Fluid Urbanism and Hydrophilic Architecture: Reconsidering the Flow of Water Through Urban Environments

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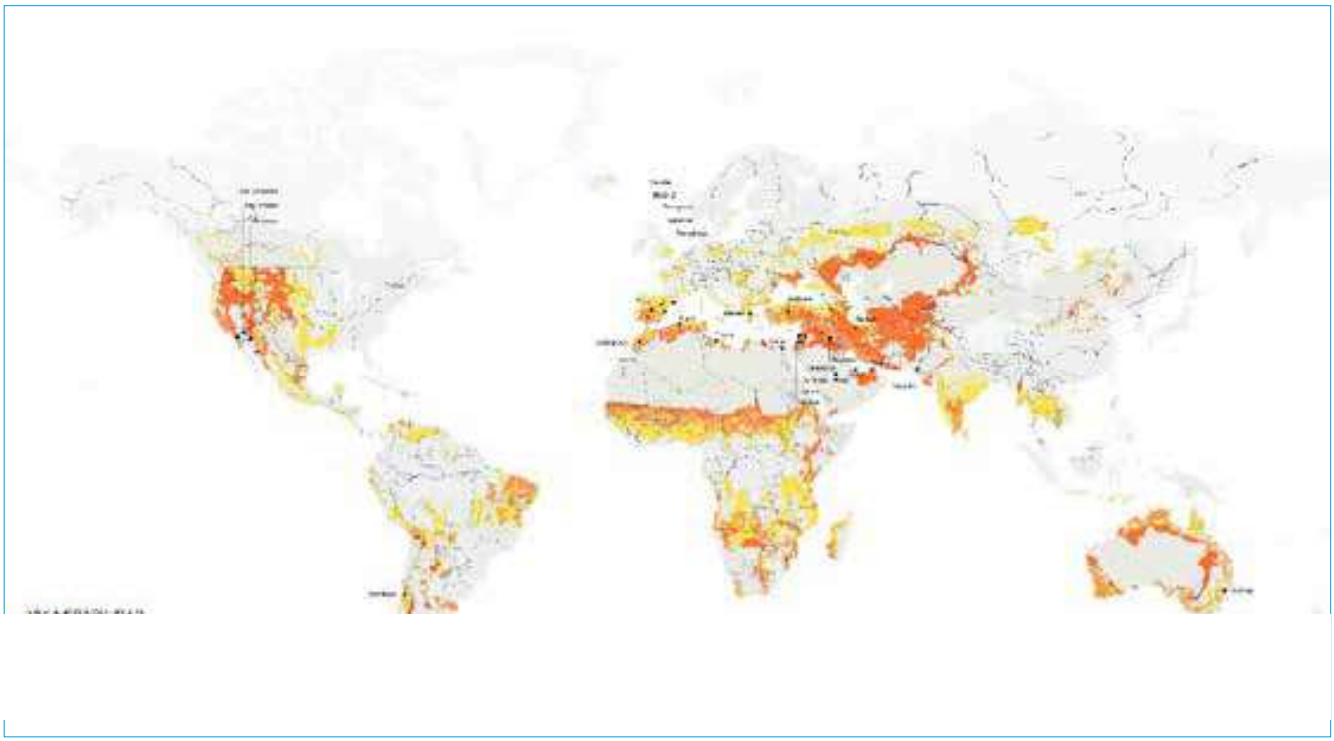
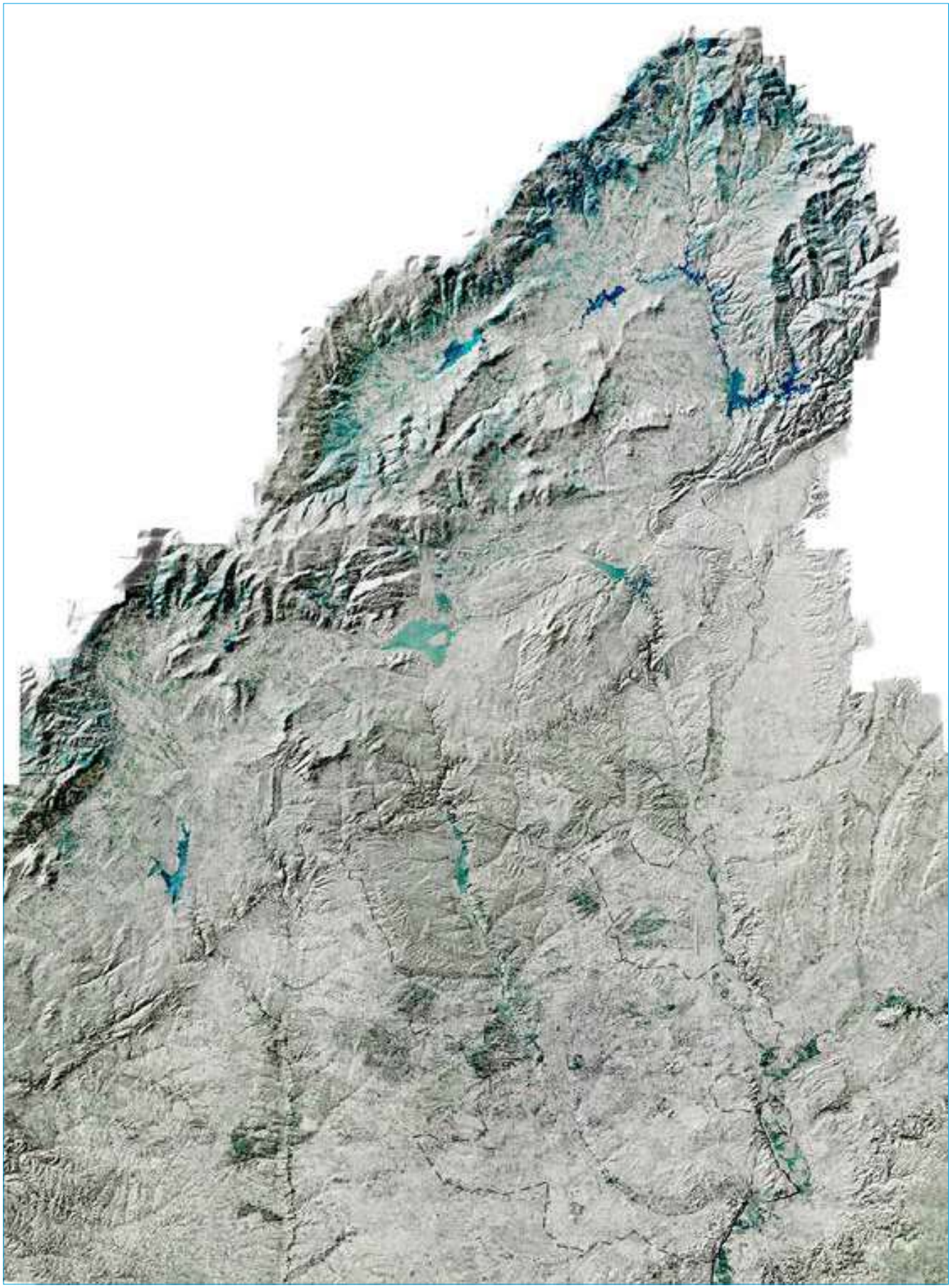
Water flows connecting huge geographic territories with closed urban interiors, drawing lines that go across scales, across ecology and economy, across living systems and technology, from the global problem of desertification, to the smaller scale of its chemical composition. This wide scope is the framework from which to review urban riverscapes.



