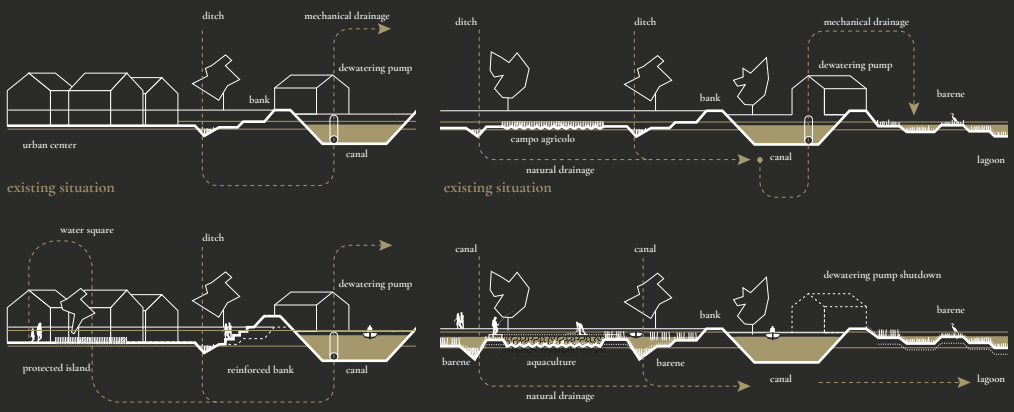


reinforcement of the embankments, construction of water squares and maintenance of water pumps in urban centres

shutdown of dewatering pumps, conversion of ditches into canals and conversion of crops into aquaculture fields

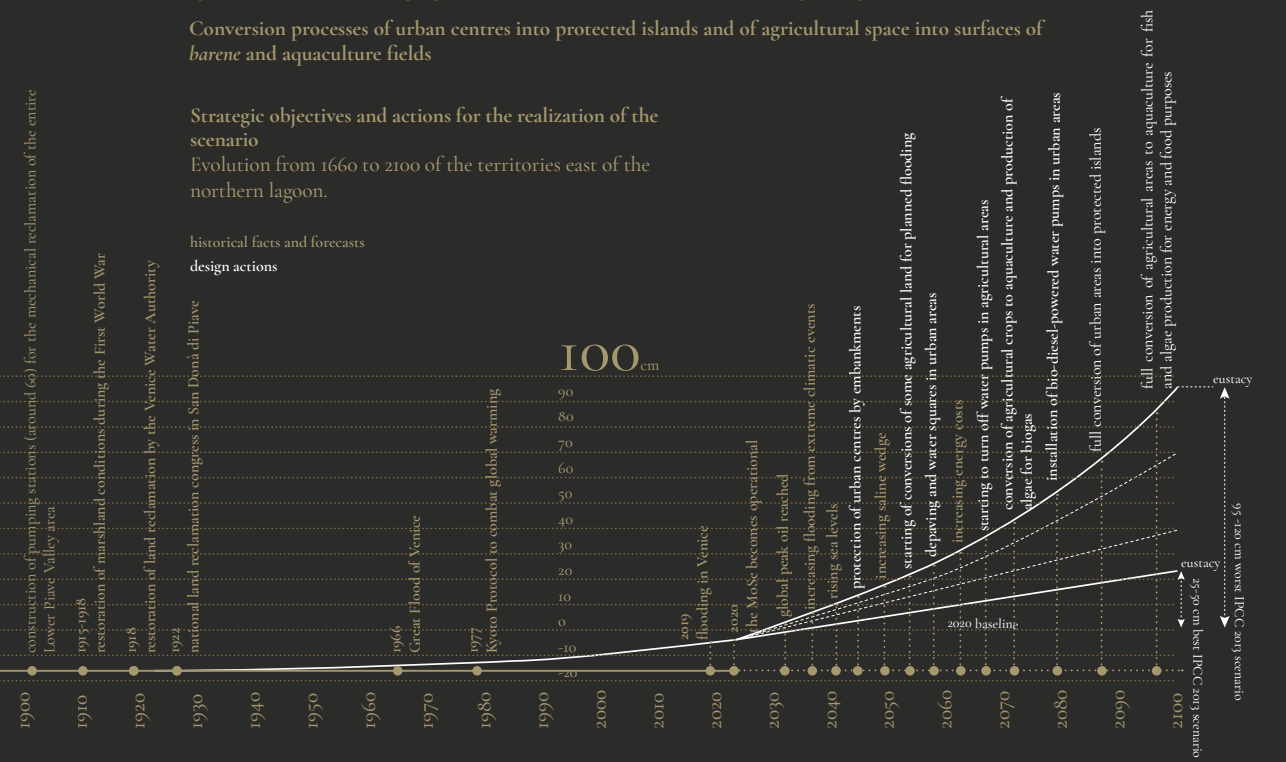
Conversion processes of urban centres into protected islands and of agricultural space into surfaces of *barene* and aquaculture fields

