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New scenarios for safe mobility in urban areas

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Editorial correspondence
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

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The cycle network: a latent environmental infrastructure

Managing urban flooding in the region of Abruzzo

Antonio Alberto Clemente

Department of Architecture
University "G. d'Annunzio", Pescara, Italy
e-mail: antonio.clemente@unich.it
ORCID: https://orcid.org/0000-0002-4100-1419

Abstract
The topic to be investigated is the potential interdependence between the cycling network and the management of rainwater in the mid-Adriatic region of Abruzzo. Preliminarily, two observations. The first concerns cycling: in Italy it is constantly increasing, both in terms of territorial diffusion and turnover. The second: the frequency of urban flooding, resulting from extreme atmospheric phenomena, has been constantly increasing. However, cycling and urban flooding are two issues addressed separately. The first is framed as a contribution to slow mobility. The second is treated as a continuing emergency. The goal is to overcome separateness. And imagine the cycle network as an environmental infrastructure that, in addition to supporting the transit of bicycles, can contribute to a better collection and management of rainwater too, as an alternative to the sewer system. This hypothesis works on those cities that have transformed water from an agent that generates dangerous conditions, into a strategic resource. Methodologically, the projects and intervention programs will be compared to the: network space, space associated with the network and context space. The comparison aims to provide some lines of action useful for orienting the actions of the urban plan in the mid-Adriatic region of Abruzzo of Abruzzo.

Keywords
Cycle network; Urban flooding; Environmental infrastructure.

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1. Introduction

In the mid-Adriatic region of Abruzzo there are two phenomena which, in recent years, have assumed an ever-greater importance.

The first concerns the spread of urban and territorial cycling that follows, and sometimes precedes, the national trend, both in the exponential increase in the volume of business linked to the bicycle economy (Il Sole 24 Ore, 2019), and in the employment growth that the sector has shown, with reference to both the production of bicycles and the creation of new cycle paths (ISFORT, 2020). An example is sufficient to demonstrate the importance that slow mobility has assumed along the Abruzzo coast: from Martinsicuro to San Salvo there is an almost seamless route that crosses Vasto, Ortona, Francavilla, Pescara, Montesilvano, Pineto, Roseto, Giulianova, Tortoreto, Alba Adriatica: about 150 km in which the bicycle is a concrete alternative to crossing by car (Comuni Ciclabili FIAB, 2021).

The second phenomenon concerns urban flooding, especially those deriving from extreme atmospheric events which, in recent years, have been constantly increasing in frequency and intensity (ISPRA, 2020). There are multiple causes. The main three are closely connected: the pervasive densification of the Abruzzo coast which "from above offers itself as an undifferentiated segment of the larger agglomeration that borders the entire western Adriatic area" (Bianchetti, 2003), the insufficient drainage capacity of the sewer network that fails to drain rainwater and the excessive waterproofing of the soil (Wright, 2015; Slaney, 2016; Salvati & Bianchi, 2019).

However, in the mid-Adriatic region of Abruzzo, cycling and urban flooding have always been treated as separate, unrelated phenomena, void of connections. On the one hand, the cycle network is seen as a contribution to sustainable mobility (Parkin, 2012; Vittadini, 2015; Calderón, 2012; Deromedis, 2019) which, when it manages to go beyond the quantitative perspective linked to the kilometers of paths built, focuses on topics of great importance such as technical functionality, safety and continuity of the route, horizontal and vertical signage, closure of the network and the search for intermodality, (Giuliani & Maternini, 2018; ECF, 2016; Fleury, 2012; Tira & Zazzi, 2007).

On the other hand, urban floodings, despite the considerable damage caused to the city and the territory, continue to be addressed as a periodic emergency to which, time after time, an answer can be given to bring the situation back to normal in the shortest possible time. An answer that arrives, thanks to the intervention of the Fire Brigade and Civil Protection; with an increase, not negligible, on the municipal budget. And, above all, without a perspective of resolution to the problem. Which becomes increasingly unsustainable: from an environmental point of view, due to the pollution resulting from the flow of surface water into which not only the rain converges but also the return flow of the sewer system; from an economic point of view, for the damages to infrastructures, cultural heritage, residential fabric and production areas; socially due to the risks to which the population is subjected.

The separation between cycling and urban flooding, of course, is not accidental. The reasons are many. One of the most important is the Italian legislative framework.

2. Sector legislative framework

The current Italian legislation does not contemplate the possibility of an interdependence between the cycle path and the management and collection of water. The Traffic Laws[1], its Implementing Regulation[2], the Main criteria and design standards of cycle paths[3], define the types of tracks, the dimensional and plano-altimetric

[1] Decreto Legislativo n. 285 of April 30, 1992. Nuovo Codice della Strada

[2] Decreto del Presidente della Repubblica n. 495 of December 16, 1992. Regolamento di esecuzione e di attuazione del nuovo codice della strada

[3] Presidenza del Consiglio dei Ministri, Circolare n. 432 of March 31, 1993. Principali criteri e standard progettuali delle piste ciclabili.

characteristics of the route, its intersections with ordinary roads, project speed and the requirements of horizontal and vertical signs.

The Regulation laying down rules for the definition of the technical characteristics of cycle paths[4] defines cycle routes in descending order with respect to the safety they offer for cycling users, such as: cycle paths in their lane; cycle lanes on reserved lanes; mixed pedestrian and cycle paths; mixed cycling and vehicular routes.