World desertification risk map

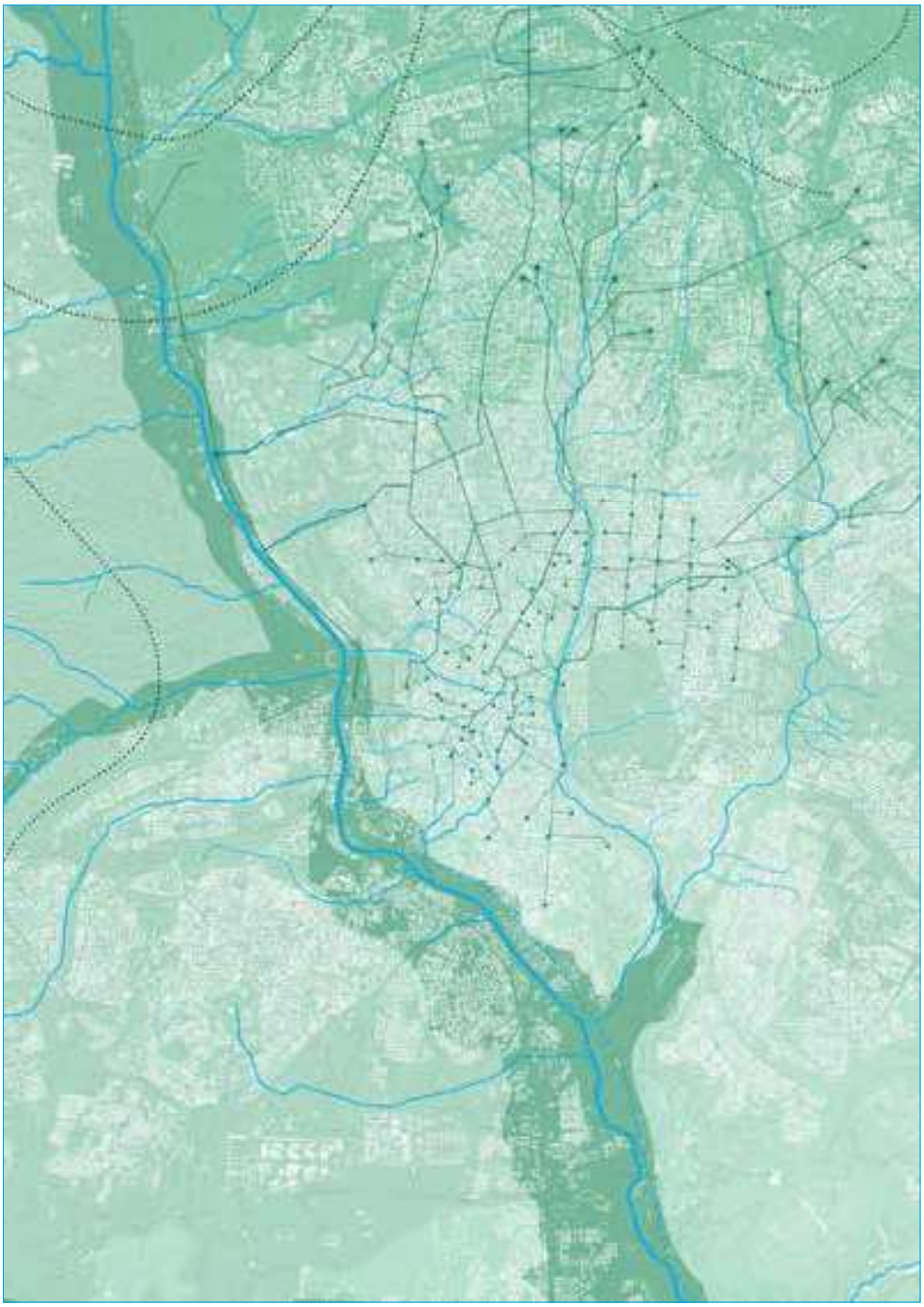
As a first step, we have to consider the magnitude of deforestation. As a global phenomena, it is growing at superfast rates, affecting more and more surface of the planet. As a way to make place for urban and agricultural developments, it means a radical change of the landscape hydrologic performance. The role that forests have, retaining water on the continent, hydrating the soil and humidifying the air through evaporation, disappears with them. Due to the cyclical condition of water, once the forest and its evaporation is lost, rain patterns also change. The small cycle of local evaporation-precipitation and its influence as thermal regulator in solar energy balances, loses its volume of water that flows to the big interchange between land and ocean by mean of big climatic events, increasing the risk of drought, flooding and raising sea levels. The recent spread of satellite image technologies documents the speed of this process over developing countries, where it has taken place very fast during 3 o 4 decades, showing direct links with the changes in rain and temperature records. The resulting desertification combines dryness, erosion, warming and the loose of fertility of the soil and has very difficult reversion.



Madrid regional topography and water

Madrid historical local watershed

Modern hydro-geographies continue this transformation of the landscape with the construction of hydraulic infrastructures which detract as much water as possible from ecosystems, turning scarcity and variability into technical, productive, effective landscapes. high energy consumptions, for pumping for instance, is one of their essential features that enable radical changes that go very far away from the spontaneous hydric dynamics of a given landscape. Besides, contemporary urban infrastructures have reached really huge, continental dimensions, especially in arid areas. For instance, water supply of Los Angeles metropolitan region, in California, has extended its technical tentacles till the very Great Divide, limiting with the Atlantic Watershed of Mississippi River. Water from this enormous territory is channeled to irrigate private lawns and agricultural plots in the dessert.