Strategic objectives and actions for the realization of the scenario

Evolution from 1660 to 2100 of the territories east of the northern lagoon.

historical facts and forecasts

design actions



deposit of infrastructures inherited from the past is converted to the new hydraulic rationalities thanks to an incremental process that is governed by the reclamation consortia (see diagrams top right): the ditch system is converted into a dense network of navigable canals, the dewatering pumps are progressively shut down, the agricultural fields gradually transformed into new surfaces of *barene* and aquaculture valleys of fish or algae for food and energy purposes, experimenting with forms of polyculture that were typical of fishing valleys; the urban centres become islands protected by reinforced embankments, in them the drainage of the water is guaranteed by the water square and by small water pumps powered by bio-diesel obtained from the cultivation of algae. The multiplication of this strategy in territories with altitudes lower than 80 centimetres allows the expansion of the northern and southern lagoons beyond the current limits of the lagoon.

A new amphibious territory beyond the North Lagoon

Micro-reliefs and subsidence

Subsidence rate (mm/year)

- 0,5 - 2
- 2 - 3
- 3 - 5
- 5 - 10

Micro-relief (m)

- 0,5 / 2,5
- -0,25 / -0,5

Water and drainage

- water network
- water pumps

Water permeability

- low
- moderately low
- moderately high
- high
- very high
- urban areas

2100 scenario: the new islands of the extended eastern lagoon

San Donà di Piave (42.000)

Jesolo (26.314)

San Stino di Livenza (12.863)

Eraclea (12.322)

Ceggia (6.145)

Torre di mosto (4.785)

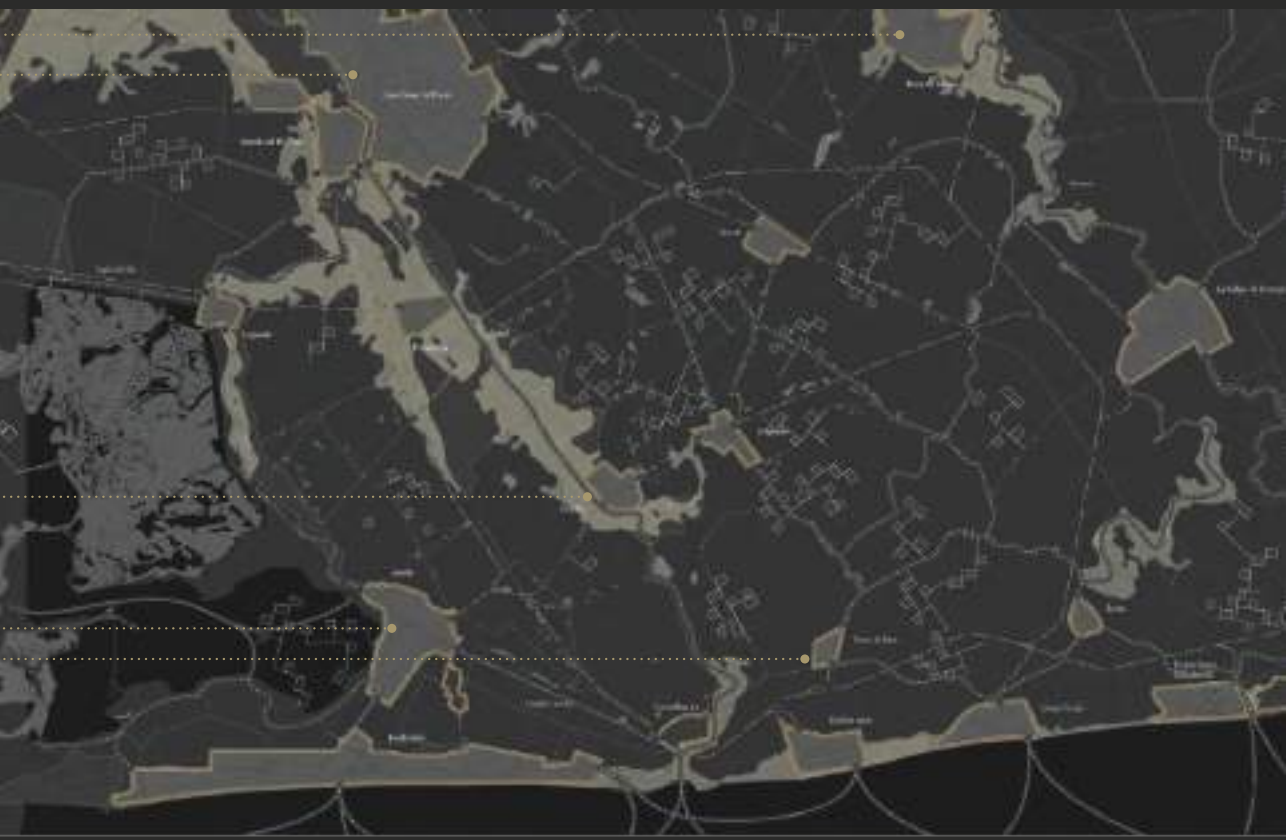
Torre di Fine (950)

