Trabajo Fin de Grado / 2024 - 2025

Villaviciosa de Odón 2050

HIDROGRAMA

'Beyond Infrastructure, Into Waterscapes'

Grado en Fundamentos de la Arquitectura
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To my parents and sisters
for their unconditional love and support.

ABSTRACT

Water remembers us. It flows through our bodies, our stories and our cities, shaping the land we call home and the ways we inhabit them. As water becomes less predictable, the connection we once took for granted begins to weaken, especially in places like Villaviciosa de Odón, where this shift urges us to rethink how we live with water.

By 2050, the city will face growing pressures on its water infrastructure. Rapid urban expansion, rising temperatures, and changing rainfall patterns will challenge both water supply and stormwater management. Existing systems, designed for a smaller and simpler city, are no longer equipped to handle the complexity of what's coming. As impermeable surfaces spread, natural infiltration decreases, while the disconnect between people and water deepens.

In response, *Hidrograma* asks a simple but powerful question: what if making water visible could reshape the way we build and live in cities? Through design, can we reconnect with the cycle that sustains us, and imagine a more resilient future for Water?

The territory is shaped by hidden streams and underground pipes, with droughts occasionally carving their presence back into the land, revealing the skeletal imprint of water. Rethinking the urban realm means going beyond technical rituals and hydrological blueprints to propose a renewed coexistence with Water. Infrastructure, once invisible and utilitarian, can now become visible, vibrant, and a living part of the urban and rural experience.

The research framework of *Hidrograma* is grounded in a broad inventory of international case studies that rethink the relationship between water and urban space. Rather than seeking a single solution, the project draws from diverse strategies (ancestral, informal, and contemporary) to build a flexible and adaptive approach. This proposal operates as a sequence of site-specific interventions aligned with the phases of the water cycle, allowing the design to respond gradually to evolving challenges.

Through a progressive intervention, Villaviciosa de Odón could become a model of a porous city, where water is no longer managed as a fragmented resource but is integrated as an essential, resilient, and adaptive infrastructure.

Hidrograma is an atlas of opportunities where water fosters slowness, gathering and adaptation. Engineering becomes landscape; necessity transforms into beauty while survival gradually evolves into celebration.

Six architectural interventions encompass the entire water cycle in Villaviciosa de Odón: from reservoir to riverbed, storm tank to public bath. Each captures a moment within the cyclical processes of capturing, treating, reusing or simply honoring the water that nourishes the region.

An urbanism based on porosity will help restore ecological balance, enhance biodiversity, and ensure equitable access to water as a fundamental right.

In the following decades, Villaviciosa de Odón could be a benchmark in the symbiosis between infrastructure and nature, where water management will drive new ways of living, producing, and coexisting, ensuring water sustainability and urban adaptation to an uncertain future.

1. Introduction

1.1 Motivation

Water is a fundamental condition for life and a declared human right, recognized by the *United Nations General Assembly*[1] in 2010. It is not only a biological necessity but a social and spatial medium; a substance that, throughout history, has shaped civilizations, beliefs, infrastructures, and landscapes. From the aqueducts of Rome to the stepwells of India[2], from Incan irrigation channels to Islamic gardens, water has never been just a resource: it has been a public presence, a generator of meaning, and a central figure in urban culture.

Today, this relationship has fractured. In modern cities, water has been largely removed from collective space and hidden inside engineered systems. It flows beneath pavements, behind walls, and through distant treatment plants: functional, efficient, and out of sight. Reduced to a background service, water is often taken for granted, noticed only in moments of scarcity, contamination, or failure. This approach, born of 19th and 20th century sanitary reforms[3] and technocratic urbanism, prioritized control, hygiene, and productivity. Infrastructures were built to separate water from bodies, nature from the city, and function from experience.

Yet as the climate crisis intensifies, these systems are being tested beyond their limits. According to the *European Environment Agency*[4], water stress is rising across southern Europe due to prolonged droughts, shifting rainfall patterns, and growing urban demand.

In Spain, despite a long and rich tradition of water management, the situation is fragile: aquifers are depleting, rivers are intermittently dry, and over 25% of treated water is lost through outdated networks, according to the *INE*[5]. Meanwhile, cities have grown increasingly impermeable, with hard surfaces accelerating runoff and overwhelming stormwater infrastructure, turning water into both a scarce good and a flooding risk.

This global disconnect takes many forms: in megacities where informal settlements lack access to clean water while gated enclaves consume it freely; in river basins where infrastructures sever rather than stitch landscapes and communities; and in towns where the origin, treatment, and fate of water remain

[1] United Nations General Assembly. **Resolution 64/292** (2010). https://digitallibrary.un.org/record/685733
[2] Rodgers, P. & Hall, A. (2003). *Water and Wastewater Management in Ancient Civilizations*. Water Science and Technology.
[3] Gandy, M. (2004). *Rethinking urban metabolism: water, space and the modern city.* City, 8(3)
[4] European Environment Agency (EEA). (2020). https://www.eea.europa.eu/themes/water/european-waters/water-stress
[5] Instituto Nacional de Estadística (INE). https://www.ine.es (Search: "Suministro de Agua INE")

entirely invisible. What was once celebrated as a civic element is now abstracted and reduced to data, valves, and buried systems.

In Madrid, the *Canal de Isabel II*[6] stands as a remarkable example of public water management. Founded in the 19*th* century, it has evolved into one of Europe's most sophisticated and visionary institutions, managing the full water cycle from supply to reuse. Its technical excellence and integrated model are admired internationally. But despite its achievements, one critical dimension remains largely absent: the spatial and civic presence of water in the urban fabric. What is missing is not engineering, but experience: the possibility for water to participate in public life.

This absence reveals a deeper gap: the lack of architectural and urbanistic perspectives within water governance. Water is managed, but rarely designed; it is treated, but not celebrated. As a result, the population remains detached from the very cycles that sustain their lives. Bridging this divide between infrastructure and public space is essential, not only for resilience, but for collective awareness, agency, and care.

Water systems do not only belong to technicians[7] and policy makers. They belong to everyone. Reimagining them through architecture offers the chance to make them visible, participatory, and deeply embedded in the rhythms of everyday life. It invites us to see water not just as a utility, but as a civic actor. Not only as a technical challenge, but as a design opportunity.

This disconnection mirrors a broader social reality. Contemporary cities are marked by fragmentation and individualism[8], where speed, zoning, and privatization dominate how we inhabit space. As our daily lives become more mediated and isolated, our bond with the environments that sustain us , both natural and communal, weakens. Public space no longer invites shared experience or environmental awareness. Instead, we move through sealed surfaces and invisible systems, detached from the ecological and social cycles that once gave rhythm to collective life.

Bridging this divide is not only an environmental task: it is a **social and civic challenge**. It demands new spatial frameworks that allow people to see, touch, and understand water again, not as a passive backdrop or a threat, but as a living actor in the urban story.

[6] Canal de Isabel II Official Website: 🔗 https://www.canaldeisabelsegunda.es
[7] Castro, L. & Arpa, J. (2016). *Manual de urbanismo ecológico: Hidráulica urbana y diseño.*
[8] Lefebvre, H. (1991). *The Production of Space.*

1.2 Hypothesis

'Contemporary water infrastructures are rarely addressed as spatial or civic opportunities in architectural discourse, revealing a critical gap where technical systems remain disconnected from public experience, ecological awareness, and urban form.'

This TFG starts from the conviction that the way water is treated in cities, hidden, functional, and out of reach, is both a symptom and a cause of our collective disconnection from the systems that sustain life. In most urban contexts, water is managed but not designed, calculated but not celebrated. What was once a civic element has become invisible infrastructure, isolated from public space, culture, and experience.

Hidrograma proposes an alternative hypothesis: that by reimagining the urban water cycle as a spatial and civic system, we can recover water's role as a public actor and activate new models of urban coexistence. This shift is not metaphorical but operational. The project restructures the six fundamental phases of the urban water cycle: catchment, transport, treatment, distribution, drainage, and reuse, through six architectural interventions that reinterpret each phase as an opportunity for visibility, public use, and ecological awareness.

Rather than proposing a single building or masterplan, the TFG works as a network of punctual, adaptable systems that integrate with the existing infrastructure and open it to civic life. Each intervention is designed not only to improve water performance (through retention, reuse, or permeability) but also to generate new types of public space, informal use, and collective care. From educational paths and canal streets to visible purification tanks and recreational wetlands, these spaces turn water from a hidden utility into a daily presence.

Together, the interventions form a coherent, scalable model for future water cities. These are cities where infrastructure is not buried but exposed, not static but participatory. *Hidrograma* does not aim to redesign the entire system from scratch but to stitch together fragments of the existing one into a more legible and civic structure. The hypothesis is that by adapting infrastructure to serve both ecological and social roles, it can become an architecture of care, an unfinished and flexible support for future urban life.

In this sense, the TFG is both speculative and pragmatic. It offers spatial systems, not finished forms. It proposes strategies, not fixed solutions. Its goal is to test how architecture can act on water, and how water can, in turn, transform the experience of the city.

The central hypothesis can be broken into several interdependent claims:

- *Revealing the Invisible*
  The invisibility of water infrastructures contributes to disconnection, disinterest, and unsustainable behavior. By making these systems visible through public architecture, landscape integration, or spatial storytelling, citizens can better understand the origins, circulation, and limits of their water supply.

- *Infrastructure as Civic Device*
  Infrastructures are not neutral. They shape everyday life, define spatial hierarchies, and reflect the values of a society. If infrastructures are designed with spatial and experiential qualities, they can become places of encounter, education, and care. They can transform from technical zones into civic thresholds.

- *Water as Spatial Narrative*
  The water cycle is not linear. It is cyclical, distributed, and temporal. Architecture can become a narrative interface, staging each stage of the cycle as a specific urban or territorial experience, from the stillness of a reservoir to the rush of stormwater. Designing along this cycle generates an alternative urban structure: a *hydrography of space and time*.

- *Porosity as Resilience*
  Climate adaptation depends not only on the efficiency of systems, but on the porosity of urban form. This includes material porosity (e.g., permeability), institutional porosity (accessibility), and spatial porosity (transitional thresholds). The project explores how water-oriented design can re-program the edge between urban and ecological systems.

- *Architecture as Translator*
  One of the most powerful roles of architecture is to mediate between abstract systems and bodily experience. *HIDROGRAMA* tests this capacity by translating hydraulic functions, filtration, evaporation, storage, purification, into spatial expressions that are meaningful, experiential, and open to appropriation.

In short, the project defends the idea that infrastructures can be spatially expressive, technically performative, and culturally generative, all at once.

1.3 Structure

This Final Degree Project is developed within the framework of *Villaviciosa de Odón 2050*, a collective brief that invites us to imagine alternative urban futures through architecture as a critical and speculative tool. Using the methodology of *Research Through Design*, the project transforms urban speculation into a process of knowledge-making where drawing, mapping, and designing are not only means of representation but of inquiry.

Hidrograma emerges from a personal line of research that places water, its presence, its absence, its cycles, as the narrative and operational thread of the project. It responds to a gap in contemporary urban design: the systematic invisibilization of water infrastructures and their disconnection from social, spatial, and ecological life. Rather than treating water as a background utility, the project reframes it as a civic actor capable of structuring public space, raising awareness, and fostering collective care.

The process begins with a theoretical and contextual foundation. Drawing on interdisciplinary sources from architecture, hydrology, urban ecology, and environmental humanities, the research maps a global condition of disconnection between people and the systems that sustain them, water among the most urgent. It integrates precedent analysis and field observations to build a critical understanding of Villaviciosa's hydrological and infrastructural landscape.

From this foundation, the project defines a clear working hypothesis: that by spatializing each phase of the water cycle, it is possible to reconfigure technical infrastructures into hybrid civic and ecological systems. The project takes the water cycle as its compositional structure: catchment, transport, treatment, distribution, drainage, and reuse, and proposes an architectural intervention for each stage. These six interventions act as moments of reconnection between the city and its invisible backbone.

The interventions are strategically inserted along the territory of Villaviciosa de Odón and designed to operate on multiple temporal and spatial scales. Rather than working with one large gesture, the TFG adopts a systemic and phased approach where each node is autonomous yet connected, and collectively they form a legible and adaptable model for future water cities.