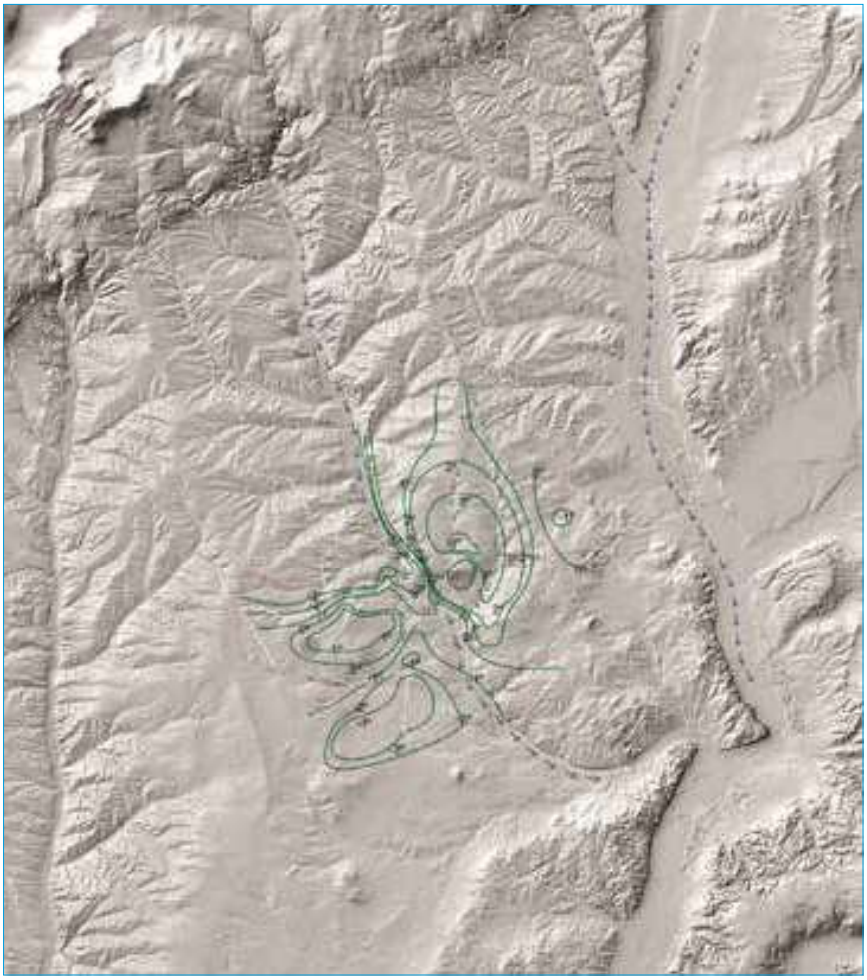


Madrid historical net of underground water supply

These modern, very fluid landscapes, are followed in the interior of urban areas with the complete waterproofing of all the surfaces, with a hydrophobic architecture and a totally dehydrated urban space. Water disappears as soon as it arrives in the cities, to flow invisible, under the impermeable carpet of asphalt. We have identify the delicate and valuable net of waterways with the system for waste management, and in the modern urban environments, almost all streams have become underground pipes and storm tanks. Even the rivers that remain have been channeled and disconnected from their aquifers.

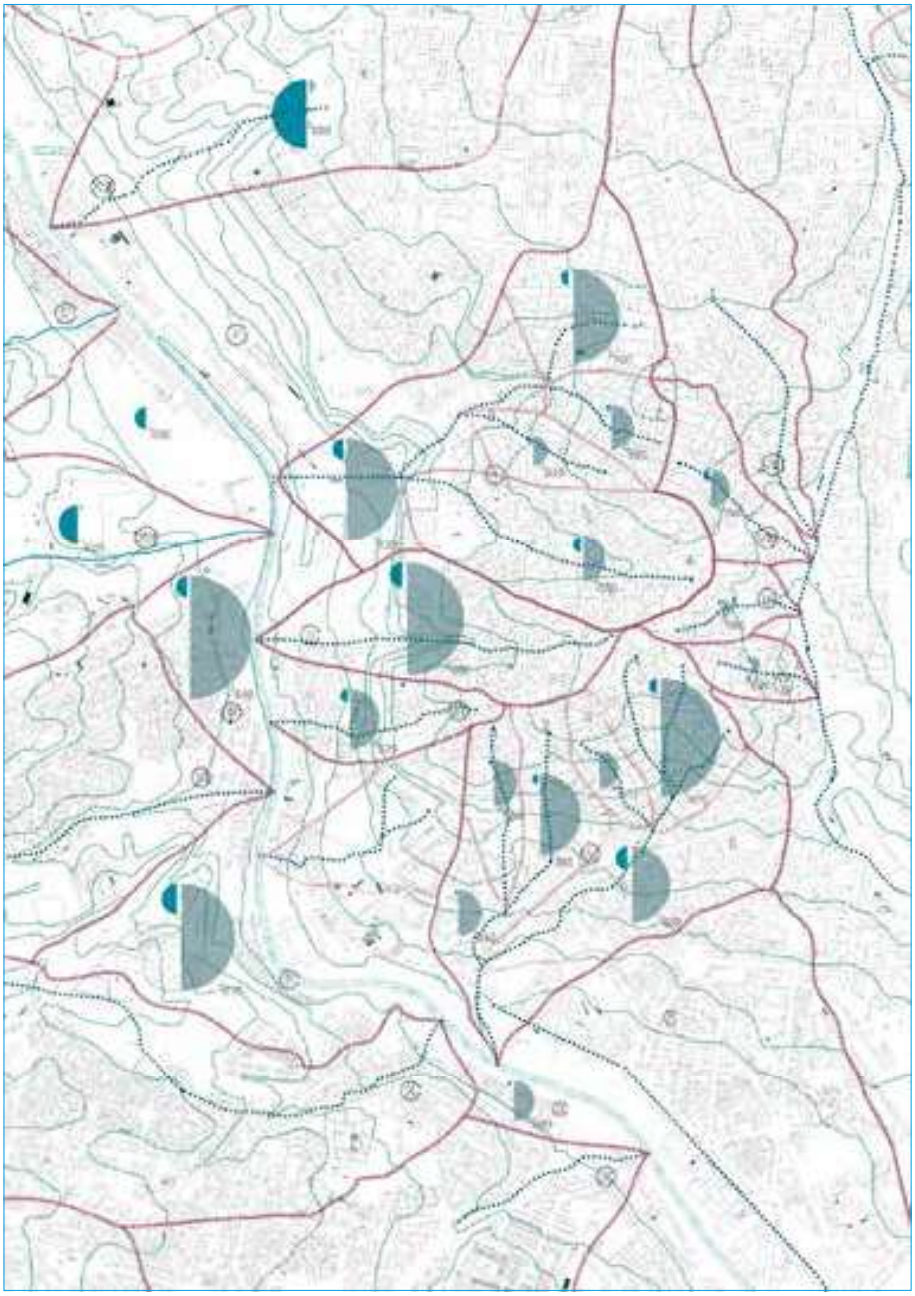
Let's consider for example Madrid as a case study. The city, that is built on a dry landscape, takes its water from a nearby mountain range, that has pine forests and much more rain. The main river, Manzanares, with very little water and totally channeled, has nevertheless preserved a very deep impact in urban environment, mainly because of its geographical form as a *significant valley in the topography* that connects the interior of the city with the humid and fresh air generated by the forest. It has traditionally channeled katabatic winds that have been breaking in two the isothermal lines of the urban heat island pointing its potential as possible green infrastructure for water and air management.