Cà Turcata (310)

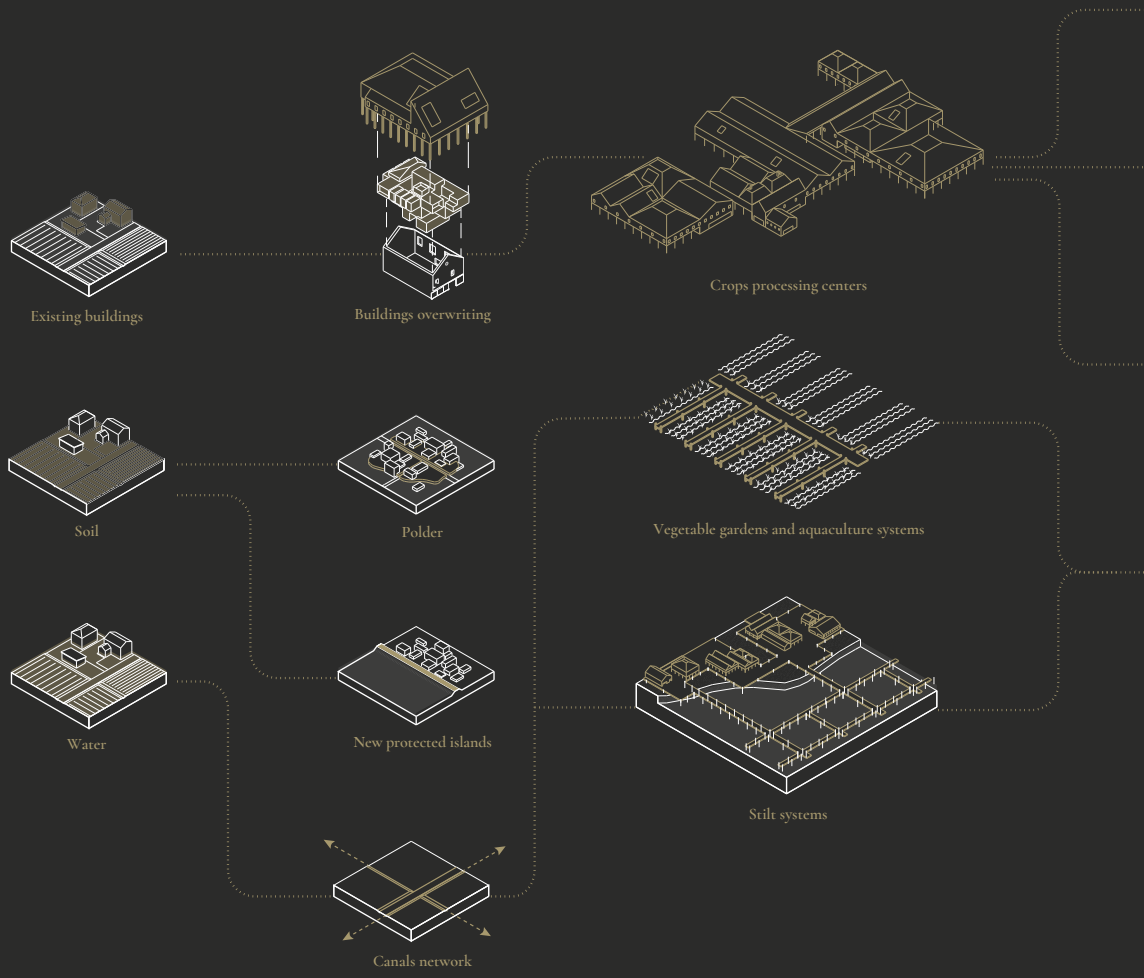
The territory located east of the northern lagoon is entirely included in the low humid Venetian plain, characterized by the presence of clayey depressed soils and of an aquifer located 1-2 m below the surface of the countryside level. The microrelief shows a territory with altitudes between 0 and minus 1.5 metres above sea level, interrupted by the natural embankments –result of the deposits of the river courses– or artificial –coinciding with the road infrastructures and in the more urbanized parts of the territory. The subsoil is characterized by the presence of fine-grained sediments (silts-clays) which cause little or no permeability of the soil. This condition, together with the waterproofing of the soils determined by the ever increasing urbanization, tends to exacerbate the propensity for flooding. The drainage of water, now guaranteed by a dense network of canals, ditches and dewatering pumps whose purpose is to eliminate excess water, will no longer be effective, nor sustainable in the perspective of an increase in sea level, of the intrusion of the saline wedge and of the depletion of fossil fuels.

