental and social perspectives. Despite their temporary nature, they play a crucial role concerning land consumption, soil quality loss [5], landscape perception [6], and residents' quality of life [7].

The ongoing study aims to develop a design methodology that can leverage the potential for territorial change inherent in construction sites, transforming them from a line of disruption to a line of conversion.

1 The line between Verona and Montebello Vicentino is the first segment of the Verona-Padua and is part of a national and continental strategic context aimed at optimizing rail traffic of people and goods. It is part of the European infrastructure corridors system, TEN-T, with the goal of connecting the most significant logistics and settlement hubs in the European Union by rail (EU Regulation 2024/1979)

2. Body

The study of landscape is a discipline at the intersection of academic research and design research [8] as the landscape itself is a highly mutable element [9], responding to the increasingly rapid changes of the real world [10].

The study begins with the definition of the term "landscape," here understood as the synthesis of human activities on a territory [11; 12]. We considered it important to define the scope within which the landscape fits to delineate the breadth of landscape research. To address the issues related to the multi-sectorality imposed by the meaning of landscape, the research methodology we decided to adopt is Research by Design. This research method is based on the premise that both project and research assume the same elements: awareness, articulation, and acceptance of a problem [13; 14].

First, we formulated the research question: Can a construction site, with its highly disintegrative character, become an element of cohesion and landscape connection?

To answer this, it is necessary to evaluate its impacts, study similar cases, and identify a design strategy that allows for assessing the specific requirements demanded by the broad disciplinary scope of the intervention.

We identified Research by Design as an effective method for managing information from multiple disciplines [15], synthesizing it into a design process that begins with a question, develops with the tools of architects for spatial understanding (data collection, analysis, drawings, mapping, site inspection, scientific literature review, and case studies collection), and aims to conclude, in this case, with a design methodology that manifests as projections of possible future scenarios responding to the initial question [16]. Indeed, design research creates new relationships, possibilities, and, in some ways, new realities [17].

The first step of our research was to analyze and evaluate the extent of soil consumption caused by the construction sites. The assessment of soil type loss is a proxy for identifying the loss of Ecosystem Services, as soil quality and land use are two fundamental indicators for the provision of ES [19].

2.1 Impact Assessment

First, we analyzed the Environmental Impact Assessment documents presented to the Ministry of Environment by IRICAV2 and contacted IRICAV2 and RFI (Italian Rail Network) to access the design drawings, which were provided to us.

We then gathered territorial data related to the project. From the Geoportal of the Veneto Region website, we obtained data on provincial boundaries, buildings, types of agricultural landscapes, and connectivity elements (roads and railways).

We downloaded land use data from Corine Land Cover, in the latest available edition, that of 2018. Finally, using the Google Satellite QGIS layer, we expanded the analysis with data provided by the Satellite Orthophoto.

The data were processed using the QGIS mapping management program to complete the mapping of the construction areas and identify portions of the construction site not accounted for in the Environmental Impact Assessment.

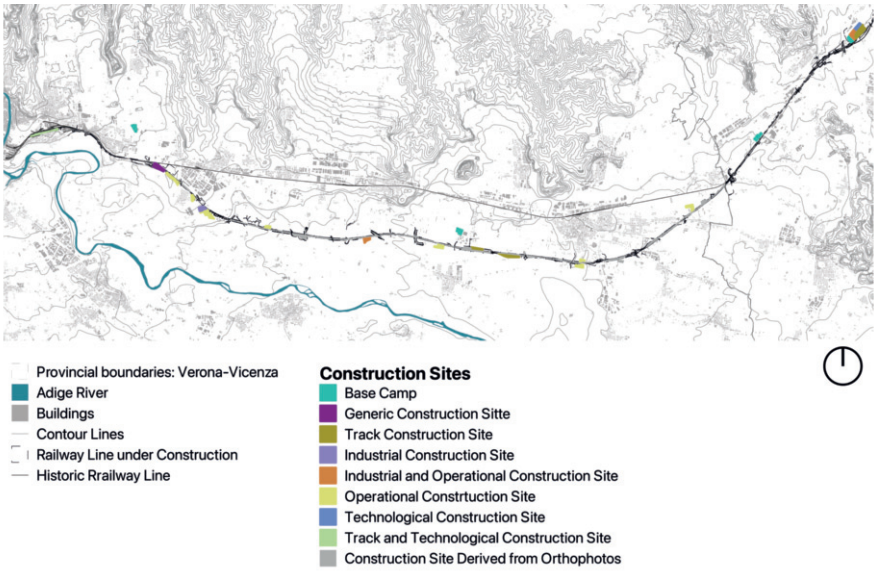
Additionally, we had the opportunity to conduct two site visits to the construction sites under study as part of a Workshop organized by the Sew-Line research in Verona at the end of April 2024. The act of walking is a methodological analysis tool [18] that allowed us to practically identify the impact of construction sites on the territory, soil degradation, and its consumption.