The purpose of the decree is to promote and encourage a high degree of cycling and pedestrian mobility, an alternative to the use of motor vehicles in urban areas; aim at the attractiveness, continuity and recognizability of the cycle route; assess the profitability of the investment with reference to real and potential users and in relation to the objective of reducing the risk of accidents and the levels of air and noise pollution; verify the objective feasibility and the actual use of cycle routes by users. And with regards to surface water drainage there are only two hints.

The first is in art. 8, which states that a cross slope of 2% is sufficient, with reference to road paving with a bituminous conglomerate wear layer that favors the discharge in the existing sewerage network. The other in art. 12 which clarifies how on the cycle paths the presence of grids for the collection of water is not allowed with main elements parallel to the axis of the tracks themselves, nor with transverse elements such as to cause difficulties for transit for cyclists.

In 2013, the Abruzzo Region Law: Interventions to promote the development of cycling[5], outlines the strategic objectives for urban bicycle mobility. Four are the main ones: increasing the existing network of cycling lanes (privileging the creation of a network), improving safety, including the introduction of specific signage and the connection with the system of public mobility.

Nor is it possible to find anything on this subject in the Provisions for the development of bicycle mobility and the creation of the national cycling network: "Municipalities prepare and adopt urban plans for cycling mobility, called "biciplan", as sector plans of Sustainable Urban Mobility Plans, aimed at defining the objectives, strategies and actions necessary to promote and intensify the use of the bicycle as a means of transport both for daily needs and for tourist and recreational activities and to improve the safety of cyclists and pedestrians"[6].

Just as there is no mention in the Guidelines for the preparation and implementation of the "Biciplan"[7], nor is there any in the Experimental guidelines for the development of cycle mobility[8], both written by the Ministry of Infrastructure and Transport.

This brief examination of the sector legislation shows that the cycle network not only does not contribute to combating urban flooding but, even, facilitates it.

The cycle network is a work of waterproofing the territory.

And considering that in 2017, the length of cycle paths in the provincial capitals is 4,541 km, with a growth (2011-2017) of 4.1% per year (Confartigianato, 2020). It is immediately obvious that this is a significant quantity of waterproofed soil.

From the point of view of the contribution to sustainable development there is a paradoxical situation: if the economic and social pillars are perfectly verified, as mentioned in the introduction, the environmental one, on the other hand, is only partly verified due to a pervasive use of waterproofing materials that could almost always be avoided, especially in the case of bicycle lanes on own premises.

Furthermore, a mono-functionality emerges aimed at guaranteeing the movement from one place to another, in which the network space is, exclusively, the support for cycling traffic.

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4 Ministero dei Lavori Pubblici, Decreto n. 557 of November 30, 1999. Regolamento recante norme per la definizione delle caratteristiche tecniche delle piste ciclabili.

5 Regional Law n. 8 of March 25, 2013. Interventi per favorire lo sviluppo della mobilità ciclistica.

6 Law n. 2 of January 11, 2018. Disposizioni per lo sviluppo della mobilità in bicicletta e la realizzazione della rete nazionale di percorribilità ciclistica.

7 Ministero delle Infrastrutture e Trasporti, October, 2019. Linee guida per la redazione e l'attuazione del "Biciplan".

8 Ministero delle Infrastrutture e Trasporti, May, 2020. Linee Guida sperimentali per lo sviluppo della mobilità ciclabile

3. Case studies

These findings introduce some questions. Does the cycle network only have to be this? Or is a form of interdependence with rainwater management possible? A form that can guarantee full sustainability and contribute to urban resilience?

The answer to these questions is the most important challenge: to overcome separateness. And imagine the cycle network as an environmental infrastructure that can contribute to urban resilience, through a project that, in addition to supporting the transit of bicycles, is able to contribute to a better collection and management of rainwater, as an alternative to the sewer system.

It is evident that such a hypothesis of work has no ambition to be a resolutive one. Rather, it intends to delimit the field of investigation in the context of a topic of great importance: to counteract the negative effects deriving from urban flooding, urban planning must transform water from an agent generating dangerous conditions, into a strategic resource for rethinking ecological regeneration; it must rethink open spaces according to their ability to provide adequate environmental performance; and again, it must go in the direction of de-waterproofing all those surfaces that allow it.

Boston, Melbourne, Philadelphia, San Rafael, Zwolle and Copenhagen are going in this direction.

3.1 Greater Boston: Western Avenue (Cambridge)

"Scientists have predicted an overall increase in sea level of 4 to 6 feet by the end of this century, which will place a large portion of existing infrastructure networks in Greater Boston under water. While conversations with community leaders have already begun in regard to how to make Boston more resilient, the challenge of implementing these ideas needs to be addressed. Infrastructure vulnerabilities in the electric grid, natural gas, potable water, sanitary sewer, and public transportation systems prevent resilient development throughout Greater Boston" (Haffner, 2015). To counter the flood risks, the metropolitan area developed a policy called *Developing resilience. Living with water strategies for Greater Boston*. The starting point was to realise that the lack of a public debate on the social and economic implications of floods has led to a general underestimation of the risks to be faced (Boston Green Ribbon Commission, 2016). That is why raising the awareness of the population and stakeholders as regards the fact that the effects of climate change are the most important challenge for the future of cities was such a fundamental step.