2100 scenario:
a new amphibious territory beyond the northern lagoon
Extension of the northern lagoon between Caposile and Eraclea Mare.

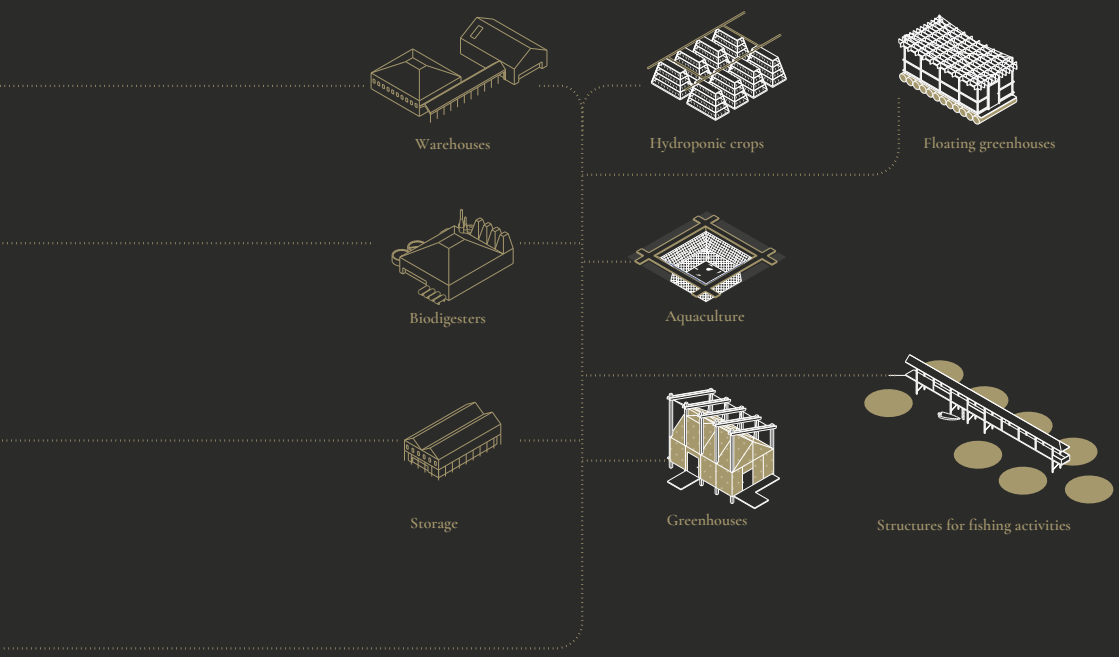
0 2,5 5 10 km



A new amphibious territory: devices



The scenario explores an alternative development model both to the abandonment of the territory and to the strategies of mechanical resistance to the intrusion of marine waters. It investigates the possibilities of amphibious life forms through the organization of a territory that remains productive thanks to the conversion of existing crops into modern aquaculture systems for the production of food or energy. New islands are created, resulting from the embankment of existing urban centres in which depaving processes, the installation of water squares and off-grid systems are tested to facilitate the disposal of rainwater. In the countryside returned to the water, prototypes of pile dwellings are investigated as a result of the redesign of existing buildings and micro-polders for farms to support aquaculture. A capillary network of navigable canals, resulting from the conversion of the hydrographic network and of the mesh of existing water drainage ditches, overlaps with public mobility systems organized by land along the embankments and elevated roads.