The recent urban design of *Madrid Rio*[1], that has brought important improvements in terms of availability of public green space, however has gone in the opposite direction, further destroying the performance of the river as such.



Madrid heat island temperature lines

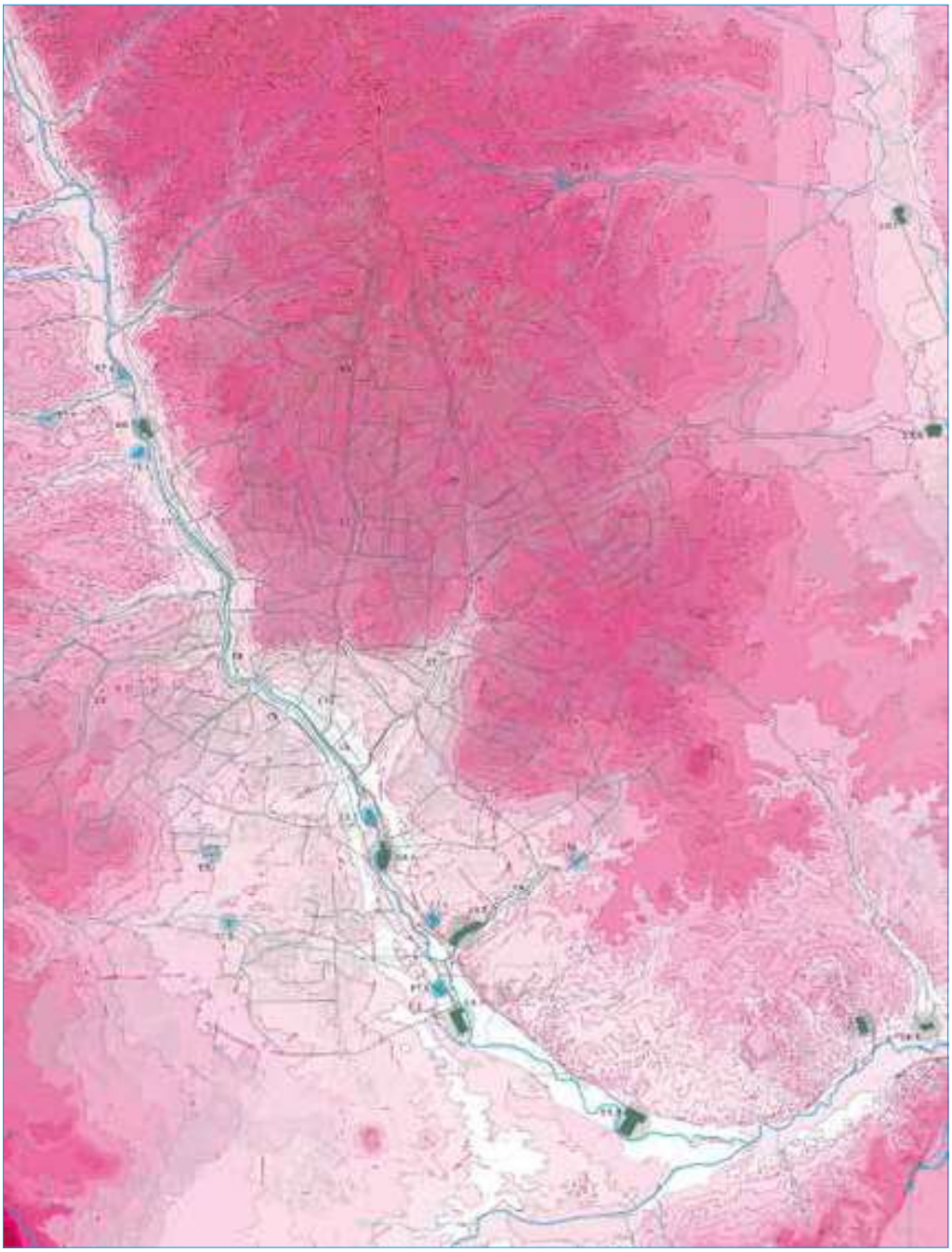
To recover the space above ground occupied by an existing highway, several tunnels have been constructed underground, and vehicular traffic has been relocated inside the riverbed aquifer. For that reason, lots of pumping stations are continuously dehydrating the soil to block the flood of the tunnels, and two enormous pipes that flow at both sides of the channel, deliver most of water. As a sustainability measure, the riverside vegetation, spontaneously evaporative, has been replaced with xeric, very dry plants. That means that the possible function of the riverbed as water storage and flood control system is lost, as also is obstructed its essential role for refrigerating the city. With opposite design strategies, the recovery of these spontaneous landscape along the line, could have intensify the movement of fresh and humid air that comes from the mountains, as a very effective measure to reduce the rigorous summer heat.