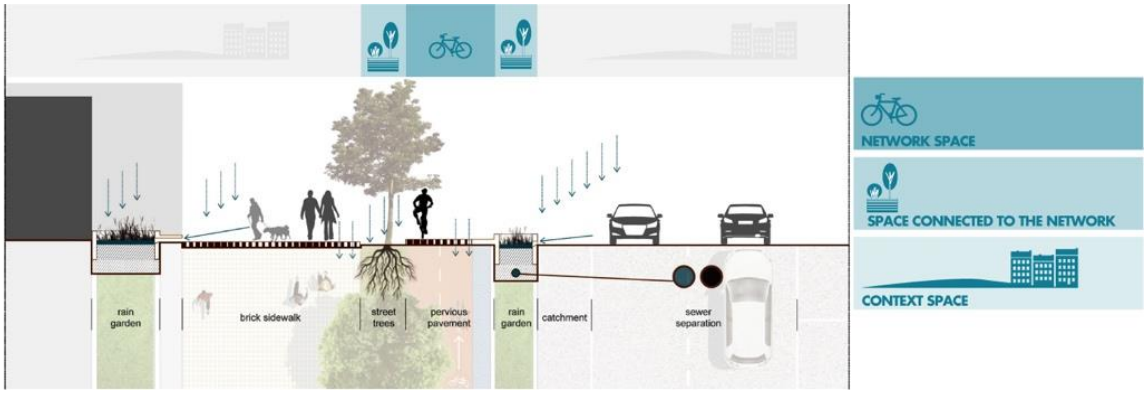

Fig.1 Greater Boston (Cambridge), section of Western Avenue

Developing resilience is a systematic set of measures on a supra-municipal scale the overall aim of which is to improve the sustainability and resilience of the urban system. From a programmatic point of view, a series of projects are planned in the residential sector in order to improve the environmental performance of buildings; in the infrastructural sector in order to reduce the vulnerability of the electricity, natural gas, drinking water and sewage networks; in the transport sector in order to make public and private mobility more sustainable.

And this is precisely the sector into which the redevelopment of Western Avenue falls. A road that plays a major role in linking Central Square and the Charles River in Cambridge. The project has two main objectives: to moderate car traffic flows and to improve rainwater treatment. The first of these objectives was pursued by reducing the carriageway and expanding the cycle/pedestrian section. The second resulted in the construction of a cycling path out of permeable material while the part immediately adjacent to it consists of green stormwater infrastructures. Both these solutions allow the water to flow towards a pipeline completely separate from wastewaters. From the hydraulic point of view, this pipeline dedicated to filtered water, both from the permeable floor and from the vegetation, has a double positive effect: it increases rainwater drainage capacity and reduces the pressure on the sewage system. Western Avenue is both a sustainable and resilient project because the soil becomes not only a support for cycling but also an environmental infrastructure which fits perfectly into the urban context.

3.2 Melbourne: The La Trobe Street Green Bicycle Lane

As part of Bicycle Plan 2012-16 (City of Melbourne, 2012 a), the La Trobe Street bicycle lane is an innovative project that combines water capture, urban greening and bicycle safety in a busy urban street. The design involves the narrowing of the roadbed and the modification of parking stalls. The lane is separated from the street by a traffic divider that also serves as a planting bed for trees. This bed is used to channel stormwater from the street and water that penetrates through the porous asphalt finish of the bike lane. The structure of the planting bed is designed to favour the passive irrigation of the tree roots. On the one hand this limits the risk of flooding and, on the other hand, helps reduce stormwater pollution. Thermal imagery has shown La Trobe Street to be one of the hottest areas in the city. The planting of trees that cover the bicycle lane serves not only to collect and manage stormwater, but also to create shade and cool the air. However, the trees can also have a negative impact on safety for cyclists. A study identified three actions for reducing this risk: the use of bike-friendly drain covers, pruning of the trees up to a height of 2.4 metres above street level to maintain the efficiency of sunlight and the selection of trees with slender trunks.