Warehouses
Hydroponic crops
Floating greenhouses
Biodigesters
Aquaculture
Storage
Greenhouses
Structures for fishing activities


STRETTI
aquaculture
aquaculture
micro-polder
people mover
barene
Livenza river
new canals
monorail
micro-polder
aquaculture
micro-polder
LA SALUTE
DI LIVENZA
CREPALTO
barene
new canals
new canals
monorail
ERACLEA
aquaculture
micro-polder
micro-polder
Piave river
BRIAN
PORTO DI FINE
PORTO ST.
MARGHERITA


station
NEW PROTECTED ISLAND
urban drainage
bank
bank
barene
construction sites
construction sites
new polder
monorail
station
new canals
new canals
new canals
new polder
algae culture
aquaculture systems


mainland
barene
barene
construction sites
construction sites
monorail
aquaculture systems
algae culture
vegetable gardens
new polder
new polder
overwritten buildings
overwritten buildings

An amphibian metropolis

Today the Venetian metropolis has extended until it largely coincides with the drainage basin of the lagoon itself, a widespread city where more than two million people live, which develops between the Brenta and Piave rivers and includes within it the cities of Mestre, Padua, Treviso, and Castelfranco Veneto.[▸8] Some recent research has highlighted the need to study this vast territory starting from its water networks (Fabian and Viganò 2010; Fabian, Secchi, and Viganò 2016). Observing the main systems of rationalization of the water network deposited over the centuries (Rusconi 1991) it appears evident that the "diffuse city" of the Venetian metropolis is the result of a long process of territorial construction based on the governance of water and its environmental infrastructures, aimed at domesticating a part of that Mediterranean which for Braudel was the 'liquid plain' (Braudel, Coarelli, and Aymard 1977).

Today in the drainage basin, due to the changing climate, widespread urbanization and waterproofing as well as the lack of maintenance of the water network, 18% of the land area is at risk of flooding; in the metropolitan area of Venice alone, it is estimated that 28% of the surface is sensitive to flooding (LIFE VENETO ADAPT 2018). In the territories on the edge of the lagoon, the combined effect of tides, eustatism, and subsidence is exacerbated by intense meteorological phenomena and the average sea rise caused by global warming. Often in autumn, in the presence of sudden and violent rainfall, the environmental fragility of the territories on the edge of the lagoon reverberates in a catastrophic way on the wet plain and the entire hydrographic system of the drainage basin of the Venetian metropolis. It is no coincidence that the weather-climatic conditions that led to the flood of 2019 are very similar to those of the last great flood that hit the heart of the "diffuse city" between the end of October and the beginning of November 2010, involving 262 municipalities in the provinces of Verona, Vicenza, Padua, Treviso, and Belluno, leading to devastation estimated at 426 million euros (Regione Veneto 2011; Regione Veneto, Servizio Statistica 2011). In addition to floods, forecasts and mathematical models for the study of climate change show how the problem of water will be increasingly related to scarcity in the future. A study conducted by ARPAV and the University

▸8 Among the many publications, see Fondazione di Venezia (2019) and in particular the chapter '*Definizione dell'area di programma: da civitas a polis che ne valorizza la struttura policentrica*' (*Definition of the programme area: from civitas to polis that enhances the polycentric structure*) (Costa, Ferranna, and Nicosia 2021).

of Padua, having as its object the analysis of the drought index on a historical series of 43 years for 20 meteorological stations in the Veneto Region, has in fact highlighted how extreme and sudden meteorological phenomena are also accompanied by a general increase in drought phenomena and a substantial and progressive reduction of their return time (Cacciatori *et al.* 2005). The studies contained in the *Piano di Gestione del Rischio Alluvioni del Distretto idrografico delle Alpi Orientali* (*Flood Risk Management Plan of the Eastern Alps Hydrographic District*) of 2016 show how the combined effect of the average reduction in rainfall and the increase in temperatures expected for the next 100 years will have consequences in the evaporation of water reserves, leading to an exacerbation of the already existing problems of water scarcity that characterize the region (Hydrographic District of the Eastern Alps, 2016).

The adaptation scenarios that have arisen from climate change may seem unrealistic, alluding to a radical transformation of the territory that will involve considerable economic resources, time and a capacity to govern the territory that would seem beyond our reach. In recent years, however, under the pressure of the devastation caused by the changed territorial and meteorological conditions, the "diffuse city" of the drainage basin has already begun to adapt and, slowly, to transform itself towards directions that are not always coherent, within which the urban and territorial project must urgently know how to position itself.