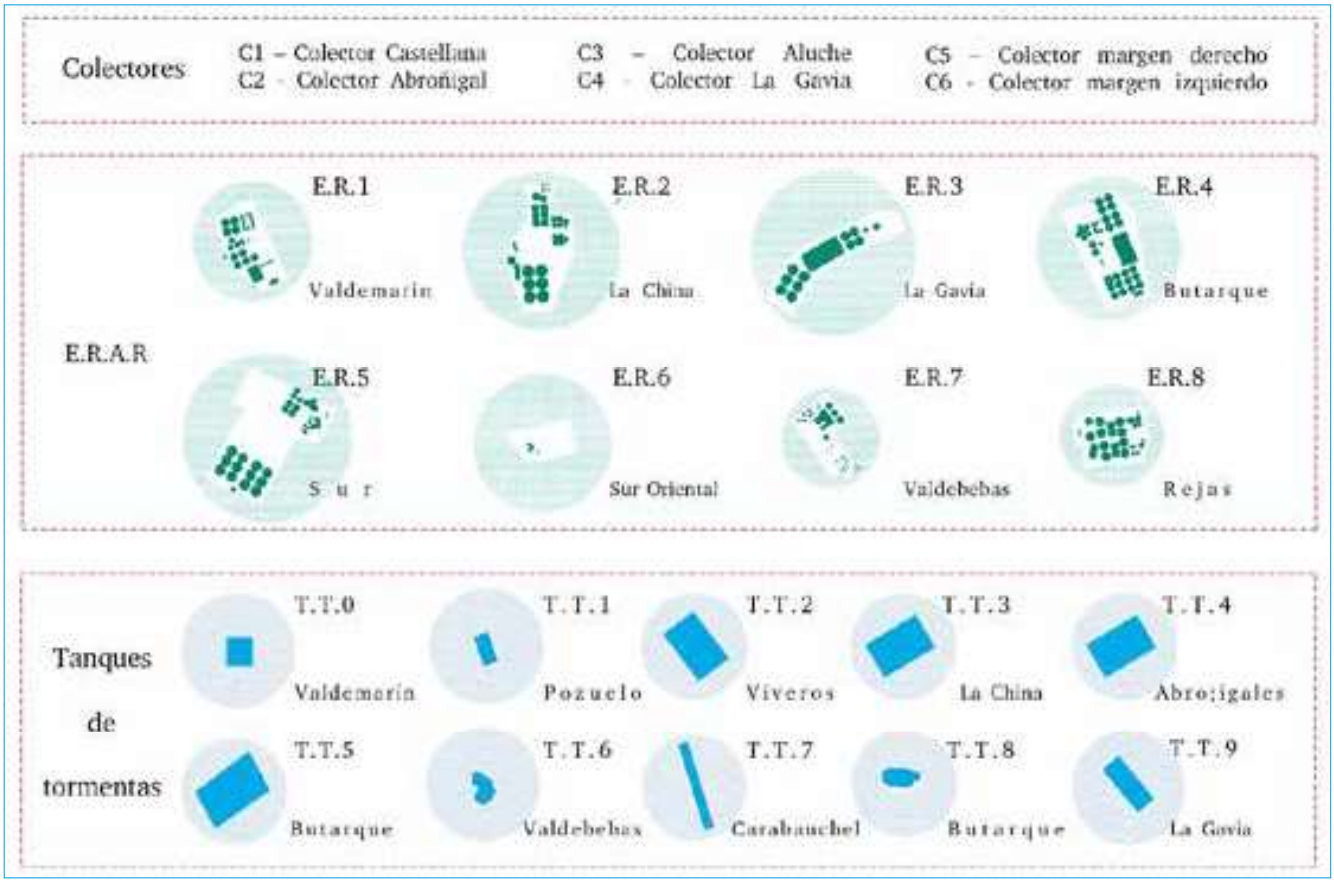
Madrid local watersheds grey and rain water