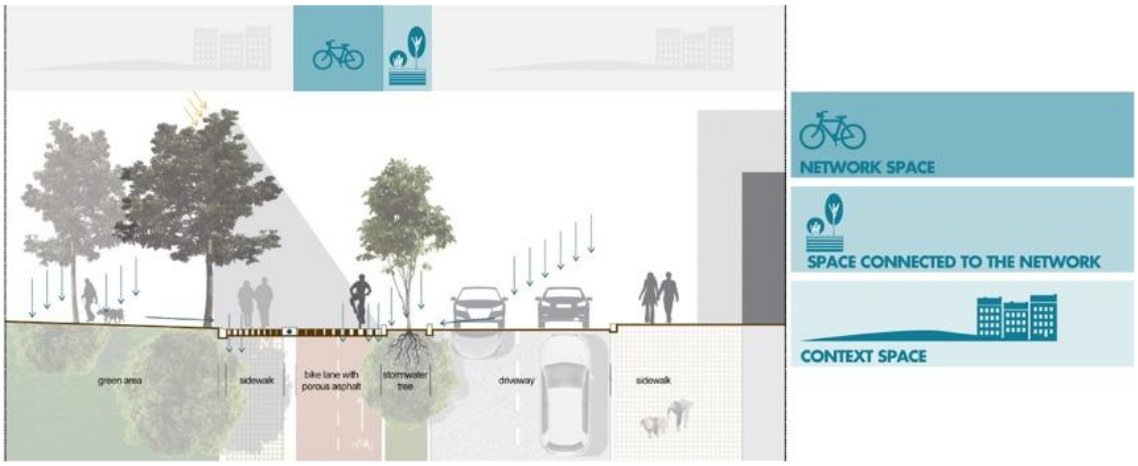

Fig.2 Melbourne, section of The La Trobe Street Green Bicycle Lane

The La Trobe Street green bicycle lane belongs to a vaster understanding of the contribution to the implementation of the *Total Watermark: City as a Catchment Strategy* (City of Melbourne, 2014) for the integrated water cycle management; the *Urban Forest Strategy* (City of Melbourne, 2012b), program to create a more resilient, healthier and diversified city by increasing urban plantings; the Bicycle Plan whose primary aim is to increase the safety and attractiveness of cycling lanes and the Climate Change Adaptation Strategy, which includes a line of specific actions designed to contrast urban flooding caused by extreme climatic events. In light of these brief considerations, The La Trobe Street green bicycle lane is more than a bicycle lane. It is

also an environmental infrastructure that integrates soil permeability with stormwater catchment, passive irrigation and the objective of contrasting heat islands (City of Melbourne, 2013).

3.3 Philadelphia: Green Streets Design Manual

In Philadelphia, *Green City-Clean Water* is an urban policy started in 2011 and continues today (Philadelphia Water Department, 2021). The general aim is to avoid overloading the sewer network, is based on a number of cardinal criteria such as recharging water tables and maintaining and expanding water infrastructures. These are precisely the objectives that a cycle network should pursue as an environmental infrastructure. Especially in the space associated with the cycle network. And this is precisely the main interest of the *City of Philadelphia Green Streets Design Manual* (City of Philadelphia, 2016) which identifies five green stormwater infrastructures for the collection and management of stormwater in densely urbanized areas:

- stormwater planters or rain gardens. Similar to flower beds, they tend to be longer than they are wider. Flanking sidewalks they are used to manage runoff from the street and sidewalk. The level of the planting media in the planter is lower than the sidewalk and paralleled by a drain at the street edge. Rain gardens are used to manage rainwater by allowing for its storage, infiltration and evapotranspiration. Excess runoff is channelled into an overflow pipe connected to the existing sewer network;
- stormwater bump-outs (midblock and corner). These planted extensions of the sidewalk project out into the street, midblock or at intersections to create what is to all intents and purposes a new curb located close to the existing one. A bump-out consists of a layer of stone covered with soil and plants. The slope of the sidewalk deviates the flow of rainwater so that it can be stored, filtered and collected by plants (evapotranspiration). Excess runoff can be channelled into the existing sewer network;
- stormwater trees. This term refers to a tree planted in a bed set into the sidewalk. The upper surface of the planting media is set below street level, and runoff is managed by drains. Water from the sidewalk runs directly into the bed. It is possible to imagine a series of tree beds that are able to manage the highest volume of rainwater, which can successively be filtered or channelled into the sewer system;
- stormwater tree trenches. This is a system of trees connected to an underground infiltration system. On the surface, it resembles a normal sequence of planted trees. However, in reality it is a system composed of trenches dug beneath the sidewalk, finished with a permeable geotextile fabric and filled with stones or gravel, covered by the amount of terrain required to support the trees' root balls. Rainwater flows from the sloping sidewalk and from the street into a horizontal drain connected to the underground infiltration system. Water can be stored in void spaces between stones and used to irrigate the trees and slowly filter through the base layer;
- green gutter. This narrow, elongated and shallow landscaped strip along the street curb (or that of a bicycle lane) that manages stormwater runoff. The upper layer of the planting media is set lower than the street level to aid runoff from the street and sidewalk. The system attenuates stormwater flows, provides for storage and, in some cases, filtration and evapotranspiration. In flow-through green gutters, overflow runoff can be conveyed to the existing storm drain system, either through an underdrain tied to the existing storm drain system, or as shallow concentrated flow that is conveyed downstream to an existing inlet.

Green Stormwater Infrastructures are extremely important for cycle networks. They represent a plurality of soil-water-plant systems. On one side (or both) of the cycle path, it can be very useful to intercept rainwater and to infiltrate a part into the soil and evaporate the remaining portion into the air.

This, without any pressure on the existing sewer system. In other words, the Green Stormwater Infrastructures considers stormwater runoff as a resource to be incorporated into the urban environment instead of a waste product requiring removal and treatment.

3.4 Elevate San Rafael

San Rafael is the city most exposed to flood risk in the whole of San Francisco Bay. In the face of this problem, more traditional solutions no longer seem sufficient, not only to counter the dangers of urban flooding but also to return the city, in a short time, to the condition it was in prior to the stress situation caused by heavy rains, rising sea levels or both. Simply raising banks to counter the disastrous effects of urban flooding can no longer be the only solution; the trends under way, with which everyone is well acquainted, need to be countered in order to plan the most appropriate measures in advance. In other words, steps need to be taken in order to move from the logic of emergency to that of priority. It is on the basis of these considerations that the "Elevate San Rafael" project was born.