Walking along the water landscapes it is not difficult to come across small and large projects for adapting the water system which, slowly and pervasively, are profoundly changing the backbone of the hydrographic system that innervates the Venetian metropolis. An ongoing study is attempting to reconstruct a synthetic image of the adaptation projects that are affecting the drainage basin starting from the great flood of 2010.[9] The mapping of reservoirs, dams, new embankments, resections of canals, sub-irrigation systems, and recharging wells, presents the synoptic picture of an imposing project, the result of the incremental mobilization of a multitude of public and private subjects who in different ways try to offer a common response to the various environmental frailties.

Some of these adaptation projects concern the body of the territory, almost always interpreting the soil as a plastic material that can be freely modelled according to the new hydraulic ra-

[9] See in particular the ongoing research by Giacomo Magnabosco (Magnabosco 2022).

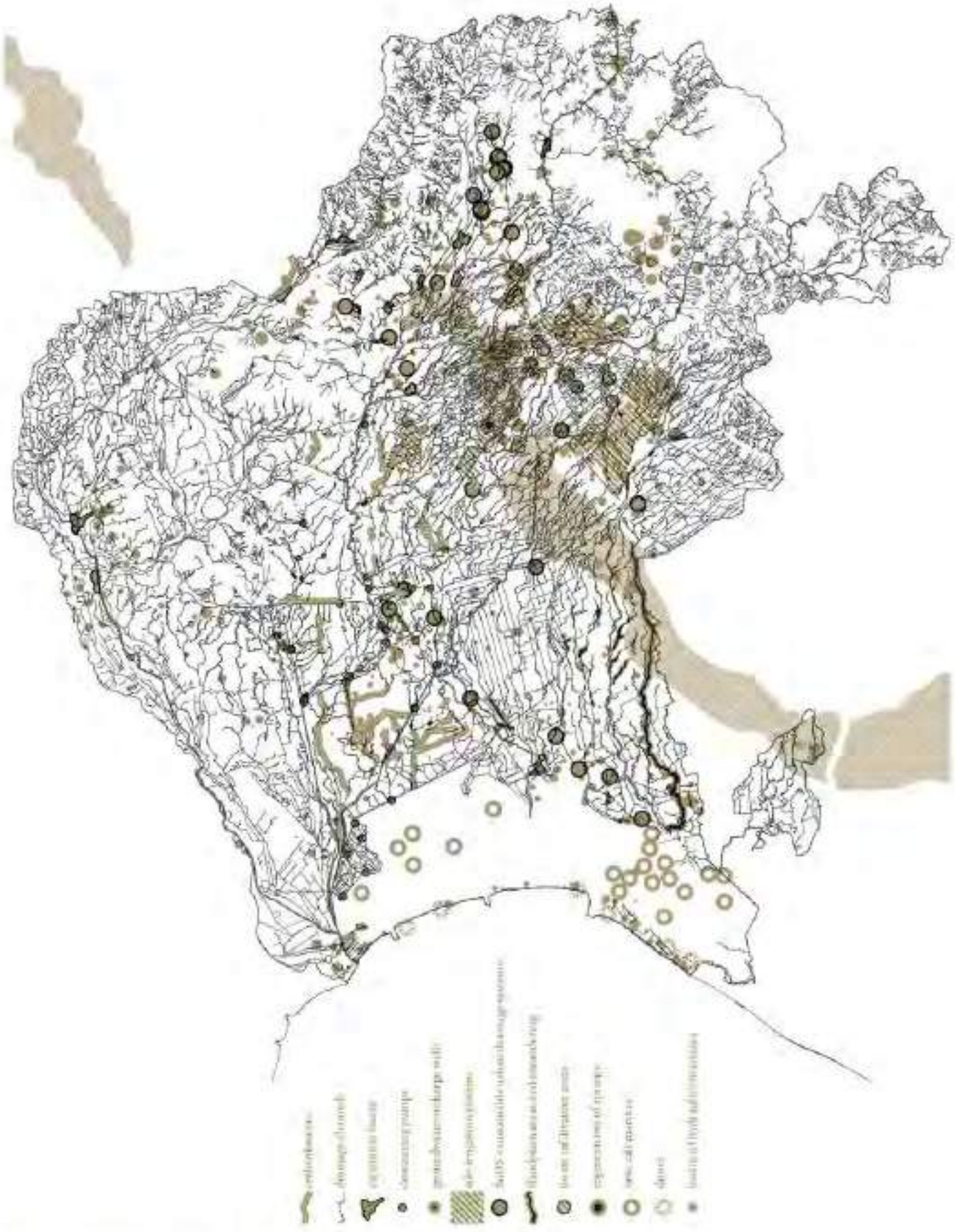
tionalities. Large reservoirs, expansion tanks, reinforcement and recalibration of existing embankments, dams, bridles, bulkheads; these are mostly the outcome of the *Piano di Mitigazione del Rischio Idraulico* (*Hydraulic Risk Mitigation Plan*) in response to the flood of 2010 (Regione Veneto 2011). The reinforcement and recalibration projects of the embankments visible above all in the low humid plain, near the areas closest to the lagoon, belong to this family. To these are added the numerous expansion tanks built at the edges of the rivers on the alluvial plain, such as the monumental 3.3 million cubic metre tank located to protect the city of Vicenza, north of the municipality of Caldogno, compressed between the margins of the springs and the Timonchio stream, or the Colombaretta rolling mill on the Alpone stream, or the expansion tank on the Muson stream in the Municipalities of Fonte and Riese Pio X. These are interventions that adapt the pre-existing and traditional agricultural function to the new rationalities imposed by hydraulic efficiency. The large basins for the expansion of rivers in the event of a flood are recognizable in the orthophotos where the grain of the position of the fields expands into large surfaces and the semantic depth of the agricultural landscape suddenly becomes simpler. Seen from within, they draw large spaces cultivated with monoculture or stable grasses, located within a new embanked territory which, near the transfer vents, reveal their nature as 'disposable voids', places designed to be flooded. They are almost always large works which, responding to a sectorial and emergency logic, owe their functioning to correct dimensioning; they are not the result of an incremental process, they are not adaptive, nor are they available for other functions capable of integrating the needs of hydraulic risk with ecological and social issues. They define, separate and specialize the territory into dry parts and freely floodable parts, interpreting the infrastructures within a purely hydraulic rationality, giving up the ecosystem potential that is intrinsic to water and its environmental resources.