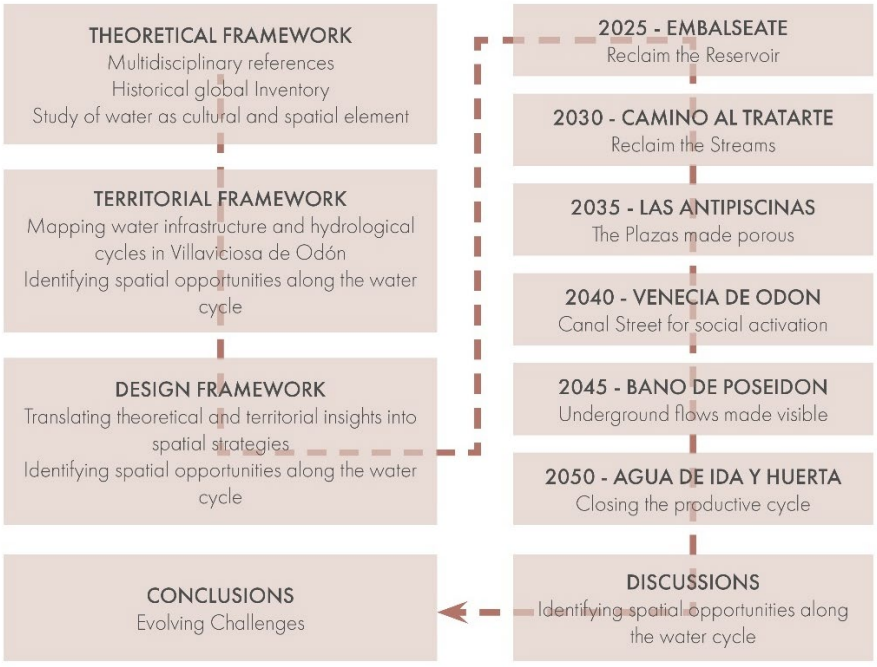
Each architectural intervention corresponds to a specific phase of the urban water cycle and is carefully positioned along a growing timeline of environmental and urban challenges. From early issues of drought and stream disappearance in 2025 to the systemic pressures of reuse and ecological reconnection in 2050, the six proposals do not emerge randomly in space or time. Instead, they respond to a layered cartography: hydrological function, urban context, and projected climate

impacts. This spatiotemporal logic reinforces the project's aim of turning invisible processes into civic experiences and ensures that the water infrastructure evolves in parallel with the town's most pressing needs.

The proposals are shaped around two core principles: technical performance (retention, reuse, permeability, filtration) and public meaning (pedagogy, leisure, care, and ritual). As such, the projects are not only spatial devices but also tools of urban pedagogy and ecological imagination. Among them: a pavilion by the reservoir that reveals the source (Embálséate), a didactic path of purification (Camino al TratArte), plazas that retain and celebrate rainwater (Las Antipiscinas), a canal street as sponge and promenade (Venecia de Odón), a civic dome that reinterprets stormwater basins (Baño de Poseidón), and a circular hub linking treated water with aquaponic agriculture (Agua de Ida y Huerta).

This progressive strategy allows testing punctual prototypes while envisioning a longer-term transformation of the water landscape. The architecture itself is designed to be open, replicable, and responsive, inviting adaptation rather than imposing form.

Finally, the project returns to its original inquiry: can we rethink infrastructure as an architecture of care? Can water, when made visible, tangible, and ritual, become a driver for new forms of urban belonging? *Hidrograma* seeks to answer these questions not through finality but through structure, a framework of situated and speculative interventions that reconnect the city with its most vital substance.



1.4 Methodology

This TFG is grounded in a methodological position that sees urban water infrastructure not only as a technical system, but as a cultural, spatial, and civic construction. The project departs from a critique of the historical and contemporary treatment of water in cities managed efficiently, yet made invisible, fragmented, and detached from public life. This critical lens forms the foundation for a design research process that seeks to reinterpret water infrastructure as an urban narrative: visible, participatory, and meaningful.

To do so, the work adopts the *Research Through Design* methodology, where drawing, mapping, and spatial modelling are not final representations but investigative tools. Design becomes a way to ask questions, challenge inherited models, and build new relationships between people, water, and territory. The speculative power of architecture is used to explore alternatives, not only to imagine new forms, but to reveal the potential already latent in existing systems.

The methodology is structured through the temporal and territorial sequence of the water cycle, which becomes both subject and framework for the project. Six architectural interventions are developed, each corresponding to one of the main phases of the urban water system: catchment, transport, treatment, distribution, drainage, and reuse. These stages are not treated as purely hydraulic operations, but as opportunities to reintroduce water into public life through specific spatial and social strategies.

Each intervention is positioned at a key territorial threshold in Villaviciosa de Odón, selected through layered mapping and contextual analysis. These sites reflect both the physical flows of water and the points where its presence or absence is most acutely felt by the community. The interventions are imagined not as monumental buildings, but as adaptable systems: structures that coexist with existing infrastructure but reveal and reinterpret it through architectural language. They are designed to be progressive and scalable, capable of transformation over time and responsive to future urban and ecological shifts.

The intervention operates at three overlapping scales:

- **Territorial scale**: water catchment, agricultural production, and urban runoff
- **Urban scale**: public space, mobility networks, and environmental corridors
- **Architectural scale**: spatial sequences, materials, sensory atmospheres, and interfaces with water

This layered structure enables the project to articulate complex systems through architectural specificity, making invisible processes tangible.

The methodology embraces time as a project material. The interventions are deployed in five-year sequences from 2025 to 2050, in line with the projected increase of water-related challenges such as drought, stormwater overflow, and the rising demand for circular resource models. This phasing reflects the belief that infrastructure can no longer be understood as static or permanent but must become an evolving field of negotiation between technical needs and public values.

Importantly, the methodology resists traditional urbanism's tendency to resolve everything in a closed, top-down vision. It instead operates through strategic insertions, fragments that propose a renewed relationship between infrastructure and citizenship. These spatial devices are not only functional. They are pedagogical, affective, and symbolic. They make the invisible visible and return agency to the urban subject by connecting the technical and the experiential, the systemic and the human.

Through this methodological lens, *Hidrograma* does not aim to redesign the entire water system, but to activate its civic potential. By intervening within each phase of the cycle, the project builds a distributed, legible, and transformative model for future water cities: cities where the infrastructure that sustains life is no longer buried or forgotten, but shared, inhabited, and cared for.

1.4.1 Design Experimentation

Each intervention was developed through an iterative loop of drawing, testing, and redesign. Specific techniques include:

- Analytical diagrams to trace flows of water, people, and infrastructure.
- Spatial sketches and axonometric exploring form, materiality, and scenography experience.
- Watercolor illustrations and speculative collages to convey atmosphere, time, and transformation (especially for Baño de Poseidón and Embálséate).
- Sectional drawings and exploded views that hybridize hydrology with architecture.
- Prototyping of material strategies such as:
    - Porous pavements for Venecia de Odón
    - Modular seating with rain tanks in Las Antipiscinas

This design process was not aimed at resolving every technical detail but at provoking spatial questions: How does one walk along a purification pipe? Can a stormwater tank feel sacred? How can runoff become recreational?

1.4.2 Narrative Tools and Spatial Storytelling

As part of the RTD methodology, narrative tools played a crucial role in constructing the experiential arc of the project. These included:

- The conceptualization of each intervention as a chapter in a water story.
- The use of naming strategies (*Embálsēate*, *Camino al TratArte*, *Baño de Poseidón*) that blend functionality, metaphor, and memory.
- The application of scenography principles: light, sound, texture, delay, and immersion to spatialize invisible flows.

Through this layered methodology, *HIDROGRAMA* presents not only an architectural proposal, but also a mode of seeing, interpreting, and transforming urban water systems.

2. State of the Art

2.1 Multidisciplinary Precedents

2.1.1 Water as Civic, Spatial, and Cultural Infrastructure

Water is often discussed in urban planning as a resource to be managed, but rarely as a civic material, a spatial factor, or a cultural presence. *Hidrograma* proposes to reverse this invisibility by drawing on a multidisciplinary constellation of references that expand the notion of infrastructure beyond the technical, and argue for water's spatial, social, and political dimensions.

In *The Infrastructural City*, Kazys Varnelis[9] (2009) examines the hidden systems shaping Los Angeles, notably its complex hydrological networks, and points to a critical disjunction between infrastructure and public life. Water, while omnipresent, becomes spatially absent, erasing the public's connection to the systems that sustain them. This invisibility is symptomatic of a broader model of urbanism where infrastructure is buried, deactivated from the civic imagination.

Architect Richard Sennett and urbanist Pablo Sendra takes this further in *Designing Disorder*[10] (2021), where they challenge the dominance of closed, rigid planning in favor of "open systems" that remain incomplete, adaptive, and participatory. Their framework resonates with *Hidrograma*'s approach to water: infrastructures that are not static endpoints, but evolving, porous support for collective life. "A space that is incomplete," they argue, "allows for continual adaptation and improvement." This aligns with the proposal to design water systems not as engineered objects, but as civic interfaces.

From a hydrological and planning perspective, Sarah Bell's *Blue Infrastructure*[11] (2017) calls for integrating water systems into public space, noting how cities have systematically removed water from urban experience in favor of technical efficiency. Similarly, Iain White (2010), in *Water and the City*[12], identifies a failure in urban planning to recognize water's role beyond functionality—particularly in the face of climate change and rising flood risks.

From a sociopolitical lens, Farhana Sultana and Alex Loftus (2012) in *The Right to Water*[13] emphasize that access to water is not only a technical or ecological matter, but a political and urban one. The notion of water justice, framed by the UN's recognition of water as a human right in 2010[14], supports the idea that how water is distributed, treated, and made visible reflects power structures, inequalities,

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[9] Varnelis, Kazys (Ed.). *The Infrastructural City: Networked Ecologies in Los Angeles*. Actar, 2009.
[10] Sennett, Richard & Sendra, Pablo. *Designing Disorder: Experiments and Disruptions in the City*. Verso Books, 2020.
[11] Bell, Sarah. *Urban Water Sustainability: Constructing Infrastructure for Cities of the Future*. Routledge, 2017.
[12] White, Iain. *Water and the City: Risk, Resilience and Planning for a Sustainable Future*. Routledge, 2010.
[13] Sultana, Farhana & Loftus, Alex (Eds.). *The Right to Water: Politics, Governance and Social Struggles*. Earthscan, 2012.
[14] United Nations General Assembly. *Resolution 64/292. The Human Right to Water and Sanitation*, 2010.

and cultural values. This is central to *Hidrograma*: the project understands that infrastructure cannot be neutral: it either includes or excludes, reveals or conceals.

Philosopher Rob Nixon, in *Slow Violence and the Environmentalism of the Poor*[15] (2011), adds an essential layer by showing how environmental degradation, such as aquifer depletion or river pollution, operates invisibly across time, disproportionately affecting marginalized populations. His idea of "slow violence" strengthens the project's intention to expose and render legible what has long been hidden in water governance.

Artistic and cinematic works, such as the documentary *Watermark*[16] (2013) by Edward Burtynsky and Jennifer Baichwal, provide a visceral exploration of humanity's shaping of water landscapes. These works inspire *Hidrograma*'s scenography ambition: not only to design functional water infrastructure, but to construct urban experiences where water becomes visible, perceptible, and emotionally present.

Finally, *Hidrograma* draws upon a historical lineage of architectures that placed water at the center of collective life. From the aqueducts of ancient Rome to the stepwells of India, from Incan irrigation terraces to Islamic gardens, civilizations have long treated water as sacred, social, and spatial. These precedents remind us that water was not always hidden, it once shaped urbanity through rituals, encounters, and civic memory.

Together, these references form the theoretical foundation for *Hidrograma*, affirming that water is more than a utility, it is a relational element, a cultural artifact, and a design opportunity. They validate the need for architectural agency in a field often dominated by engineers and open the way for a new generation of water infrastructures that are civic, adaptable, and participatory.

[15] Nixon, Rob. *Slow Violence and the Environmentalism of the Poor*. Harvard University Press, 2011.
[16] Baichwal, Jennifer & Burtynsky, Edward. *Watermark* [Documentary Film]. 2013.

2.1.2 Water Infrastructures and Public Space: Visibility, Belonging and Memory

Throughout history, water infrastructures have not only supported survival but have also structured the collective memory and identity of communities. From Roman aqueducts to Ottoman fountains, and from Andalusian irrigation channels (*acequias*) to the qanats of Persia, societies have developed highly visible, performative relationships with water that interwove function with ritual, aesthetics, and belonging. These systems often acted as both technical and symbolic backbones of civic life, creating shared rituals around gathering, waiting, or cleansing.

However, the rise of the modern technocratic city during the 19th and 20th centuries radically altered this relationship. Urban water infrastructures were increasingly buried, hidden, and abstracted designed for efficiency and hygiene, not for experience. As Shannon Mattern[17] notes, "Infrastructure, as it is now conceived, is usually out of sight and out of mind until it breaks" (Mattern, 2016). The result is a city where one of our most vital resources becomes invisible and detached from everyday public consciousness.

This invisibilization is not neutral. It produces a disconnection between the population and the cycles that sustain their life, diminishing civic awareness and emotional ties to territory. As philosopher Ivan Illich warned in *H2O and the Waters of Forgetfulness*[18] (1985), this erasure of water from public life also erases part of our historical and mythological relation to it: "Water used to be a substance full of stories, taboos and rituals. It has become a neutral flow, measured and managed."

Today, this disconnection coincides with increasing environmental vulnerability. According to the European Environmental Agency[19] (2021), Southern Europe is among the regions most affected by climate-related drought and flooding, with urban hardscapes intensifying both extremes. In Spain alone, over 25% of treated water is lost due to aging infrastructure (INE, 2023)[20], while urban sprawl and impermeable surfaces accelerate runoff and reduce resilience.