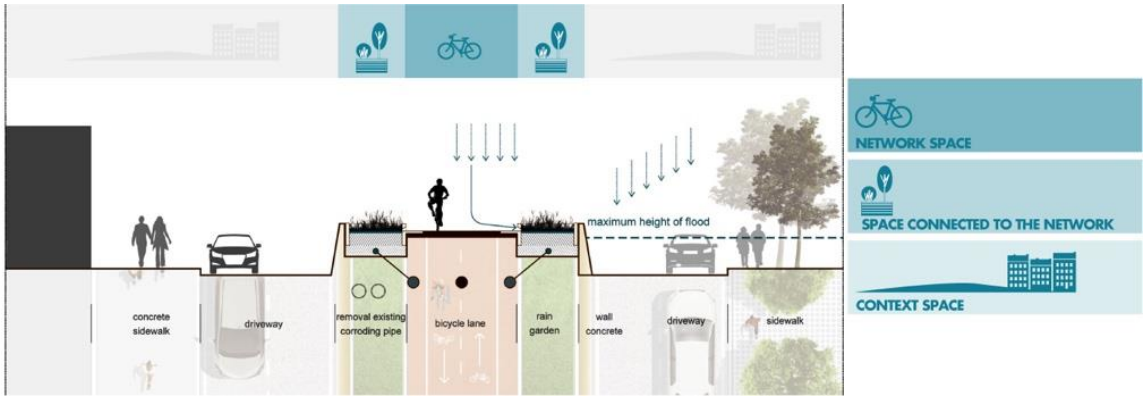

Fig.3 San Rafael, section of Canal Street

A project characterized by a multidisciplinary approach to the theme of urban flooding in which "Elevate San Rafael is a new paradigm to respond to the complexity of environmental change. We propose that the city evolve by employing time-tested approaches to coastal adaptation in combination with a moral, financial, and infrastructural agenda for large scale preparedness. In this process of strategic change and redefining the relationship to the bay, we see the singular opportunity to elevate all aspects of life. To physically elevate habitation, and the bonds of community and dignity. To elevate ones social and financial position in life, and policy for urban change. To lift infrastructure to new elevations and purposes and allow for ecology to persist and expand" (Bionic Team, 2018). The strategy is based on an immediate response which includes a series of measures called pilot and catalyst projects with the aim of protecting San Rafael now, to better prepare for the future, and a longer-term response consisting in the re-elaboration of the entire urban structure, its mobility, its infrastructure and its residential and productive areas. As part of the pilot and catalyst projects, a new elevated cycling path is planned along Canal Street and Francisco Boulevard, which, on the one hand, would complete the Bay Trail route and, on the other hand, would protect the city closest to the sea from flooding. Such solution envisages the Bay Trail being raised by 30 cm to about 130 cm in all its parts to ensure the community is protected until the middle of the century and reduce the need for additional short-term protection measures along the coast.

This is a special case for a cycling path: it is not only a bike path but also a project that, through soil modelling, relates to the needs of the urban context because it links the coast with the downtown areas and becomes a tool for sustainable local development. The prerogatives of this bike path do not however stop there. The track is, in fact, a new environmental infrastructure for the drainage of water that works in two directions: it provides for the replacement of existing metal pipes, now corroded, with new materials and increases the dispersion of water in the landfill used for the elevation. A real stormwater infrastructure that contributes to the greater resilience of the urban system.

3.5 Zwolle and Plastic Cycle Road

The Plastic Road is a prefabricated road structure with which a section of the cycle network in Zwolle in the Netherlands was built. Beyond its modest planimetric extension, it is important to emphasize its degree of innovation. Three fundamental characteristics. The first concerns a fact of extraordinary interest from the point of view of sustainability: be made with entirely recycled plastic materials and, above all, recyclable even after its disposal. Another important aspect is the prefabricated production and the design realized in light modules that makes the installation very fast, to the point that the times for its realization are reduced by about 70%. All this is combined with much higher resistance and durability than traditional cycle paths. Although these two peculiarities are very relevant from an environmental, social, and economic point of view, what matters most with respect to the issue of treatment and management of rainwater is the hollow modular structure inside. This third characteristic was imagined to counteract rain flooding even in the presence of extreme atmospheric phenomena, thus avoiding overloading the sewage system.

Fig.4 Zwolle, section of the Plastic Cycle Road in Deventerstraatweg

Considering that the surface of the Plastic Road is completely waterproof, the water collection system consists of a storm drain located at a lower level than the road. This storm drain runs parallel to the hedge which helps to manage the flow of water due to the slope, since the ground level is at a lower level than the cycle path. This allows you to manage rainwater allowing storage, infiltration, and evapotranspiration. An effect that is amplified by the system of trees adjacent to the hedge (Plastic Road, 2018).