An ecosystem vision: towards the possible construction of parks on a territorial scale

Water understood not only as infrastructure but in its broader meaning as an environmental resource brings us back to the concepts of territorial capital and heritage and to the idea of an ecosystem that knows how to integrate the complex schedule of

tangible and intangible services that pass through it. The concept of ecosystem services, developed in an attempt to find a space for reconciliation between economic rationalities and ecology, pushes us to interpret the environmental resources of water in the broadest sense, as a reserve capable of producing wealth, providing services aimed at benefitting quality of life (through access to water resources for energy and agricultural uses and the related benefits), safety (through the regulation of vulnerability, risk reduction and the ability to live in safe surroundings), health (through the possibility of having access to water for human sustenance and nourishment), cultural capital (through the opportunity to satisfy historical, social, aesthetic, recreational and spiritual values) (Bettinetti, Crosa, and Galassi 2007; Giupponi, Galassi, and Pettenella 2009; Boyd and Banzhaf 2005; Reid 2005).

It is possible to grasp the elements of an ecosystemic tension of the water project in some widespread interventions carried out in the last ten years and under construction, which integrate the hydraulic risk with new important ecological, social and active mobility functions. An example of this are the renaturalization interventions of the loan quarries located on the high dry plain, which in this perspective are converted into retention basins connected to the hydrographic network, such as the conversion project for Merotto quarry, from disused quarry to water basin of the plain to ensure water in summer and reduce the risk of flooding of the Meschio river in the Treviso area (Viganò 2009): a project financed in part with European funds, today a space of naturalness, a new centrality and a device for the lamination of flood waters. The interventions connected to 'LIFE Risorgive' also head in this direction: the overall project plans to re-establish and consolidate a 'green infrastructure' made up of a network of springs, irrigation channels and canals in the territory of Bressanvido in the province of Vicenza (Comune di Bressanvido 2016). This infrastructure is located in an area with a high agricultural activity, mainly for the breeding of dairy animals, in which the loss of biodiversity caused by excessive land use can be significantly counteracted. The project was consolidated in the Risorgiva Lirosa, whose restoration completed in 2018 is linked to the wider system of existing springs and as an expansion of the vegetation systems and ditches on the edge of agricultural fields (Consorzio Brenta 2018). Through a stabilized gravel path that crosses the riparian groves and connects