Amid these conditions, a new generation of architectural and urban practices have emerged that seeks to reintroduce water into the civic imagination. Projects like *La Quebradora* in Mexico City (Taller Capital) or the *Stormwater Park* in Rotterdam show that it is possible to treat water infrastructure not only as a technical system but as a spatial opportunity: generating parks, gathering places, and

[17] Mattern, S. (2016). *Infrastructural Tourism*. Places Journal.https://placesjournal.org/article/infrastructural-tourism/
[18] Illich, I. (1985). *H2O and the Waters of Forgetfulness: Reflections on the Historicity of "Stuff"*. Dallas Institute Publications.
[19] European Environment Agency (EEA). (2021). *Urban adaptation to climate change in Europe 2020: Transforming cities in a changing climate*. EEA Report No 12/2020.
[20] Instituto Nacional de Estadística (INE). (2023). *Encuesta sobre el Suministro y Saneamiento del Agua*.

learning landscapes. These interventions signal a broader shift toward *hydro-civic design* (Waldheim, 2020[21]), which argues that water must be both infrastructural and experiential.

In this sense, *Hidrograma* follows and contributes to this current by exploring how water infrastructures can be re-stitched into urban life through civic engagement, temporality, and visibility. It asks: What forms of public space emerge when water is no longer hidden? What kind of culture and community can be built around the shared stewardship of water cycles? And how can architecture act not only as a spatial solution but as a medium of memory, imagination, and care?

[21] Waldheim, C. (2020). *Hydrology and Civic Design: Reclaiming Urban Infrastructure.*

2.1.3 Hydrological Framework and Infrastructural Context

To articulate an architectural hypothesis grounded in real conditions, this project is informed by a detailed territorial and hydrological analysis of Villaviciosa de Odón and its relationship to regional water infrastructure. The methodology combines GIS mapping, climate modelling, and the interpretation of public datasets from *Canal de Isabel II*[22], the *Confederación Hidrográfica del Tajo*[23], and Spanish national institutions such as the *Instituto Geográfico Nacional*[24] and the *Instituto Nacional de Estadística*[25].

The study begins with an understanding of Villaviciosa's geographic position within the broader basin of the Río Guadarrama and its subbasin El Arroyo de la Madre, which flows toward the Alberche river. Topographic analysis and runoff models based on *LIDAR* data allow the project to trace the historical and current water flows in the territory, identifying key moments of disconnection and loss where streams have been piped, canalized, or buried beneath urban expansion. These hidden waters represent both a spatial resource and a cultural memory to be reactivated.

Further, the project maps the entire functional water cycle in the municipality from catchment in the Santillana reservoir and the upstream network operated by *Canal de Isabel II*[26] to purification, distribution, drainage, and reuse. The layout of pumping stations, ETAPs, tanks, and the EDAR defines an infrastructural skeleton that currently operates in the background of civic life. By visualizing this network, the project aims to challenge the current paradigm that sees water infrastructure as technical but not spatial.

Demographic projections from the *Instituto Nacional de Estadística* forecast population growth and heat vulnerability in the region by 2050, which intersect directly with increasing strain on water systems. According to the *Agencia Estatal de Meteorología*[27], Villaviciosa will likely experience a rise in both summer drought intensity and extreme precipitation events, reinforcing the urgency of designing multi scalar and adaptive infrastructure capable of absorbing, reusing, and communicating hydrological dynamics.

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[22] Canal de Isabel II. *Memoria Anual 2023*. Canal de Isabel II, Comunidad de Madrid. https://www.canaldeisabelsegunda.es/web/canal-de-isabel-ii/memorias-anuales

[23] Confederación Hidrográfica del Tajo. *Sistema Automático de Información Hidrológica (SAIH)*. Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO). https://saihtajo.chebro.es/

[24] Instituto Geográfico Nacional (IGN). *Centro de Descargas CNIG – Datos LIDAR y cartografía base*. Gobierno de España. https://centrodedescargas.cnig.es/

[25] Instituto Nacional de Estadística (INE). *Proyecciones de población por municipios y pirámides demográficas*. https://www.ine.es/

[26] Canal de Isabel II. *Infraestructuras del Ciclo Integral del Agua*. Red de captación, ETAP, depósitos, redes de distribución y saneamiento. Mapa interactivo. https://www.canaldeisabelsegunda.es/web/canal-de-isabel-ii/el-ciclo-integral-del-agua

[27] Agencia Estatal de Meteorología (AEMET). *Escenarios regionalizados de cambio climático en España (Proyecciones 2020–2099)*. Gobierno de España. https://www.aemet.es/es/serviciosclimaticos/cambio_climatico

These data are not only used as environmental baselines but become projective tools for design. The spatial distribution of water consumption, leaks, and untreated runoffs inform where interventions are needed most, while the mapping of heat islands and impervious surfaces helps identify zones where permeable and cooling urban strategies can be implemented. Moreover, the identification of public infrastructures such as schools, parks, and health centers near these systems allows for strategic synergies between civic activity and ecological care.[28]

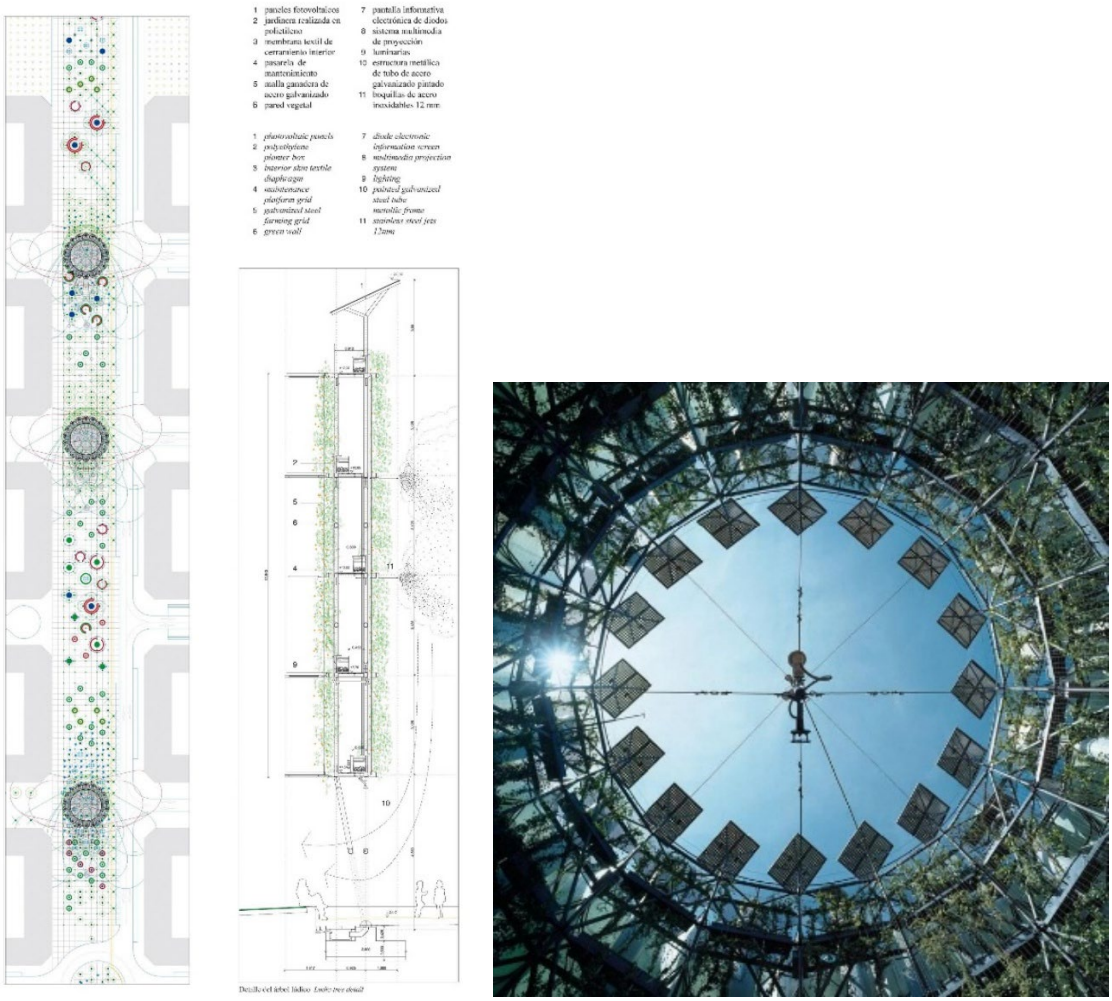
By anchoring the project in this layered territorial and technical knowledge, Hidrograma moves beyond metaphor into operative reality. The proposal does not work on abstract narratives but on infrastructural truths. It makes visible what sustains life and transforms it into architectural opportunity.

[28] Observatorio de Sostenibilidad Urbana en España. *Atlas de Sostenibilidad Urbana*. Fundación CONAMA. https://www.conama.org/

2.2 Architectural precedents

2.2.1 Eco Boulevard of Vallecas (Ecosistema Urbano, Madrid)

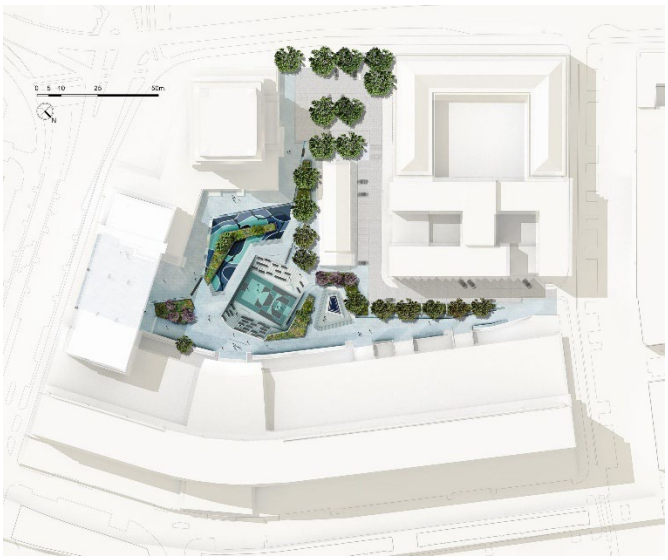
The Eco Boulevard in Vallecas is an urban experiment that proposes a new model of public space as a climate-adaptive infrastructure. Through three "air trees" light structures that provide shade, generate solar energy, and use evaporative cooling — the project demonstrates how urban design can improve microclimates and reclaim residual urban areas. Importantly, this intervention is not simply technological but civic: it turns infrastructure into a generator of social encounter and ecological awareness. For *Hidrograma*, it inspires the idea of modular, responsive water systems that adapt to urban rhythms while producing visibility and comfort.



Water Trees and Promenade Plan
https://arquitecturaviva.com/obras/ecobulevar-en-vallecas

2.2.2 Water Squares (De Urbanisten, Rotterdam)

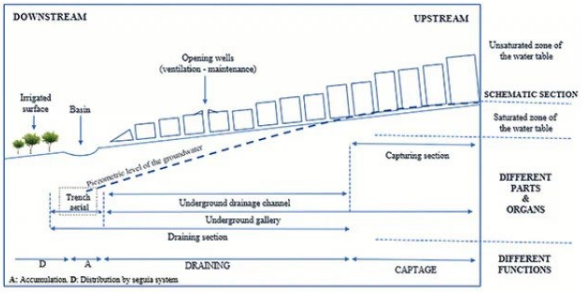
Designed for flood-prone Rotterdam, the Water Squares (or Benthemplein) convert plazas into dual-use infrastructure: they store stormwater during heavy rains and serve as public spaces in dry weather. The project transforms a technical necessity into a playful, inviting civic environment. It redefines risk as spatial opportunity and reinforces community awareness of the water cycle. *Hidrograma* adopts this logic of hybrid use, proposing spaces that both perform hydrologically and act socially.



Porous plazas that collect excess rainwater
https://www.urbanisten.nl/work/benthemplein

2.2.3 Qanats / Khettaras (Middle East and North Africa)

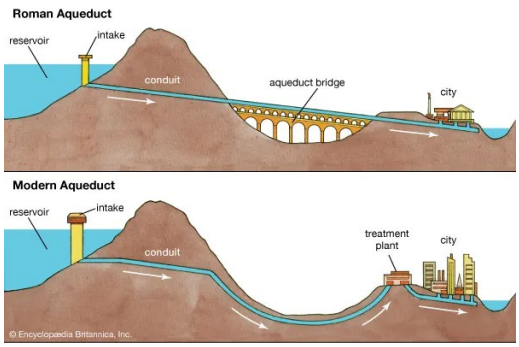
These ancient underground canals demonstrate a vernacular form of sustainable water management. Relying on gravity, they channel water from distant mountain aquifers to settlements, minimizing evaporation in arid climates. Though largely invisible, they shaped entire urban systems. In *Hidrograma*, the logic of the qanat is reinterpreted: how can hidden water systems be translated into spatial experiences, making the invisible civic again?



Khettara in Ait Oulghoum, Morocco and Akdima, Oasis of Tinghir, Morocco
https://www.watermuseums.net/campaigns/valuing-ancient-water-cultures/moroccan-khettaras/

2.2.4 Roman Aqueducts

Beyond their technical feat, Roman aqueducts functioned as monumental expressions of public life. Their scale and visibility reflected water's civic importance. They integrated seamlessly with city structures, often ending up in public fountains or baths. In *Hidrograma*, this historical precedent justifies the reappearance of infrastructure in public space, not as background, but as architectural protagonist.