3.6 Copenhagen

"Climate change challenges are clearly defined in Copenhagen and in Denmark. 1000 km of dikes protect many parts of the country from the sea, but the new threat is the water from within and from above. Our fate has become being inundated with torrential rain that floods entire neighbourhoods. The existing sewer system is completely inadequate to tackle the volume of water from cloudbursts" (Colville-Andersen, 2015). The *Climate Adaptation Plan* (City of Copenhagen, 2011) includes a range of actions to contrast urban flooding. However, it was in the wake of the July 4, 2011 flood that the problem created by heavy rainfall during extreme weather events became one of the principal points for rethinking the entire city. This rethinking began with the *Cloudburst Management Plan* (City of Copenhagen, 2012) and evolved with the *Cloudburst Concretisation Masterplan* (Ramboll, 2013), in other words, proposals to transform streets into infrastructures for storing and draining stormwater. However, these infrastructures require a certain road section that is not always available. This is precisely the reason for the creation of *The Copenhagenize Current – Stormwater Management and Cycle Tracks*, thanks to this design solution even the narrowest streets can help contrast urban flooding. The strong idea is to use the space beneath bicycle paths with the twofold objective of creating a diffuse

stormwater drainage system, separate from the city's sewer network, and to improve the infrastructures offered to cyclists.

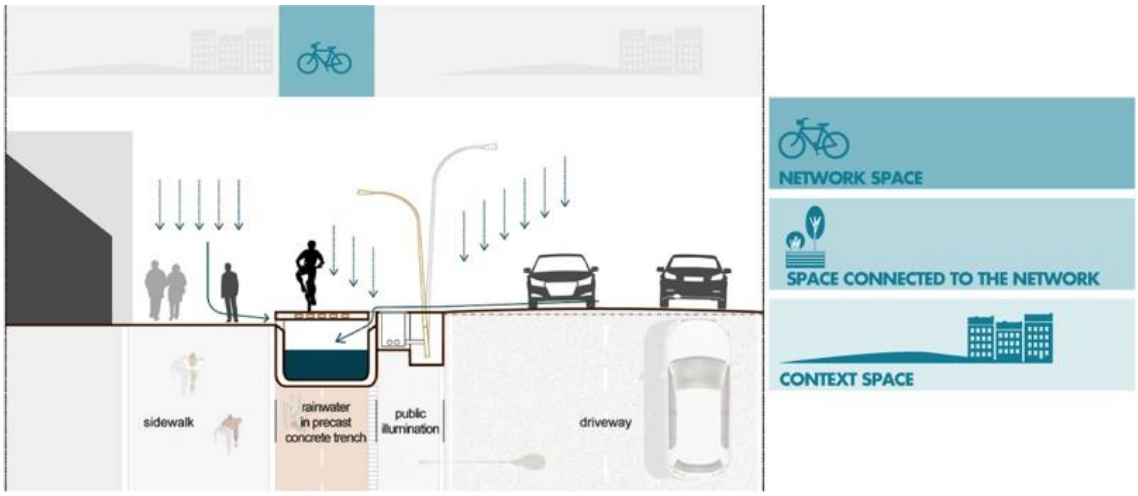

Fig.5 Copenhagen, Copenhagen, section of *The Copenhagenize Current*

These objectives are pursued using prefabricated concrete channels covered by concrete slabs, also prefabricated, that form the base of the bicycle path. The slabs can support the weight of thousands of cyclists as well as the weight of automobiles crossing at street intersections. Additionally, the slabs feature integrated LED lights to improve visibility and heating coils that melt ice during the winter. Other elements of the project include storm drains flanking the sidewalk and street to drain stormwater from both sides, while simultaneously blocking the flow of detritus. The entire system is easy to install and maintain. What is more, it also provides for the possibility to reserve space, when necessary, for the insertion of underground urban utilities. *The Copenhagenize Current* integrates the drainage capacity of the existing sewer network, accelerating drainage of water that is channelled toward the river, the sea and Saint George's Lake (Colville-Andersen, 2015).
This experience was also accompanied by another. Marina Bergen Jensen, professor in Design and Construction of Urban Landscapes Adapted to Climate Change at the University of Copenhagen, has developed a project to create a vegetal wall that functions as both an acoustic barrier separating bicycle and automobile traffic and as an element for the capillary rising of stormwater that accumulates in the channel beneath the path (Bergen Jensen, 2015).