Key madrid local watersheds grey and rain water

This contemporary approach to urban metabolism that mixes water and waste, has grown in parallel with an culture of repugnancy, aversion to humidity and organic matter, as well as a radical change in our notion of the body. Hygienic and cleanliness as main targets of modern urbanism, start in the XIX century an architectural ideal where water doesn´t exist. It appears only as a static, flat plane in the ponds, and very recently, through the metaphor of the cloud. Since Le Corbusier to Kazuyo Sejima, we prefer buildings that doesn't have cellars, that even don't lie on the ground but over pilotis, often built with white, synthetic finishing, apparently without thickness. As if they were laboratory pipes. The modern city, the landscape too, are aseptic above all, more mineral, dry and warm. Over them, the spread of mechanization has created a toxic environment, with an important impact in water quality.



Madrid wastewater system with topography



Key wastewater map

What can be proposed for this new hydric landscape that we have built mainly characterized by desertification and dehydration? Which kind of water projects are possible within our urban environments, designed as hydraulic machines for the instant disappearance of water? How our toxic atmosphere is conditioning the desirable change of place for water?

The recovery of urban rivers is linked to the necessary transformation of the whole urban fabric´s hydric performance, according to water *extensive presence over the whole space,* to the connection between the flow and other phases of its cycle like evaporation or infiltration, to the unavoidable connection between waterways and watersheds. It also questions our cultural *approach to cleanliness and disinfection*, searching for new ways of understanding organic matter and promoting urban biodiversity. It requires *increasing levels of artificiality* in technician ecosystems, searching for an even more sophisticated mix between living systems and technology.

Even in very small projects, the recovery of ephemeral streams is a radical improvement of the urban environment, as can be seen for example in Bañoles old town center[2], close to the Piriness, where the historical channels that irrigate the orchards with water from the nearby lake have been recovered. They underline the connection between urban space and the surrounding landscape that supports it, make easier to understand the dependence between economy and ecology. The recovery of water visibility brings back to the public discussion the management of scarce and valuable resources.

Park Güell by Antonio Gaudi in Barcelona, is a built example of an architecture aware, adapted to the distributed, extended presence of water. Gaudí design criteria show how forms and

materials of buildings and public spaces are useful tools for the water management of an urban settlement.

Aerial view Park Güell Antoni Gaudi

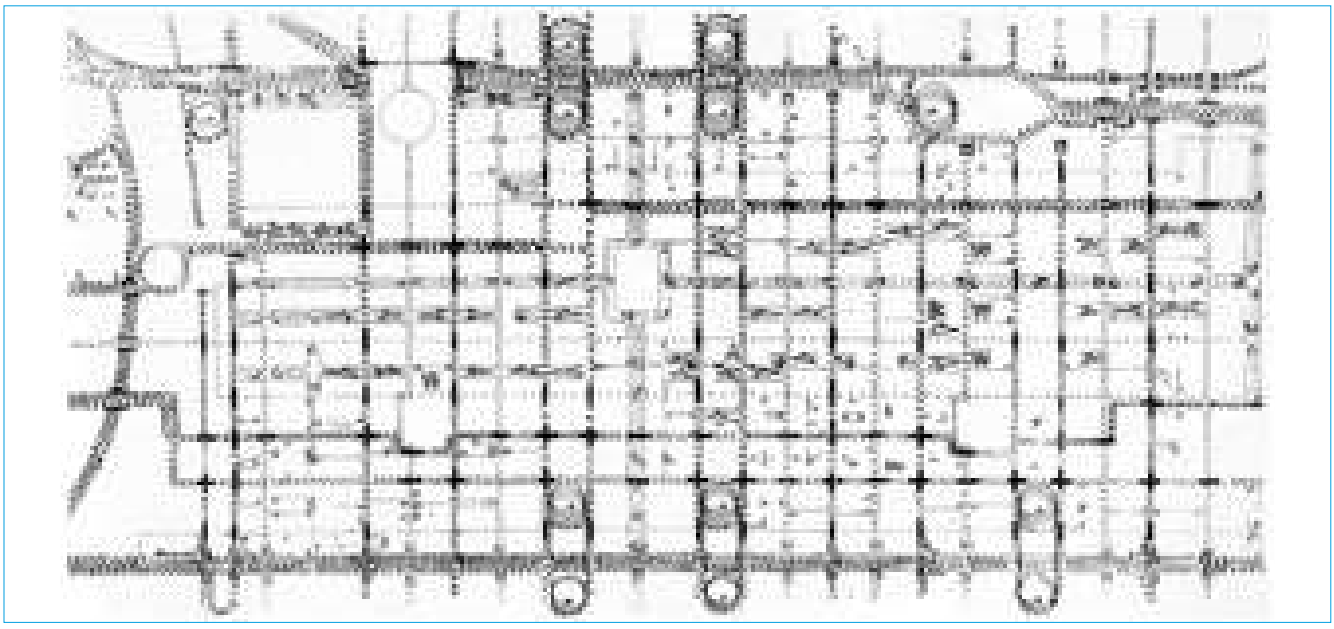
With a stony soil and high slope, the mountain where it is located couldn't retain the torrential rains of the Mediterranean Basin, and therefore, there was not much vegetation. The commission for the architect was the creation of a garden for a following urbanization of single familiar housing. The way he organized the traffic paths divides the slope in three as huge traditional agricultural terraces that reduce water speed and enable infiltration into the soil through the open joint stone pavements that retains it. The division of plots and the pedestrian stairs form a secondary net of channels that deliver water to permeable areas or localized deposits. This double-function elements improve water absorption and create a new biophysical matrix with an autonomous garden. Afterwards, many years later of this project, that remained as a public park with no dwellings, the streets have been paved with asphalt, creating a waterproofed surfaced that has destroyed its performance, and consequently requiring a new water supply net for irrigating the park.