Pont du Gard, Nimes, France
https://www.britannica.com/summary/aqueduct-engineering

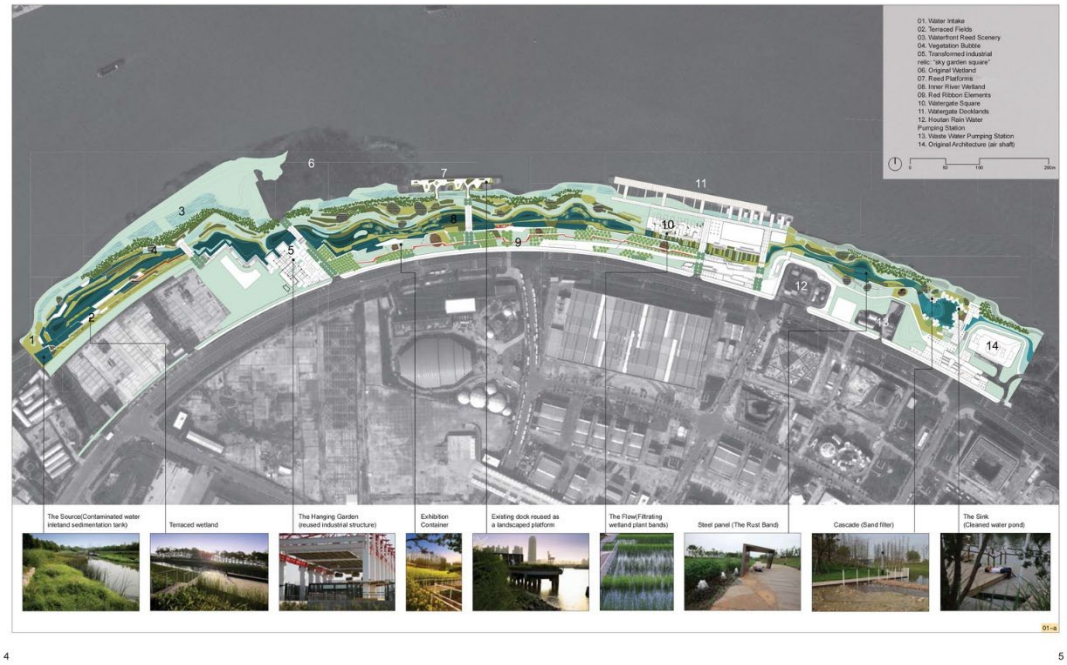
2.2.5 The Green Village (TU Delft)

This experimental research environment in the Netherlands tests future-proof infrastructures within a real urban context. With projects in circular water, energy, and mobility systems, it positions the infrastructure as adaptable, open, and citizen oriented. *Hidrograma* draws from this model to propose urban water infrastructures that are not fixed but continuously tested, modified, and shaped by use.

The Green Village: living lab for sustainability
https://www.tudelft.nl/en/delft-outlook/articles/maart-2020-start-ups/the-green-village-living-lab-for-sustainability

2.2.6 Houtan Park (Turenscape, Shanghai)

Located on a former industrial site along the Huangpu River, Houtan Park is a linear landscape that purifies river water through a series of stepped wetlands. It combines ecological function with pedestrian experience, offering a slow and sensory encounter with water's movement and transformation. The project is central to *Hidrograma's* vision of treatment spaces not as exclusion zones but as poetic, restorative, and public domains.



4 5

Houtan Park Plan and Illustrations
https://www.tudelft.nl/en/delft-outlook/articles/maart-2020-start-ups/the-green-village-living-lab-for-sustainability

2.2.7 Cheonggyecheon Restoration (Seoul) This iconic project removed a highway to uncover and restore a buried stream in the heart of Seoul. It reintroduces nature into a dense urban setting, reduces the heat island effect, and increases biodiversity. Importantly, it reclaims the river as a social and symbolic space. In *Hidrograma*, this precedent supports the idea of de-engineering as a spatial act—making water visible, accessible, and participatory again.

Elevated highway over Cheongye stream in 1972 and the canal restoration in 2025, Seoul, South Korea
https://www.archdaily.com/1020945/re-naturalization-of-urban-waterways-the-case-study-of-cheonggye-stream-in-seoul-south-korea

2.2.8 Water Temple and Church on the Water (Tadao Ando, Japan)

In both sacred buildings, Ando uses water not only as a visual or reflective surface but as a material of contemplation and ritual. The visitor's movement, light, and silence are choreographed through its presence. These projects reveal how water can generate atmosphere, memory, and slowness in architecture. *Hidrograma* reclaims this emotional power, especially in interventions like Bano de Poseidon.

Church on Water, Tadao Ando, 1988
https://archeyes.com/the-church-on-the-water-by-tadao-ando-nature-and-the-sacred/

Water Temple, Tadao Ando, 1991
https://arquitecturaviva.com/works/templo-del-agua-higashiura

2.2.9 Subak Irrigation System (Bali)

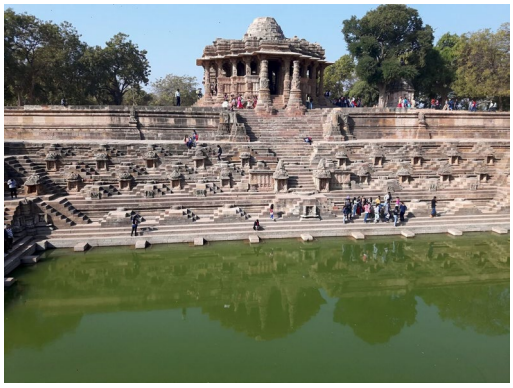
A community-managed system of rice terraces and water temples, Subak exemplifies how governance, ecology, and spirituality can coexist in water systems. Its cooperative structure links land use, religious practice, and sustainability. *Hidrograma* draws from Subak the notion that water infrastructure is never neutral: it carries cultural, social, and spiritual significance that can be reactivated.

Subak Irrigation System, Water reserve, Ministry of Education and Culture of Indonesia

https://whc.unesco.org/fr/list/1194/gallery/

2.2.10 Indian Stepwells

Stepwells are monumental subterranean structures combining water storage, architecture, and social use. They create dramatic spatial experiences while providing access to water. Their depth, light play, and ornamentation turn utility into architecture. *Hidrograma* explores this potential: how to spatialize the journey to water as a collective, sensual, and ritualized act.



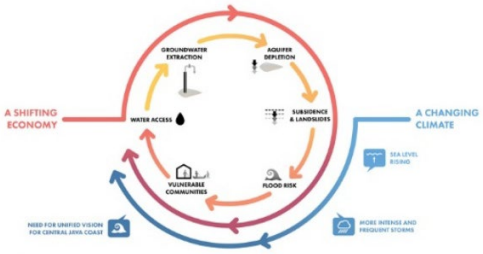
1 Surya Kund stepwell, part of the Modhera Sun Temple complex in Gujarat.

2 The Toorji ka jhalra stepwell in Jodhpur.

https://reasonstobecheerful.world/reviving-indias-stepwells-water-scarcity/

2.2.11 One Urbanism (Semarang, Indonesia)

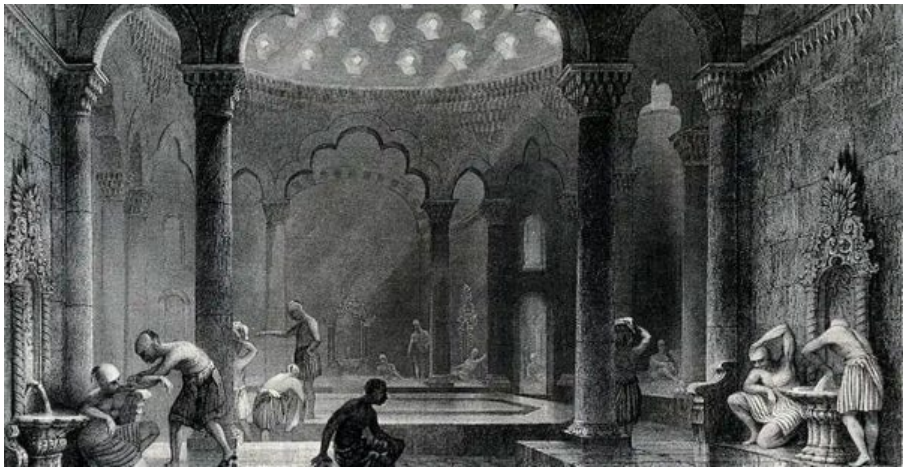
Facing rising sea levels and urban flooding, this design framework proposes hybrid infrastructures for housing and water management. It recognizes informal settlements not as problems but as collaborators in resilient design. *Hidrograma* similarly treats water risk as an opportunity to rethink civic and urban space in vulnerable conditions.



Water as leverage : Semarang, 2020
https://oneurbanism.com/one-work/one-urbanism-planning/#top

2.2.12 Traditional Hammams

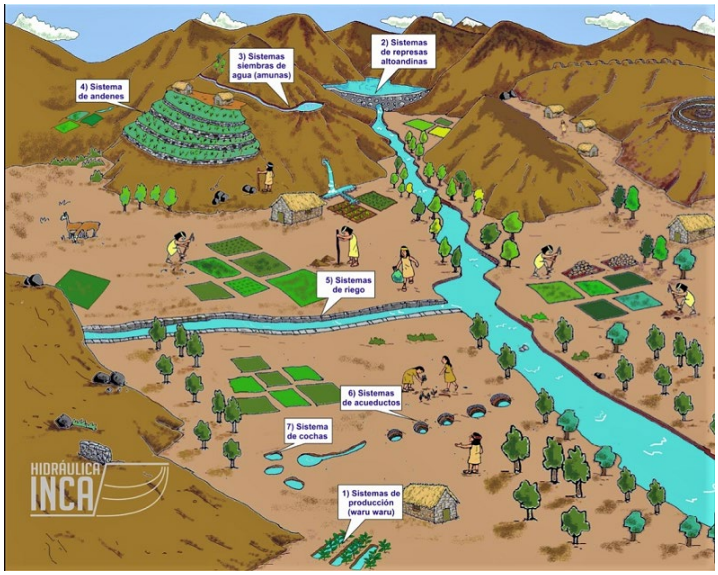
Public baths in the Islamic world embody water as a medium of purification, sociality, and transition. The spatial sequencing of heat, moisture, and rest creates a choreography of care. Hammams reflect a model of collective water use and sensory experience that *Hidrograma* echoes in its civic approach to infrastructure.



Historical Turkish Baths
https://toweltogo.com/fr/blogs/news/unveiling-the-timeless-elegance-the-thrilled-history-of-hammam-towels

2.2.13 Qochas and Inca Canals

Ingenious water management systems in the Andean highlands, these circular ponds and carved channels maximize water retention and distribution in arid terrain. Their forms blend with the landscape and operate through deep ecological knowledge. *Hidrograma* learns from their integration with topography and their balance between storage, use, and cultural identity.



Qochas Scheme and Results
https://earthjournalism.net/stories/in-the-peruvian-andes-residents-sow-water-for-the-future

2.2.14 Chinampas (Aztec Floating Gardens)

A system of raised beds within shallow lake zones, chinampas exemplify the productive interweaving of urbanity and water. They merge agriculture, settlement, and transport into a single metabolic landscape. *Hidrograma* uses this example to rethink peri-urban agriculture and wastewater reuse as integrated civic landscapes.

Chinampa en la Laguna de Tecocomulco
https://permies.com/t/63991/wetlands/Images-Chinampas-share-teaching-education

2.2.15 La Quebradora Hydraulic Park (Loreta Castro / Taller Capital, Mexico City)

One of the most emblematic recent projects in water urbanism, La Quebradora collects and treats rainwater in a decentralized system while creating public space and social infrastructure. It shows how engineering and design can work together to produce civic, ecological, and inclusive urban systems. It is perhaps the clearest precedent for *Hidrograma's* approach.