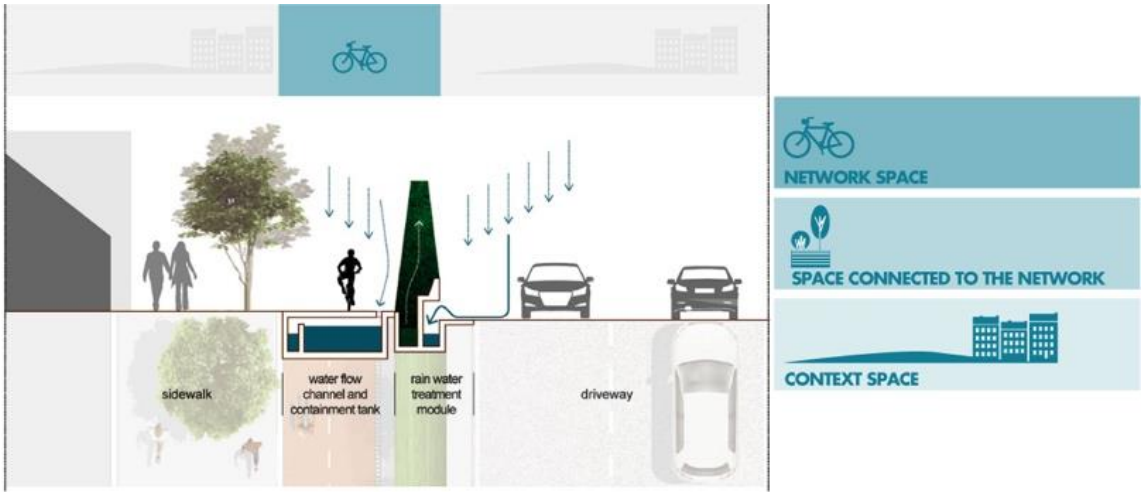

Fig.6 Copenhagen, section of the project idea by Marina Bergen Jensen

These two examples are also two testimonies. While Copenhagen can boast of one the largest and safest bicycle networks in Europe, it continues to innovate. In terms of sustainability: the public administration has made cycling a priority over the use of any other means of transport and is currently implementing a series of policies to dissuade the use of private vehicles. The government is also creating conditions to permit more rapid connections by bicycle. In terms of resilience: *The Copenhagenize Current* and the project by Bergen Jensen create a different thickness and greater depth of the ground level with respect to that strictly necessary for the transit of bicycles. Thanks to the use of prefabricated channels, in addition to serving as support for mobility, the network also helps improve stormwater collection and management.

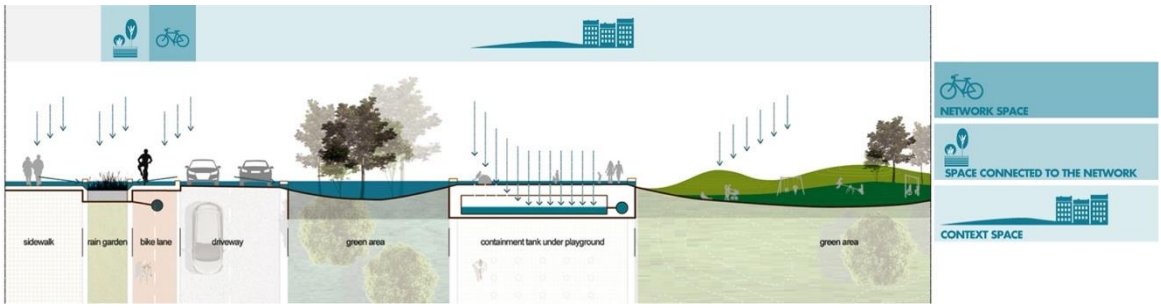

Fig.7 Copenhagen, section of the Skt. Kjelds District

It is once again a perspective of sustainability and resilience that presides over the requalification of public spaces such as Saint Kjelds, referred to as *The First Climate District* (Tredje Natur, 2016) and Hans Tavsen's Park (Andersson, 2019). Thanks to different architectural solutions, during extreme weather events the urban landscaping of these public spaces drains heavy flows of water and, when they are truly excessive, channels them into underground reservoirs. In this landscape, bicycle paths participate in achieving these objectives thanks to their necessary slopes, which channel water toward these stormwater infrastructures.

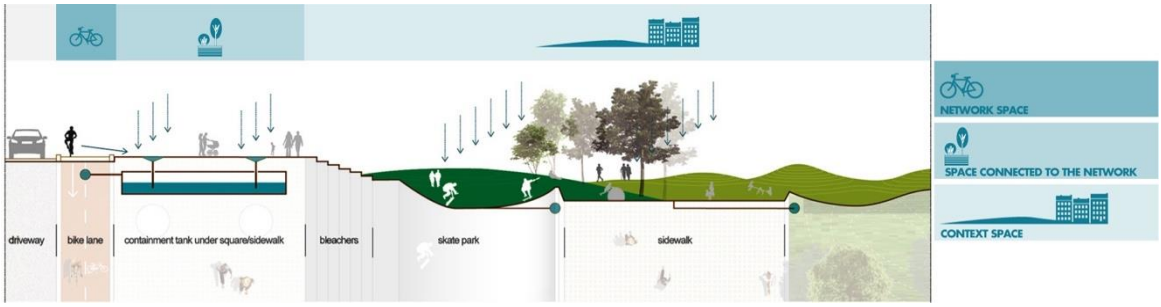

Fig.8 Copenhagen, section of the Hans Tavsen's Park

Perhaps this explains why "the Little Mermaid is a brilliant fairy tale, but the statue, in my opinion, is a lame monument for a city like Copenhagen. I firmly believe that the greatest monument we have ever erected is our bicycle infrastructure network. It is an intricate and complex work, ever changing and in constant motion and constantly modified and improved by hundreds of thousands of citizens and visitors alike who use it each day. An organic structure of such overwhelming beauty. There is no ownership of this monument. It is completely open-source and it's not reserved for Copenhagen alone" (Colville-Andersen, 2018).

4. Conclusions

From the environmental infrastructure viewpoint, the cycle path is a much larger and complex system than a strip of asphalt: the comparison of case studies says that the system is mainly made up of three types of spaces, strictly interrelated to each other.