Synoptic representation of the adaptation works of the hydrographic system for the drainage basin of the Venice lagoon

to the Napoleonic road, to the wider system of dirt roads and shrub vegetation that cross the agricultural landscape, the project integrates the recreational functions of active and cultural mobility with the hydraulic and biodiversity-related functions. It is connected to various small forestry interventions to facilitate the infiltration of the surface waters of the aquifer that dot the area with the aim of restoring the ancient agroforestry systems that characterized the Veneto landscape of the upper Vicenza area. The system of forest infiltration areas, conceived and developed starting from 2007 by *Sezione Ricerca e Gestioni Agroforestali di Veneto Agricoltura* (*Research and Agroforestry Management Section of Veneto Agriculture*), in addition to restoring the original level of the aquifers, also triggers natural wastewater purification phenomena, improving the quality and the availability of water. Furthermore, the forest areas, which are planted and cultivated to favour the introduction of surface water into the subsoil, can be managed with further multiple purposes, such as the production of renewable energy in the form of woody biomass (Dal Prà, Mezzalira, and Niceforo 2010). The idea of a project capable of integrating the complex of tangible and intangible services that revolve around water landscapes finds perhaps its clearest explanation in the widespread interventions concerning the hydrographic system between Venice and Treviso, on the eastern edge of the drainage basin of the lagoon. In this portion of the territory, the interventions of the *Piano per la prevenzione dell'inquinamento e il risanamento delle acque del bacino idrografico immediatamente sversante nella Laguna di Venezia* (*Plan for the prevention of pollution and the rehabilitation of the waters of the drainage basin immediately flowing into the Venice Lagoon*) have been developed for more than ten years, aimed at enhancing the ecological complexity of these territories (Cornelio *et al.* 2012). The interventions that, relying on the Dese, Zero and Sile hydrographic system, are wedged in the city spread between small urban centres, cultivated fields, houses and productive activities, ensure the recalibration of the riverbeds in order to renaturalize the reclamation network, for the construction of wetlands in order to increase residence times and the lamination of the waters of the Zero and Dese rivers in the event of a flood and, through phytodepuration processes of the new riparian strips of reed beds and herbaceous marsh plants, reduce nitrogen and phosphorus inputs and pollution of the waters that flow into the lagoon. The

interventions resulting from an incremental process promoted by the *Consorzio di Bonifica Acque Risorgive* (formerly the *Consorzio di Bonifica Dese Sile*) effectively show how the objectives of increasing biodiversity, construction and strengthening of ecological corridors, and a reduction of pollutants through natural purification processes are associated with a drastic reduction in the risk of the flooding that characterizes these territories (Cornelio *et al.* 2012, p. 310). This landscape is associated with new important functions for active mobility on foot, by bicycle and canoe which, especially along the Sile, give rise to the progressive construction of a park on a reticular territorial scale, in support of the city spread between Venice and Treviso.[▸10] Already today a multiplicity of subjects, who find new resources for their free time here, are using this network for active mobility: those looking to practise some form of citizenship sport but also students, home helpers and carers. Along the paths of water one can move running or strolling, to go to school or to work, or to be outdoors in leisure time and walk with friends, rediscovering and drawing ever more dense and interesting plots of land that get wedged into the systems of urban areas of the "diffuse city". The water infrastructures thus understood, together with the hydraulic and ecological functions, participate in the construction of a new 'layer', a layer for the active mobility of the "diffuse city" that we should also consider as 'fundamental' (Bozzuto, Fabian, and Munarin 2021).

By overcoming images linked to emergency and forced constraint within a specialized and sectorial field, the project for the water aspires to affect the entire territory of the Venetian metropolis again, through the creation of 'integrated green infrastructures' which are spaces for hydraulic government but also places for leisure time in support of the "diffuse city", for the diffusion of naturalness and biodiversity. The project for the water can rethink the spaces of the hydraulic infrastructures as places from which to start a process of overall recycling of the materials that make up the Venetian metropolis, rethinking its own sustainability.

▸10 See *Parco Naturale Regionale del Fiume Sile*, n.d.

Opposite page:
a. groundwater recharge well_Montecchio Precalcino (VI)_March 2022;
b. dunes vegetation_Cà Roman (VE)_June 2021;
c. water intake for sub-irrigation system_Loria (PD)_February 2022;
d. spring efficiency improvement_Schiavon (VI)_April 2021;
e. bank recalibration_Dueville (VI)_January 2022;
f. intake mouth of a flood-retention and flood-retarding basin_Caldogno (VI)_February 2022;
g. flood-retarding basin_Monticello Conte Otto (VI)_February 2022;
h. SuDS - sustainable urban drainage systems_Vigonza (PD)_May 2021;
i. spillway channel_Piazzola sul Brenta (PD)_February 2022;
l. renaturalisation and meandering_Cazzago (VE)_December 2020;
m. freshwater inlet sluice-gate into the Lagoon_Porto Trezze (VE)_December 2020;
n. forest infiltration areas_Schiavon (VI)_November 2020.