SITE	TYPE OF CONSTRUCTION SITE	AREA (m^2)	DURATION (months)	WORK PROCESSES	USE OF LAND	MITIGATION	RESTORATION
Loc. Mattaranetta, Vr	Base Camp	41000	80	-	Agricolo	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land
Loc. Campagnetta, Vr	Truck Construction Site	160340	72	AC Railway Line Trucking Construction	Arable Land in Irrigated Areas	Grass-covered dune (2m high) along the perimeter of the construction sitelato nord-est	Restoration of agricultural land
Loc. Campagnetta, Vr	Technological Construction Site	26820	80	Technology Platforms; Substations	Arable Land in Irrigated Areas	Mitigations outside the construction site area. Grass-covered dune along the project line	Restoration of agricultural land
Loc. Campalto, Vr	Operational Construction Site	37439	66	Railway Trench; RRailway; Interferences Management; Tunnel; Extension Manholes e Underpass; Buildings; Deviazioni strade; Retention Baisins	Grass-Covered Areas: Non-Rotational Grasses	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of uncultivated land
Loc. Campalto, Vr	Industrial Construction Site	39758	66	Interferences Management; Tunnel; Extension; Manholes e Underpass; Buildings; Retention Baisins; Railway Overpass; Viaduct	Grass-Covered Areas: Non-Rotational Grasses	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of uncultivated land
Loc. La Fumanella, Zevio (Vr)	Operational Construction Site	25580	66	Viaduct; Railway Embankment; Railway Overpass; Manholes; Underpass; Bridge	Arable Land in Irrigated Areas. Fruit trees	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land (fruit tree)
Loc. C.Nova, Belfiore (Vr)	Industrial Construction Site	33670	66	Manhole; Railway Overpass; Bridge; Viaduct; Underpass	Arable Land in Irrigated Areas. Vineyards	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land(vineyard)
Loc. Castelletto, Belfiore (Vr)	Base Camp	41857	80	-	Area awaiting use designation. Currently uncultivated - fallow land	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of uncultivated land
Loc. La Tacchetta, Belfiore (Vr)	Operational Construction Site	43260	66	Railway Embankment; Railway Overpass; Manhole; Underpass; Bridge; Road Diversions; Restoration of traffic routes; Viaduct	Arable Land in Irrigated Areas	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land
Loc. Fossa Bassa, San. Bonifacio (Vr)	Operational Construction Site	51524	66	Viaduct; Deviazione stradale; Underpass; Railway Embankment; Manhole	Arable Land in Irrigated Areas. Vineyards	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land(vineyard)
Loc. Fossa Bassa, San Bonifacio (Vr)	Industrial Construction Site	36210	66	Viaduct; Underpass; Manhole; Railway Overpass; Extension Underpass; Station; Retention Baisin	Arable Land in Non-Irrigated Areas.	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land
Loc. Corte Bosco, San Bonifacio (Vr)	Operational Construction Site	43680	66	Railway Embankment; Underpass; Manhole; Railway Overpass; Extension Underpass; Station; Retention Baisin; Underpass	Arable Land in Non-Irrigated Areas.	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land
Loc. Ca' Bandita. Lonigo (Vi)	Base Camp	45130	80	-	Arable Land in Non-Irrigated Areas.	Grass-covered dune (2m high) along the perimeter of the construction site	Restoration of agricultural land

Table 1: type of construction sites according to the project documents

2.2. Results & Discussion

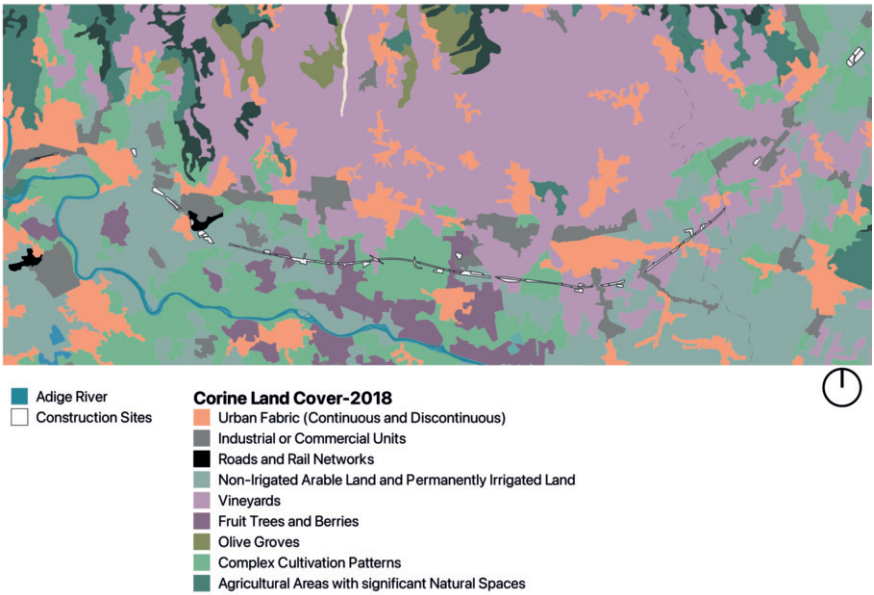
From the study of the documents and design drawings, a discrepancy was found between the project documents and the drawings. The number of construction sites classified in the documents and design drawings (Table 1) is lower than the number of sites mapped from the orthophotos (Map 1). A related issue is the lack of mitigation strategies: the construction sites declared in the project documents are indeed accompanied by an environmental mitigation strategy, which does not appear to be present for those mapped by the research.