The network space: the area on which cycle traffic passes which can be used for permeable pavement. The pavement porous surface and subterranean stone reservoir provide temporary storage before the water filters into the soil.
The network space could also entail the prefabricated concrete channels which, placed under the path, would allow the collection and management of water. The space connected to the network: the ideal place for green stormwater infrastructures that contribute to increasing the permeability of the soil on one or both sides of the cycle path. Finally, the context space within which the cycle network opens itself up to the city. It relates to the places it crosses, it establishes privileged relationships with the public space, and opens to an interdependence between infrastructure and context.
Unfortunately, the region of Abruzzo is going in another direction. An emblematic example is the "Biciplan" of Pescara: a sector plan of the Sustainable Urban Mobility Plans, according to the provisions of the Law n. 2, January 11, 2018 and to the subsequent guidelines of the Ministry of Infrastructure and Transport (October, 2019 and May, 2020). In fact, the "Biciplan" of Pescara is made of three levels: Infrastructural, Services and Promotional.
The Infrastructural one includes the Urban Cycle Network which integrates the priority cycle network of the municipal area (crossing and connection between the parts of the city along the main traffic routes) and the secondary cycle network (neighborhoods cycle paths). La Ciclopolitana consists of four perimetric circuits and three crossing axes. The services for cycling comprise bike-sharing stations; guarded cycle-parking areas; charging stations for e-bikes, Infopoints and bicycle repairing shops. The Promotional plan outlines policies to encourage the use of bicycles, both in terms of information and incentives. Promotion is also pursued through advertising, targeted communication campaigns, marketing activities, dedicated days, events, involvement of stakeholders, testimonials, etc."[9].
In other words: nothing more than what the law requires. The Biciplan of Pescara shows a real lack of interest with regards to a better collection and management of rainwater. Despite what clearly emerges from the meteorological data: "the most frequent problem in Pescara concerns flooding due to heavy rains that almost paralyze the entire city, often causing problems in lower floors of public and private buildings and making it difficult for citizens to move around, and use public facilities" (Legambiente, 2020).
The perspective of intervention must be reversed bringing the relationship between the cycle network, collection and management of rainwater within the ordinary themes of the urban plan. This is what Boston, Melbourne, San Rafael, Zwolle and Copenhagen have done, transforming the cycle network into an environmental infrastructure. It has become necessary to make a multiplicity of strategic choices In Pescara and the rest of all the mid-Adriatic region of Abruzzo. Three are the main ones.
Firstly, it is necessary to exit the sector logic. The cycle network is not a small highway in which specialization of transit, controlled speed or safety and route continuity are the only locus of attention. The cycle network, instead, does not remain at the side of the territory, with which it fails to activate any link. It is in relation to the places it passes through, establishing privileged relationships with the public space and opening to the interdependence between infrastructure and environment. To achieve this, it is essential to give importance to the cycle network relation created with the context space.
The second strategic choice concerns the need to focus on smaller networks and, in particular, slow mobility. For the mid-Adriatic region of Abruzzo, it would be a historic reversal of the trend: the perspective of transport engineering would be overturned. Transport engineering, from the second post-war period, imposed the idea that to solve the problems of mobility and accessibility one should invest only in large infrastructure. Pescara is an undisputed icon of this method. Its construction was strongly influenced by the railway along the coast, by the State Road 16, the A 14 Motorway, the "Asse Attrezzato" and the junctions connecting with the urban road network.

[9] http://versopescara2027.comune.pescara.it/bici-plan/

Changing direction is possible, as Copenhagen demonstrates. The capital of Denmark, after the flood of 2011, was able to innovate the practices of urban planning and design. Innovation also involved the cycle network and was conceived as an opportunity to guide the morphological quality of the interventions. The district of Sankt Kjelds and the park of Hans Tavsen Park are the clearest evidence of this.

Only apparently, the third one is the most paradoxical choice. The cycle network must work even in the absence of traffic when atmospheric events occur, especially extreme ones. In this case, the network loses its support function for the bicycle transit to acquire a permeable body which has the purpose of reducing the recovery times of the area affected by the negative effects of a flood. To achieve this result, the project can go towards the permeability of the cycle path (Boston, Melbourne, San Rafael), or provide for the installation of underlying prefabricated canals (Copenhagen), or grids for rainwater collection (Zwolle). Even more, deciding how to design the space connected to the network and the context space concerns the geomorphological conditions, the width of the road section, the possibility of integrating the underground system or not and, more generally, the possibility of creating alternative solutions to the sewerage system for the collection and management of rainwater. Respecting this third strategic choice means going in towards the direction of full sustainability because it would remedy the paradox of the cycle path as a work of soil waterproofing.

The cycle network as an environmental infrastructure is not just a vision for the future of Pescara and, more generally, mid-Adriatic region of Abruzzo. It can be so much more. The technical-architectural devices used in the case studies, although not explicitly provided by Italian legislation (national and regional), are not even prohibited. This means that it is necessary to innovate. And this is precisely the responsibility that, ultimately, who plans a cycle network must assume: making it become a part of a wider territorial project capable of triggering not only sustainable development processes but also urban resilience.

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Image Sources

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Author's profile

Antonio Alberto Clemente

Professor of Urban Planning at the University of Chieti - Pescara "Gabriele d'Annunzio". Since 2018 he has been a member of the Council of Representatives of the Italian Society of Urban Planners (SIU). In 1999, he obtained its Ph.D. in Urban Planning at the Universities "Sapienza" of Roma and "G. d'Annunzio" of Pescara. Since 2013 he has been actively collaborating with various research groups working on issues related to sustainability and territorial resilience with particular

reference to Slow Mobility. In 2021 he obtained the National Scientific Abilitation (ASN) as Associate Professor in Urban Planning (SSD ICAR 21).