A very similar idea has been proposed recently by Ground lab team form China developments. The proposal designed by Urbanlab for Chicago[3] city goes beyond combining contemporary technology and living systems performance. In this case, the urban grid has completely deleted the local topography and watersheds. In this case, as an alternative to the current collector, that delivers waste water to the sea by Mississippi river basin, a completely new net of surface waterways is proposed, with a new geometry lead by the slope to the Lake Michigan and the grid of buildings. This new constructed hydrology is an urban size purification plant that treats water in situ for its reuse or for returning it to the lake. Along this lines, technician ecosystems, based on the patent living machine[4], collect water from different sources and improve its quality by mean of the action of plants and microorganisms activated by pumps and other *devices*. It is a very interesting solution that alternates aerobic and anaerobic processes and improves the spontaneous performance.

At a regional scale, other interesting project affords the recovery of a riverscape: the Jordan River valley[5], between Syria, Israel, Lebanon and Palestine. The river crosses arid territories ending in the Dead Sea, but has recently lost the majority of its flow due to the growing agricultural and urban consumes. The proposal of Fady Massoud coordinates actions at several scales, including the form, size and position of urban developments, as well as buildings. The building typologies proposed are a mixture between architecture and infrastructure, combined with environmental strategies like for instance the recovery of local non consumptive crops, as a way of reclaiming the river. The new architecture will perform as rainwater collector device, located far enough from the waterway, in the valley slopes, leaving riverside ecologies to survive and operating as protection structure against erosion. It also considers the necessary proximity and interchange between domestic interiors and urban agriculture. The water taken from the river goes through urbanization, and afterwards, following the topography, irrigates the fields or goes across purificative landscapes in order to return to the riverbed. The settlements are linked to the secondary net of rivers, tributaries to Jordan, along linear hydraulic infrastructures as main public spaces.

Jordan river baisin project Fadi Massoud

This three examples differ in time and location, but all point alternative strategies for the recovery of water flows within urban environments. Their criteria can be systematiced and coordinated to propose a new understanding of the city as a *COMBINATION OF FLOWS AND EDDIES*, of open linear nets that manage the interchange between different areas of the city, and closed nets, that purifies water in situ to reuse, creating loops of different qualities.



Louis Kahn Philadelphia traffic study 1955

The famous drawing of Louis Kahn is taken literally here. Local small watersheds that manage its waters as autonomous units take advantage of the land form, to channel it along new low energy lines. These watershed units contain open lines and closes nets. The basin-squares are central spaces with very little toxic pollution that solve the retention, purification and storage of water for its reuse. They are connected with the blue boulevards that regulate the flow and redistribute the water in other spaces. In this new city, water recovers visibility and its classical role of articulate the public space. It draws the main lines within the urban fabric, as significant spaces with better environmental quality that also define the perception and the image of the city.

Notes

[1] See further information of the Project here http://www.west8.nl/projects/madrid_rio/
[2] By Josep Mias. See http://www.miasarquitectes.com/portfolio/banyoles-old-town/
[3] See http://www.urbanlab.com/h2o/
[4] http://www.livingmachines.com/Home.aspx
[5] https://www.asla.org/2010studentawards/066.html