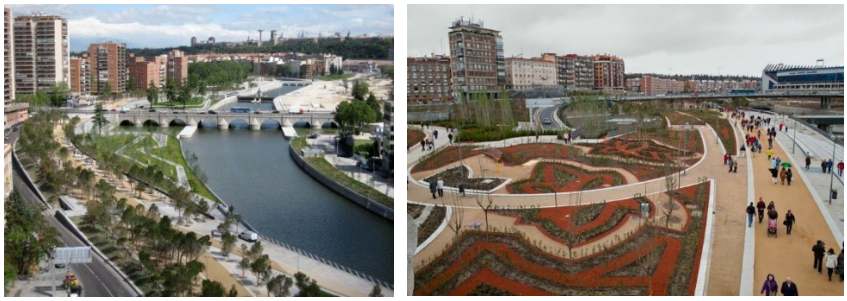
La Quebradora Hydraulic Park system and view.
https://www.archdaily.cl/cl/1017835/parque-hidrico-la-quebradora-taller-capital

2.3 Models of Contrast

2.3.1 Madrid Río: Landscape Infrastructure or Cultural Spectacle?

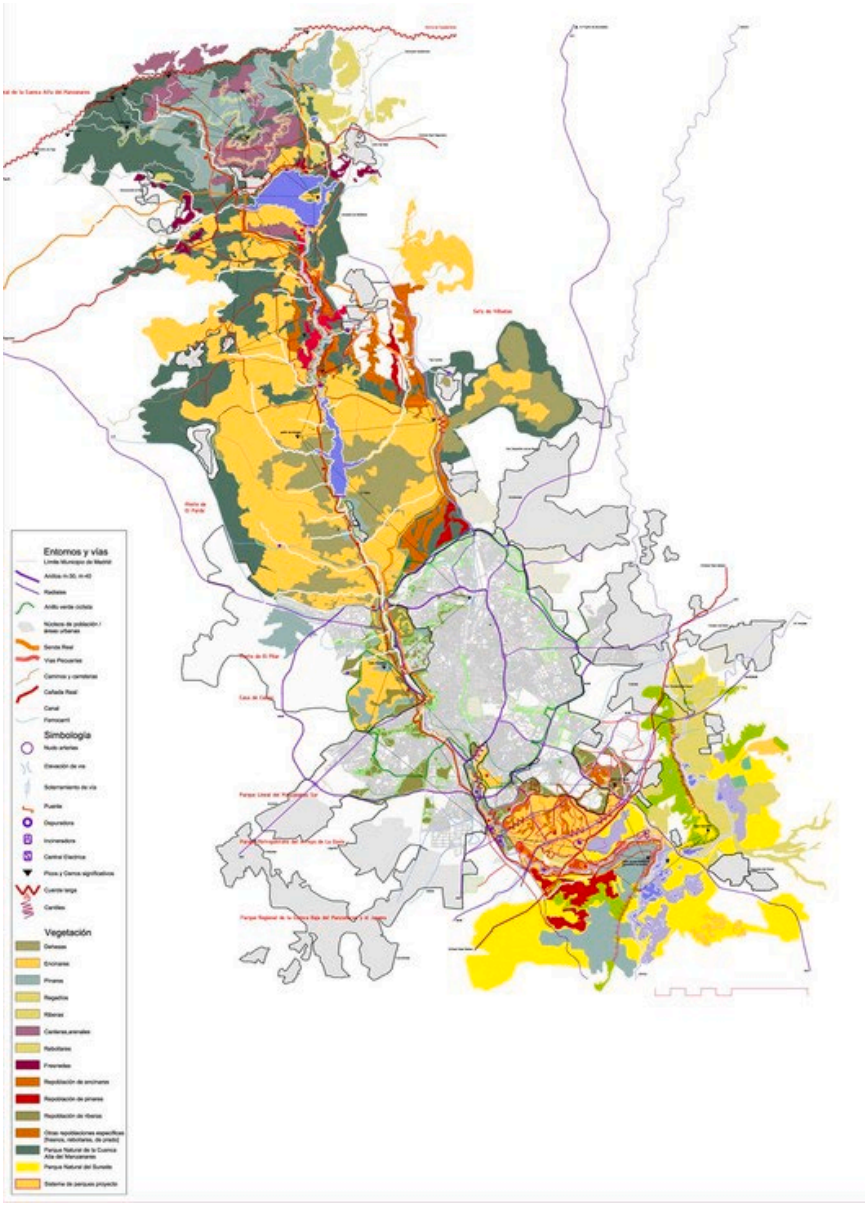
Madrid Río[29] is one of the most significant urban transformations in recent decades in the city of Madrid. Developed on top of the buried M-30 highway[30], the intervention converted a vehicular corridor into a pedestrian green space along the banks of the Manzanares River. It introduced cultural facilities, recreational areas, sports amenities, and large landscape zones. On the surface, it appears to reintegrate the river into public life, making water visible and accessible, and creating a new axis of civic activity. However, from the perspective of *Hidrograma*, Madrid Río can also be read critically as a beautification project that fails to address the structural role of water as a civic and infrastructural system. While the river is visually recovered, the deeper cycles of water management, such as catchment, treatment, reuse, or civic awareness, remain disconnected from the urban fabric and the public imagination. Water becomes a scenic backdrop rather than a protagonist.

Furthermore, the design logic behind Madrid Río prioritizes controlled pathways[31], predefined uses, and centralized spatial organization. Despite its generous scale, it offers limited space for informal appropriation, local adaptation, or community participation. The experience of water remains passive. In contrast, *Hidrograma* proposes a more distributed, fragmentary, and pedagogical model, where water becomes an agent of proximity, interaction, and care. Rather than a continuous monumental park, it imagines a network of micro-infrastructures that integrate water into everyday civic life. If Madrid Río monumentalizes water, *Hidrograma* domesticates it, making it tangible, legible, and participatory.



Proyecto Madrid-Río / Burgos & Garrido, Porras La Casta, Rubio A. Sala, West 8[32]
https://www.archdaily.cl/cl/02-89344/proyecto-madrid-rio-mrio-arquitectos-asociados-y-west-8

[29] Metropolis. (n.d.). *The Madrid Río project: A linear park along the Manzanares River*. Urban Sustainability Exchange. Retrieved June 2025, from https://use.metropolis.org/case-studies/the-madrid-rio-project
[30] West 8. (n.d.). *Madrid Río Infrastructure*. Retrieved June 2025, from https://www.west8.com/projects/madrid-rio-infrastructure/
[31] Harvard Graduate School of Design. (2015, November). *Veronica Rudge Green Prize in Urban Design 2015: Madrid Río*. Retrieved June 2025, from https://www.gsd.harvard.edu/event/veronica-rudge-green-prize-in-urban-design-2015-madrid-rio/
[32] ArchDaily. (2015, November). *Madrid Río wins Harvard's 2015 Veronica Rudge Green Prize in Urban Design*. Retrieved June 2025, from https://www.archdaily.com/776943/madrid-rio-wins-harvards-veronica-rudge-green-prize-in-urban-design

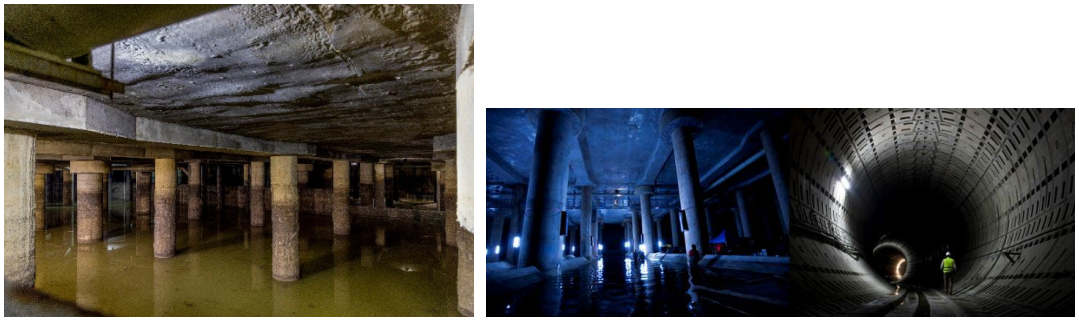


While *Madrid Río* successfully reintroduced the Manzanares River[33] into the urban imagination through a large-scale landscape operation, its approach remained largely linear, scenic, and post-factual, intervening after the river's course had already been heavily canalized and disconnected from its ecological function. In contrast, *Hidrograma* operates upstream in both time and scale: rather than restoring a river's image, it seeks to reconfigure the entire water cycle within the city as an active, civic and infrastructural system. Where *Madrid Río* offers a continuous promenade, *Hidrograma* proposes a network of strategic, adaptable interventions that expose, interpret, and reactivate hidden water flows, from catchment to reuse, thus embedding water not only in the landscape, but in daily life and collective consciousness.

[33] Llena-Morales, A. (2019). *Sustainability Analysis of the M-30 Madrid Tunnels and Madrid Río through the MIVES method. Applied Sciences*, 10(20), 7368. https://doi.org/10.3390/app10207368

2.3.2 Stormwater Tanks: Technical Infrastructure Without Urban Dimension

Stormwater tanks are underground infrastructures designed to retain large volumes of rainwater during intense weather events, thus preventing sewer overflows and reducing urban flood risk. In Madrid, *Canal de Isabel II*[34] has developed a system of these tanks as part of a broader climate resilience strategy. From an engineering perspective, they represent an efficient and robust solution. Yet, these tanks embody the paradigm of invisible infrastructure: deeply technical, buried, and isolated from the spatial and social dynamics of the city. They manage water but do not communicate it. They solve a problem but do not generate cultural or experiential value. *Hidrograma* offers an alternative approach. In the proposal *Baño de Poseidón*, the logic of the stormwater tank is reinterpreted as a visitable space, part educational facility, part public installation, part ritual architecture. It stores rainwater but also displays it. The tank becomes a stage for understanding hydrological cycles, not just a machine for diverting them. It is also the case with *Las Antipiscinas* as you can visually notice the rainwater being collected and stored to mix with the main underground storing canal of *Venecia de Odon*. The storage space is now dynamic and multipurpose. Rather than reinforce the divide between technical and civic space, *Hidrograma* seeks to bridge them. It transforms hydraulic performance into architectural narrative. Instead of hiding water away, it invites the public to interact with it, learn from it, and care for it. In this way, the contrast is not only spatial but epistemological: one model conceals the complexity behind efficiency, while the other reveals it as part of a broader ecological and civic education. Where traditional systems prioritize control, *Hidrograma* prioritizes comprehension and coexistence.



Estanque de Tormentas de Arroyofresno, Club de Campo Villa de Madrid
https://as.com/actualidad/sociedad/el-tanque-de-tormentas-mas-grande-del-mundo-esta-en-madrid-su-objeto-es-retener-el-agua-de-las-lluvias-n/

Madrid's Arroyo Fresno stormwater tank, located beneath a golf club, is the largest in Europe, with a capacity of 400,000 m³ to prevent flooding during heavy storms.

[34] Canal de Isabel II. (n.d.). *Storm tanks: Defending our rivers.* Retrieved June 2025, from https://www.canaldeisabelsegunda.es/en/-/storm-tanks-defending-our-rivers

3. HIDROGRAMA – Beyond Infrastructure, Into Waterscapes

Hidrograma *(n.)*

From the Greek *hydro-* (water) and *-gramma* (written, drawn)

In the context of this project, Hidrograma refers to a conceptual and spatial framework that reinterprets the urban water cycle as a visible, civic, and emotional landscape. It is both a diagram and a design strategy that maps the movement of water, from catchment to reuse, through a series of architectural interventions that aim to reconnect citizens with the ecological systems that sustain them.

Rather than treating water solely as a technical resource, Hidrograma positions it as a narrative and relational agent: a medium for urban coexistence, public space, and environmental awareness.

3.1 HYPOTHESIS - *Making Water visible transforms the city'*

The Analysis starts by establishing the foundational framework of the *Hidrograma* project by tracing the visible and invisible relationships between Villaviciosa de Odón and its water infrastructure. Using geographic information systems (GIS), environmental data, and historical archives, the study maps the full hydrological cycle, from the San Juan Reservoir to municipal consumption and projected climate shifts.

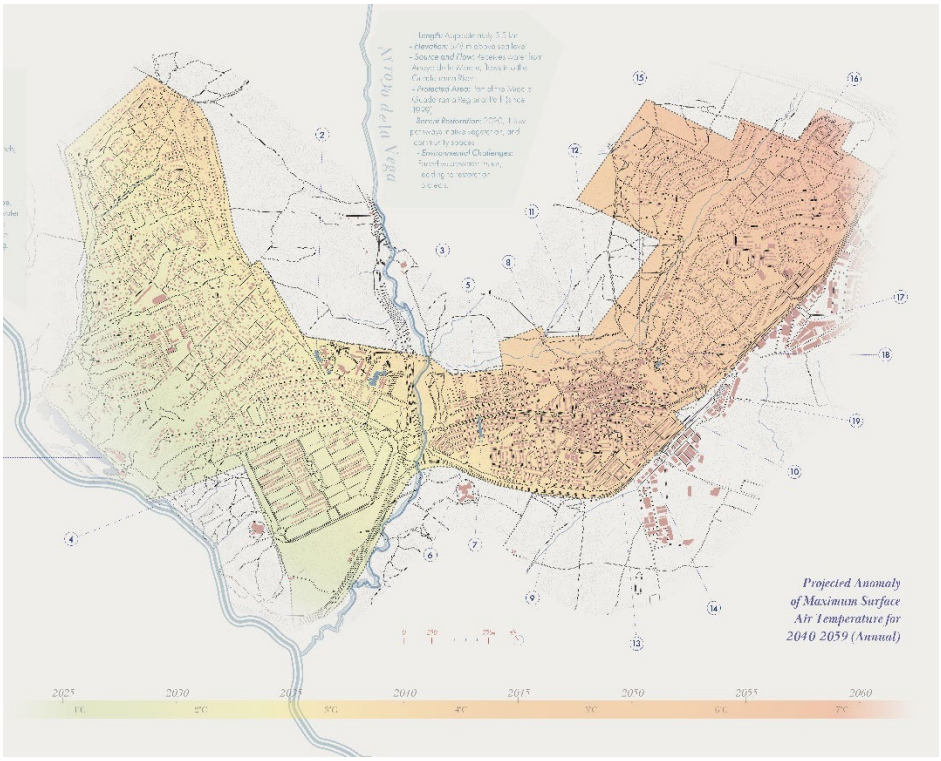
The method combines historical cartography, satellite imagery, environmental indicators (biodiversity, contamination, temperature), and demographic trends to identify where water systems intersect with urban life or fail to. This multiscale analysis reveals critical moments of disconnection and sets the stage for architectural interventions that reweave hydrology and habitability into the city's future.