Map 1: Mapping of Construction Site

The map is an analysis conducted using QGIS to represent the construction areas of the section. The colored fills represent those derived from the project documents; in gray, instead, are the construction sites inferred and traced from the Google Satellite layer. The territorial data (the historic railway line, contour lines, provincial boundaries, and the course of the Adige River) are sourced from the Veneto Region Geoportal.

We then analyzed and quantified the type of Land Cover affected (Map 2; Chart 1). The majority of the consumed land is agricultural, with a prevalence of non-irrigated arable land and vineyards.



Map 2: Land Cover Types Affected by Construction Sites

The map is an analysis conducted using QGIS to evaluate the types of land cover impacted by the construction sites. The data are sourced from CORINE LAND COVER 2018.

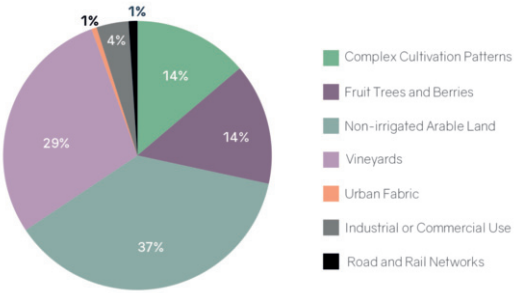


Chart 1: Construction Site Land Consumption based on Land Cover (CORINE 2018)

Processing of territorial data derived from the map: Land Cover Types Affected by Construction Sites.

Out of a total of 2,582,525 m² of construction areas, 66% was determined from the processing and overlay of satellite data, resulting in an increased actual land consumption.

The site visits allowed us to qualitatively assess the impact of the construction sites on the territory, particularly in terms of their disintegrative effect on the land, as well as soil degradation [18] (Images 1 and 2). The visited construction sites appeared as expanses of bare earth where existing trees had been uprooted, separated from the surrounding landscape by orange nets. Soil compaction is a well-known problem concerning soil quality maintenance [19; 20].

Thus, the construction site proved to be a disturbing element from both a perceptual and ecological standpoint.

Figure 1: Construction Site, photograph by the author

Figure 2: Construction Site, photograph by the author

Figure 3: Construction Site, photograph by the author

Figure 4: Construction Site, photograph by the author

The results show that the agricultural land consumption caused by construction activities is a significant factor in the overall impact assessment of the infrastructure. The construction sites affect an agricultural area for 96% of their extent. Land consumption proves to be a problem from many perspectives. Firstly, for the provision of ecosystem services [21], and secondly, for the loss of soil quality. Indeed, agricultural areas are extremely important vectors for providing ecosystem services, especially those related to maintaining ecological integrity [22;23].

Unfortunately, the proposed compensation measures do not seem adequate to offset the damage (Table 1). The mitigation measures presented in the Environmental Impact Assessment do not cover all construction areas, as there are discrepancies between the actual areas and the planned areas, leading to a severe crisis regarding the maintenance of ecological and landscape integrity.

From the site visit to the two construction sites, it was also possible to qualitatively assess their impact on the territory. It is interesting to note how the construction sites indeed function as a buffer zone completely disconnected from the traversed territory. According to the project documents, the previous state will be restored once the sites are decommissioned. However, it will take a significant amount of time for the landscape to return to providing the ecosystem services and environmental, social, and productive functions that were disrupted by the presence of the construction site.

A limitation of the collected results is the partial update of the data, especially those from Google Satellite: the different satellite cells are not all from the same period, so they do not all have the same level of update.

3. Summary

The ongoing study of the AV/AC line construction sites between Verona and Montebello Vicentino, part of the Sew-Line project, highlights the importance of a holistic approach in designing and managing construction sites for large-scale infrastructure. The research reveals a significant impact on the landscape, with 96% of the affected areas being agricultural land. This leads to a loss of productive and environmental functions, contributing to territorial degradation.

A key issue identified is the discrepancy between the construction areas planned in official documents and those observed on-site, which results in inadequate mitigation strategies for some regions. This lack of proper planning threatens ecological integrity and the provision of essential ecosystem services. Site visits provided qualitative insights, showing that construction zones often exist as disconnected marginal spaces, further fragmenting the landscape.

The study calls for a design approach that integrates construction site management into the broader process of territorial transformation. By treating construction sites not merely as temporary disruptions but as opportunities for landscape cohesion and ecological restoration, the negative impacts can be minimized, fostering greater resilience in the affected regions. This proactive strategy could transform construction sites into instruments of territorial regeneration rather than fragmentation.

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