Water Usage Matrix – Villaviciosa de Odón

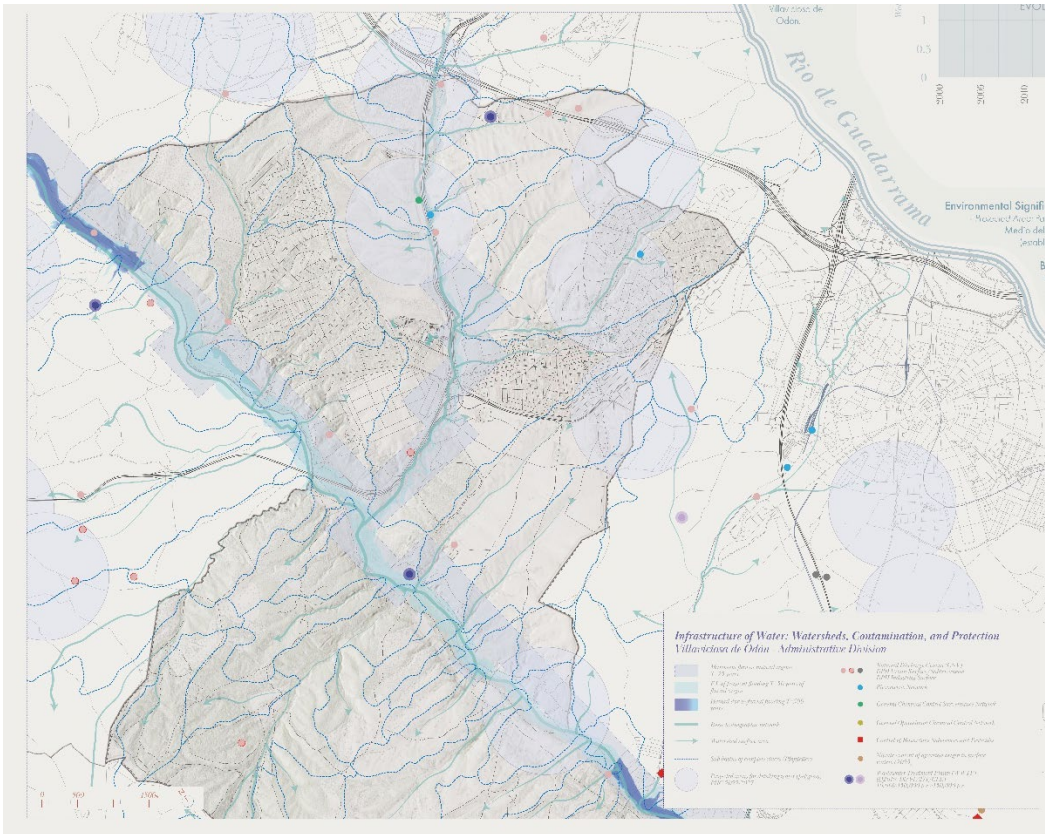
Sector	Estimate Consumption (m^3/year) 2025	Projected Consumption (m^3/year) 2050	Estimated Share (%)
Domestic	1,650,000	1,800,000	65%
Municipal	400,000	450,000	15%
Industrial	300,000	350,000	12%
Agricultural	200,000	250,000	8%
TOTAL (Estimated)	2,550,000	2,850,000	100%

Assumptions and Sources Used

- *Estimated Population:* Approximately 38,000 inhabitants.
- *Average Domestic Consumption:* 129 liters/person/day, based on INE data for the Community of Madrid in 2020 (ine.es).
- *Municipal Consumption:* Around 15% of the total, including green spaces and public buildings, following national data (ine.es).
- *Industrial Consumption:* Estimated at 12%, reflecting moderate industrial activity in the area.
- *Agricultural Consumption:* Estimated at 8%, considering water use for irrigation of local agricultural areas.



Projected Anomaly of Maximum Surface Air Temperature for 2040-2059

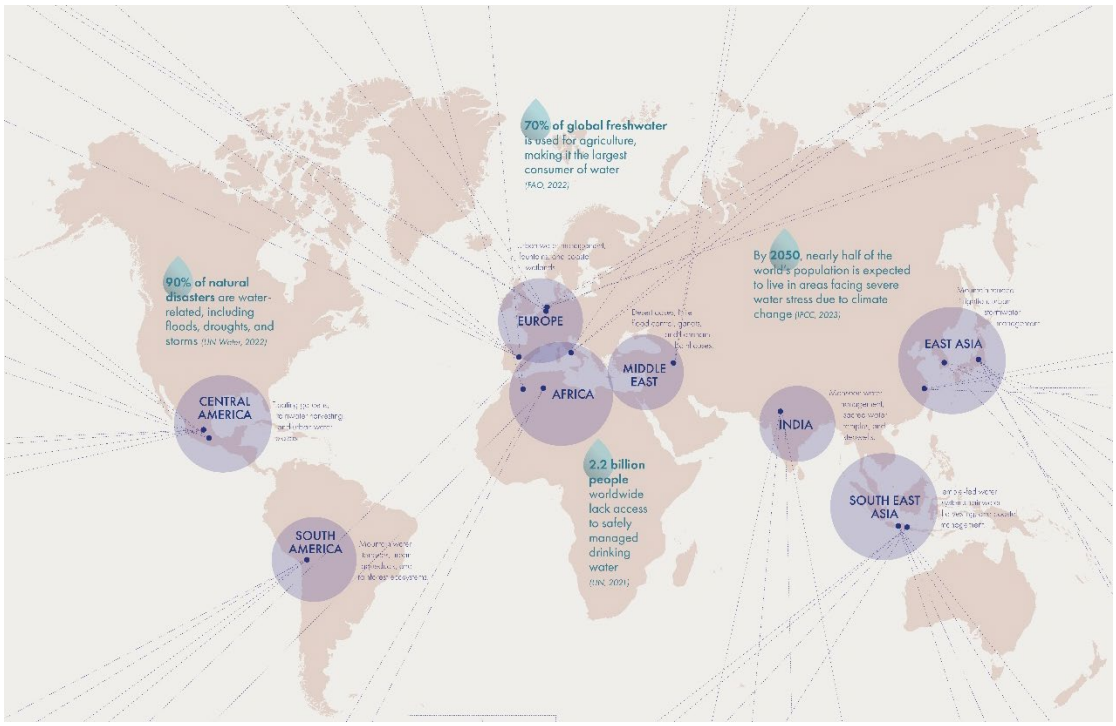


Infrastructures of Water in VDO - Map

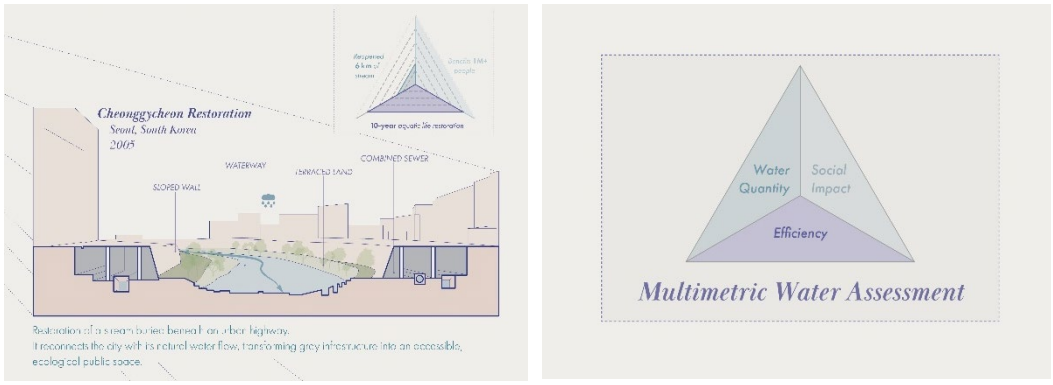
3.2 REFERENCES - *From Ancestral Past to Resilient Future'*

The second phase was to gather a curated atlas of water-based architectural precedents from across time and geography. From ancient irrigation systems like qanats, chinampas, and stepwells to contemporary innovations such as water plazas and urban sponge strategies, each case illustrates how water can structure public space, foster resilience, and nurture collective life.

By organizing the references along global coordinates and thematic diagrams, this phase of the project constructs a transhistorical vocabulary of spatial, social, and ecological water infrastructures. These references inform Hidrograma not only as technical solutions, but as cultural, experiential, and symbolic frameworks that reimagine water as a protagonist of urban futures.



Center summary World Map with important data on Water

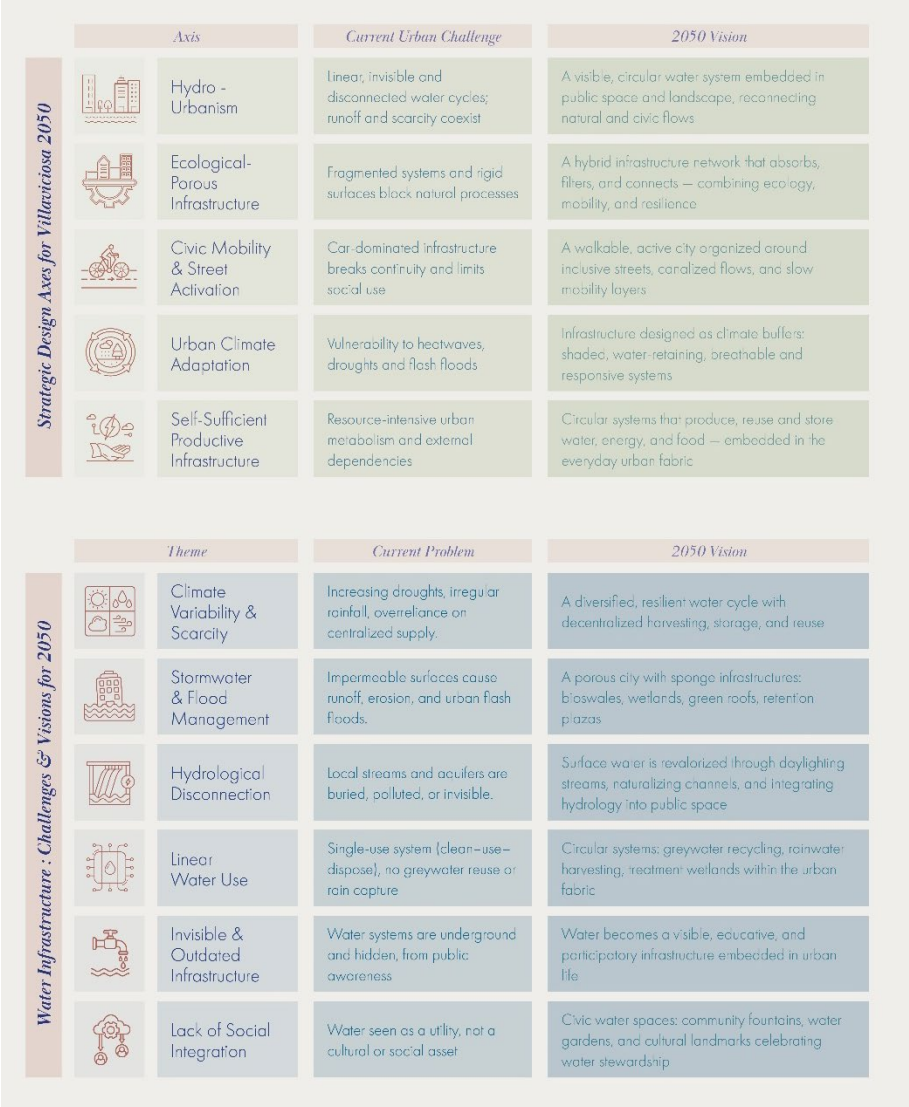


Example of one Reference and its multimeric water assessment (all illustrations are personally made)

3.3 OBJECTIVES - *Redesign Water as Public Infrastructure'*

This stage of the project traces the hidden path of water from source to purification, unveiling the hydraulic backbone that sustains Villaviciosa de Odón. By mapping the reservoirs, treatment plants, and distribution infrastructures of Canal de Isabel II, this phase reveals a fragmented yet essential system that remains largely invisible to the public eye.

Simultaneously, the poster defines the strategic objectives of Hidrograma: reimagining each phase of the water cycle as an opportunity for civic space, environmental restoration, and public awareness. From captation to drainage, the goal is to transform technical nodes into accessible, meaningful, and socially integrated urban milestones.



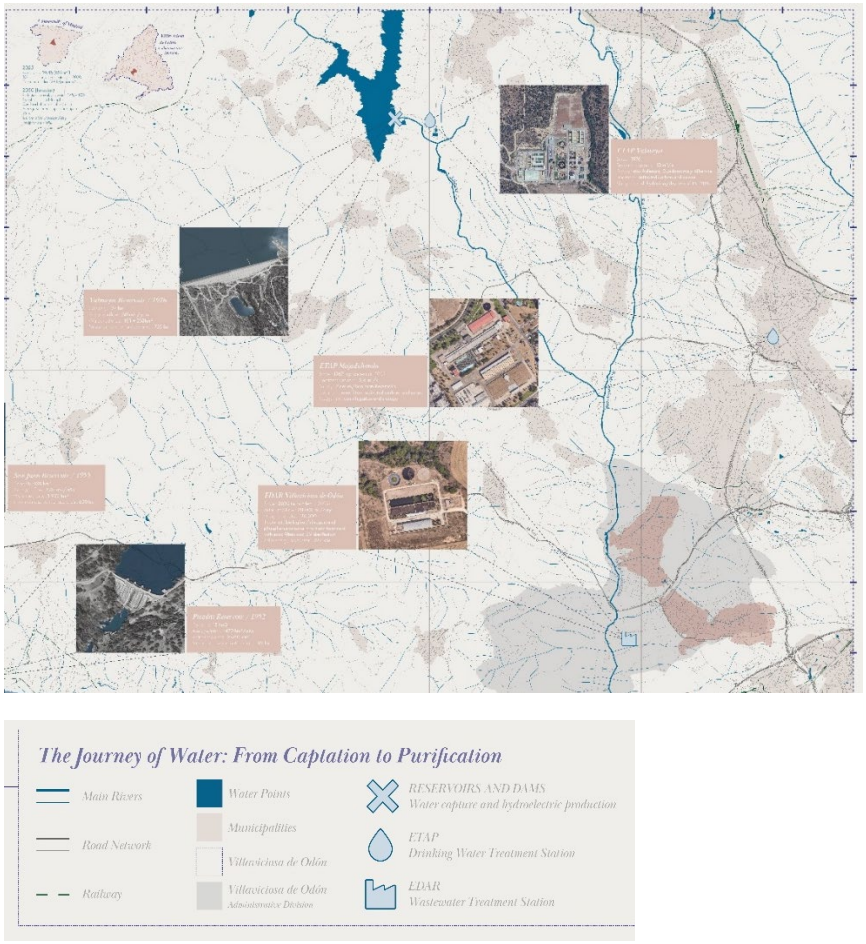
Strategic Design Axes for Villaviciosa 2050

Axis	Current Urban Challenge	2050 Vision
Hydro - Urbanism	Linear, invisible and disconnected water cycles; runoff and scarcity coexist	A visible, circular water system embedded in public space and landscape, reconnecting natural and civic flows
Ecological-Porous Infrastructure	Fragmented systems and rigid surfaces block natural processes	A hybrid infrastructure network that absorbs, filters, and connects — combining ecology, mobility, and resilience
Civic Mobility & Street Activation	Car-dominated infrastructure breaks continuity and limits social use	A walkable, active city organized around inclusive streets, canalized flows, and slow mobility layers
Urban Climate Adaptation	Vulnerability to heatwaves, droughts and flash floods	Infrastructure designed as climate buffers: shaded, water-retaining, breathable and responsive systems
Self-Sufficient Productive Infrastructure	Resource-intensive urban metabolism and external dependencies	Circular systems that produce, reuse and store water, energy, and food — embedded in the everyday urban fabric

Water Infrastructure : Challenges & Visions for 2050

Theme	Current Problem	2050 Vision
Climate Variability & Scarcity	Increasing droughts, irregular rainfall, overreliance on centralized supply.	A diversified, resilient water cycle with decentralized harvesting, storage, and reuse
Stormwater & Flood Management	Impermeable surfaces cause runoff, erosion, and urban flash floods.	A porous city with sponge infrastructures: bioswales, wetlands, green roofs, retention plazas
Hydrological Disconnection	Local streams and aquifers are buried, polluted, or invisible.	Surface water is revalorized through daylighting streams, naturalizing channels, and integrating hydrology into public space
Linear Water Use	Single-use system (clean–use–dispose), no greywater reuse or rain capture	Circular systems: greywater recycling, rainwater harvesting, treatment wetlands within the urban fabric
Invisible & Outdated Infrastructure	Water systems are underground and hidden, from public awareness	Water becomes a visible, educative, and participatory infrastructure embedded in urban life
Lack of Social Integration	Water seen as a utility, not a cultural or social asset	Civic water spaces: community fountains, water gardens, and cultural landmarks celebrating water stewardship

Charts of Hidrograma goals and objectives



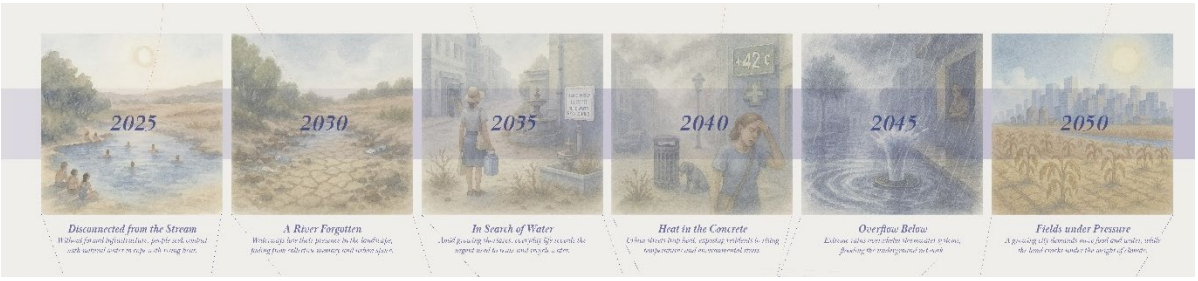
Mapping of the Water Cycle in the Region

3.4 PROPOSAL - *A Porous City Where Water Takes Its Place'*

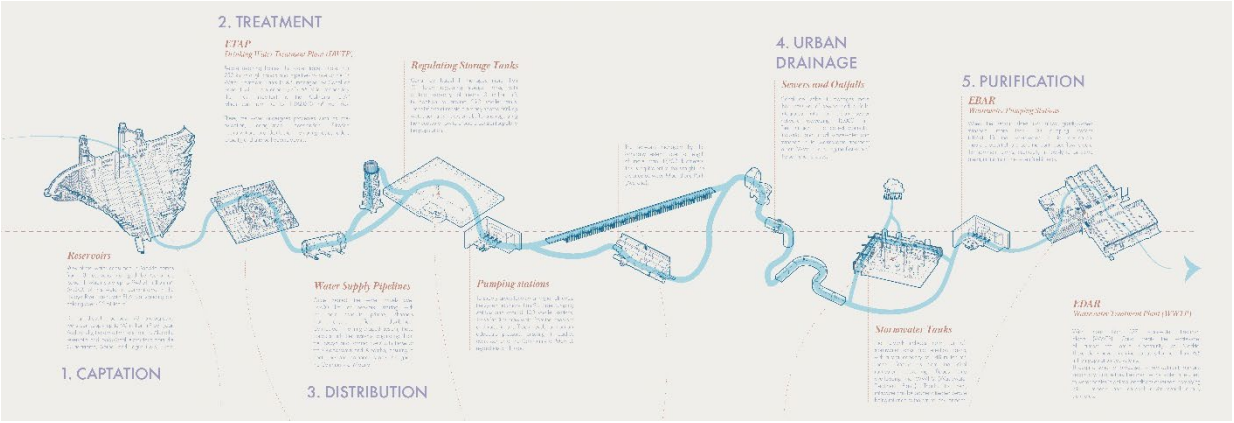
This final stage of the Research brings together the full vision of *Hidrograma* as a spatial, ecological, and civic reinvention of the urban water cycle. Structured along the five phases of the hydraulic system, captation, treatment, distribution, urban drainage, and purification, it translates technical flows into a sequence of architectural and public space interventions.

Each project: *Embálsēate*, *Camino al TratArte*, *Las Antipiscinas*, *Venecia de Odón*, *Baño de Poseidón*, and *Agua de Ida y Huerta*, responds to a different stage of the cycle, reimagining infrastructure as lived space. Together, they form a new hydrological landscape that is accessible, adaptable, and socially engaged.

The timeline at the center projects a speculative narrative from 2025 to 2050, tracing the transformation of Villaviciosa de Odón through droughts, floods, and community reconnection. Here, water is no longer hidden or feared, it becomes a civic protagonist, shaping a porous, resilient, and inclusive urban future.



Timeline of Future Challenges each 5 years



Detailed Water Cycle Infrastructures

Location of each Intervention along the water streams feeding Villaviciosa de Odon

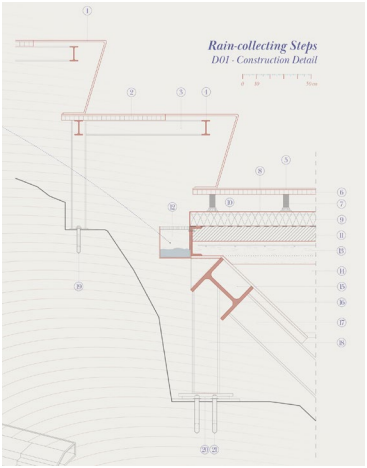
3.5 THE SIX INTERVENTIONS

Each intervention corresponds to a precise phase in the water cycle. They are designed with site specificity, but also as a module in a replicable system. Their articulation forms a hydrographic sequence, both spatial and experiential, that can be adapted to other municipalities.

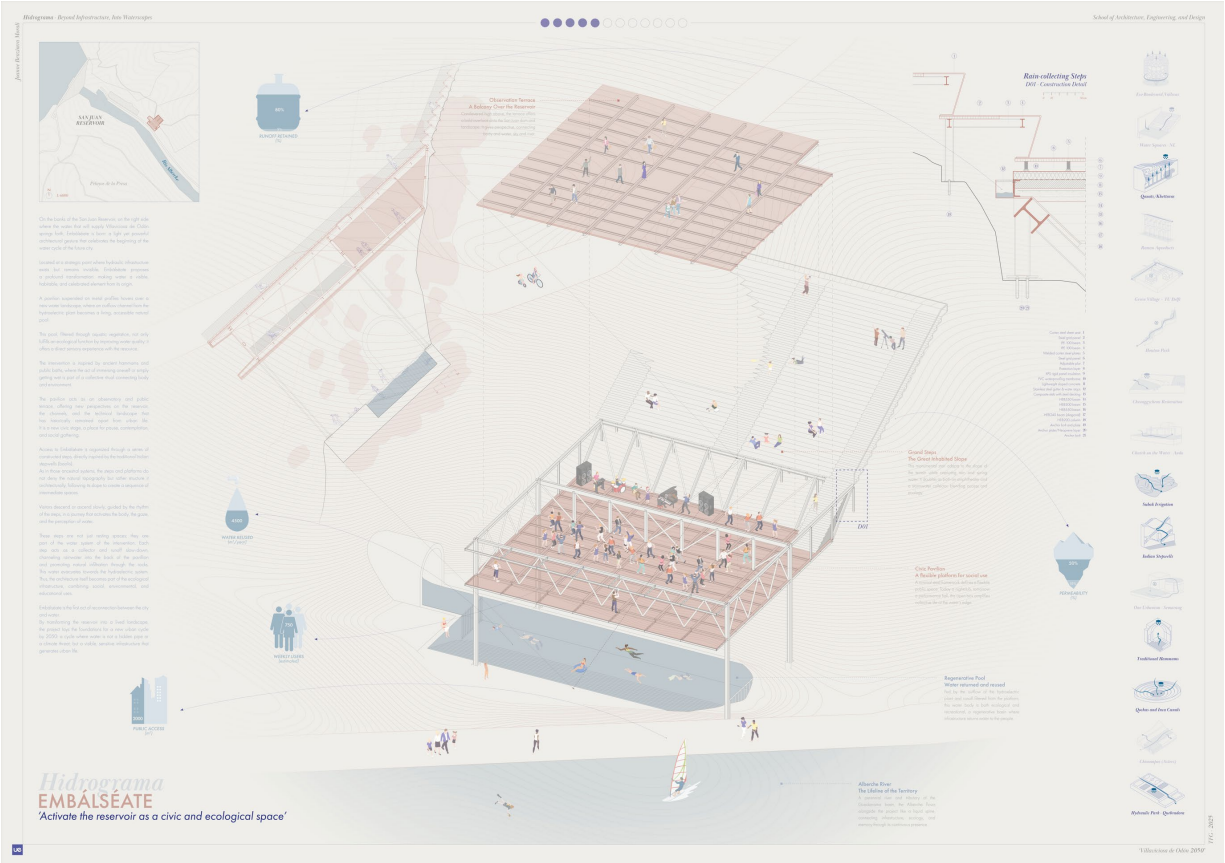
A. Embálséate - *'Activate the reservoir as a civic and ecological space'*

On the banks of the San Juan Reservoir, where the water that supplies Villaviciosa de Odón emerges, Embálséate is born: a light yet powerful architectural gesture that celebrates the beginning of the future city's water cycle. Located at a strategic point where hydraulic infrastructure exists but remains invisible, Embálséate proposes a profound transformation, making water a visible, habitable, and celebrated element from its origin. A pavilion suspended on metal profiles hovers above a new water landscape, where the hydroelectric outflow channel becomes a living, accessible natural pool. Filtered through aquatic vegetation, this pool improves water quality while offering a direct, sensory experience of the resource. Inspired by ancient hammams and public baths, the intervention turns immersion into a collective ritual reconnecting body and environment. The pavilion also acts as an observatory and public terrace, offering new perspectives on the reservoir and the technical landscape historically disconnected from urban life. It becomes a civic stage, a place for pause, contemplation, and encounter. Access unfolds through a sequence of constructed steps, referencing traditional Indian stepwells (baolis). These steps do not deny the topography but shape it architecturally, creating intermediate spaces that guide visitors in a rhythmic descent or ascent, activating the body, the gaze, and the perception of water. Beyond rest, these steps form part of the system: each one slows runoff, channels rainwater to the back of the pavilion, and encourages infiltration through the rock, ultimately reconnecting with the hydroelectric network. In this way, architecture becomes ecological infrastructure, serving social, environmental, and educational purposes. Embálséate is the first act of reconnection between the city and its water. By transforming the reservoir into a lived landscape, the project lays the foundation for a new urban cycle by 2050, where water is no longer a hidden pipe or a threat, but a visible, vital infrastructure that sustains urban life.

Site Plan: San Juan Reservoir

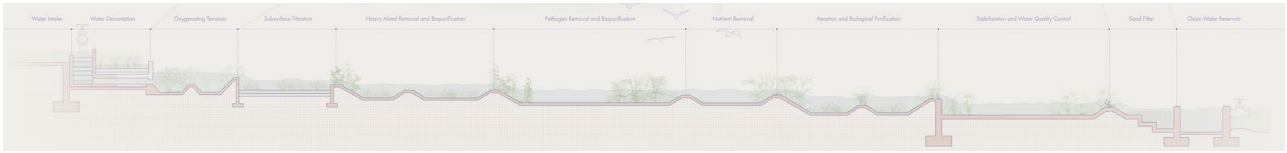


Construction Detail: The collecting steps

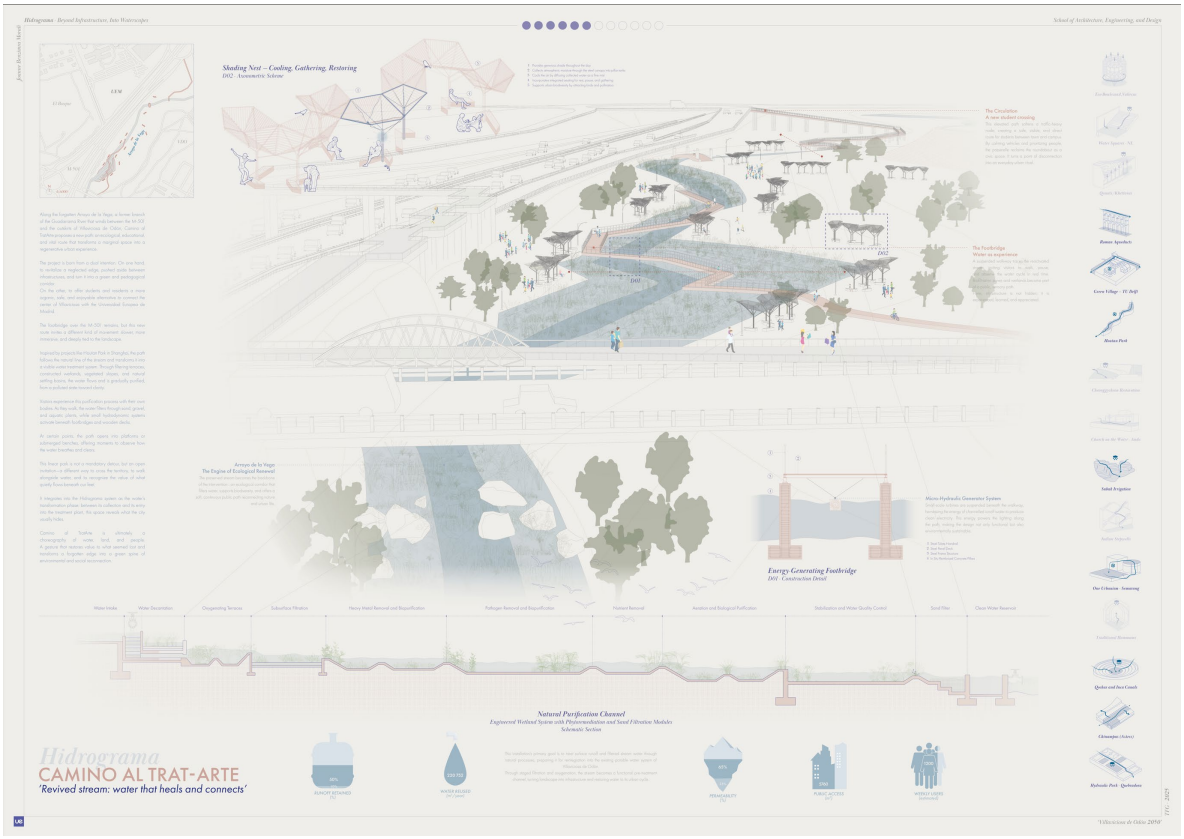


B. Camino al TratArte - *'Revived stream: water that heals and connects'*

Along the forgotten Arroyo de la Vega, a former branch of the Guadarrama River, nestled between the M-501 highway and the edges of Villaviciosa de Odón, unfolds Camino al TratArte: a new ecological, educational, and vital path that transforms a neglected fringe into a regenerative urban experience. The project seeks to recover this overlooked space and reconnect the town center with the Universidad Europea through a greener, slower, and safer pedestrian route. The existing footbridge remains, but the intervention introduces a new rhythm—immersive and attuned to the landscape. Inspired by projects like Houtan Park in Shanghai, the stream becomes living infrastructure: terraces, wetlands, and vegetated banks naturally purify runoff water. Visitors witness this process as they walk, observing water filtering through gravel and aquatic plants, microturbines generating energy beneath footbridges, and mist diffused from shaded canopies above. These architectural "nests" collect humidity, offer rest, and attract birds and pollinators, transforming the linear route into a biodiverse corridor. At times, the path opens into contemplative thresholds—benches, platforms, and crossings where water, people, and terrain interact. The channel's key role is to clean runoff before it enters the municipal potable system. This segment of the Hidrograma reveals a hidden phase: the choreography of water's treatment before reuse. More than a path, Camino al TratArte is a restorative gesture—blending land, infrastructure, and urban life into one poetic and resilient system. A green spine that redefines how we move, observe, and care.



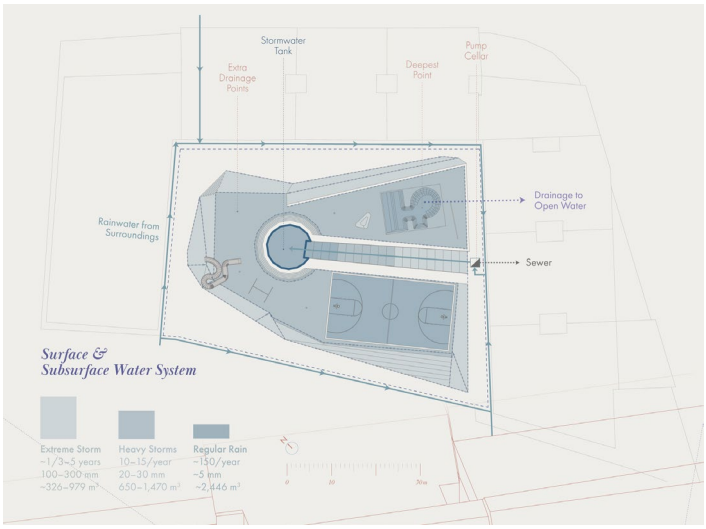
Natural Water Treatment Section



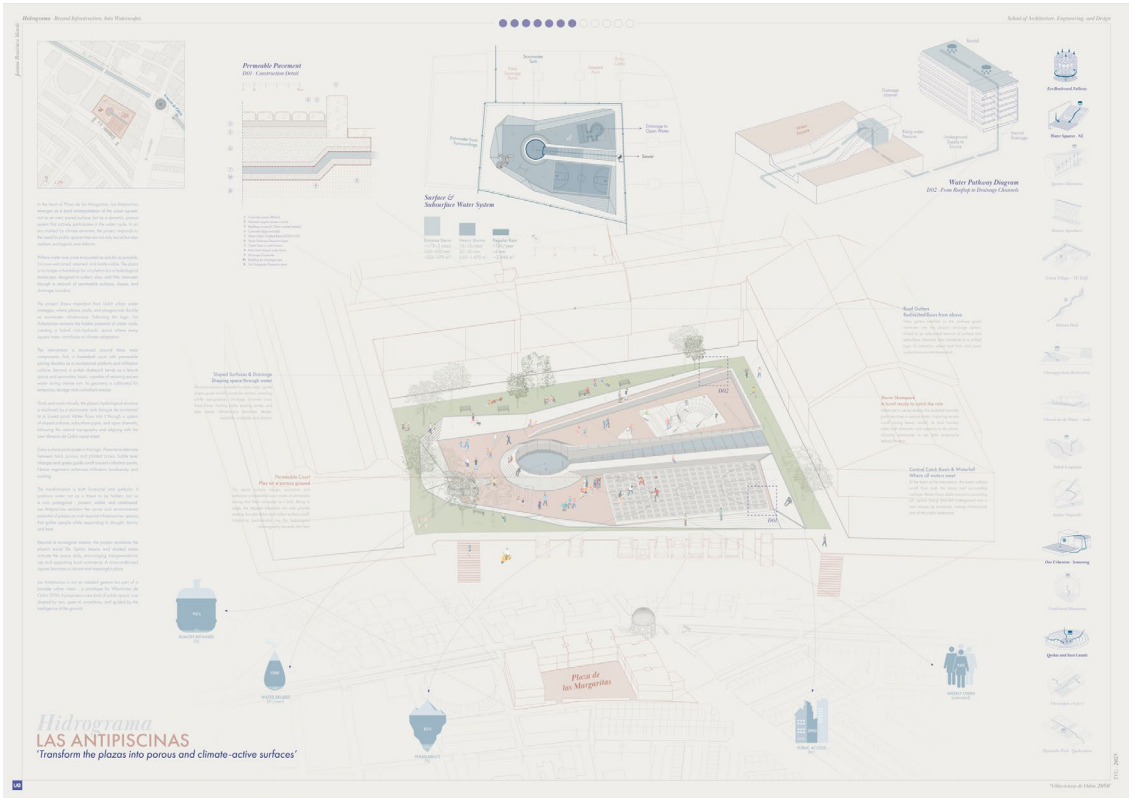
C. Las Antipiscinas - *'Transform the plazas into porous and climate-active surfaces'*

In the heart of Plaza de las Margaritas, Las Antipiscinas emerges as a bold reinterpretation of the urban square, not as a static, paved surface but as a dynamic, porous system that actively engages with the water cycle. In an era of climate extremes, it offers a public space that is social, resilient, ecological, and didactic. Where water was once quickly evacuated, it is now welcomed, retained, and made visible. The square becomes a hydrological landscape, designed to collect, slow, and filter rain through permeable surfaces, gentle slopes, and drainage corridors. Inspired by Dutch water plazas, where urban spaces double as stormwater infrastructure, Las Antipiscinas reclaims the latent potential of civic voids, turning them into hybrid spaces where every surface supports climate adaptation. The intervention is organized around three components. First, a basketball court with permeable paving acts as both play space and infiltration surface. Second, a sunken skatepark doubles as a leisure zone and temporary retention basin, its geometry calibrated for controlled water storage. Third, at the plaza's lowest point, a stormwater tank collects runoff through sloped surfaces, pipes, and open channels, connecting to the Venecia de Odón canal street. Every element contributes to the system: pavements alternate between hard, porous, and vegetated; subtle topographic shifts and grates guide water;

native plants enhance infiltration and cooling. This transformation is both practical and symbolic: water becomes a civic protagonist—visible, celebrated, and central. The plaza becomes a layered infrastructure, gathering people while responding to drought, floods, and heat. Beyond its ecological role, the project revitalizes social life. Sports, leisure, and shaded areas activate the space daily, encouraging intergenerational use and supporting local commerce. A once-underused square becomes a vibrant civic node. Las Antipiscinas is not a standalone gesture, but a prototype for Villaviciosa de Odón 2050: a public space shaped by rain, open to uncertainty, and guided by the intelligence of the ground.

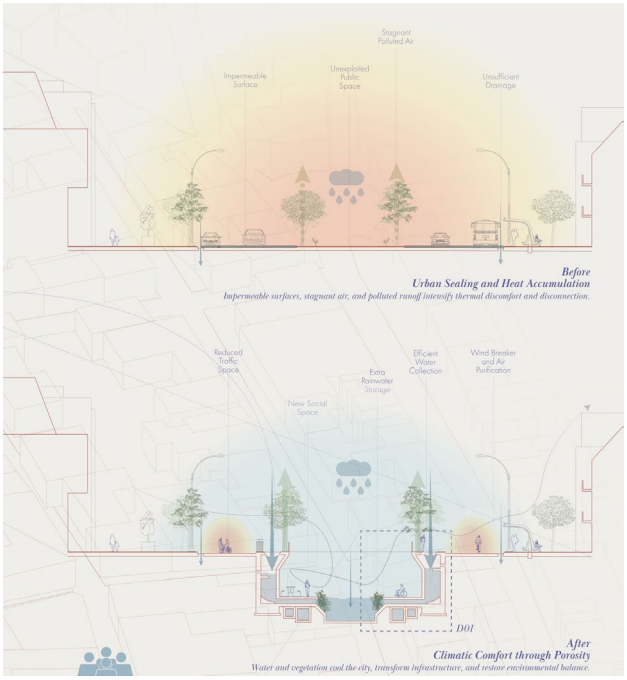


Plazas de las Margaritas: Water Collection System

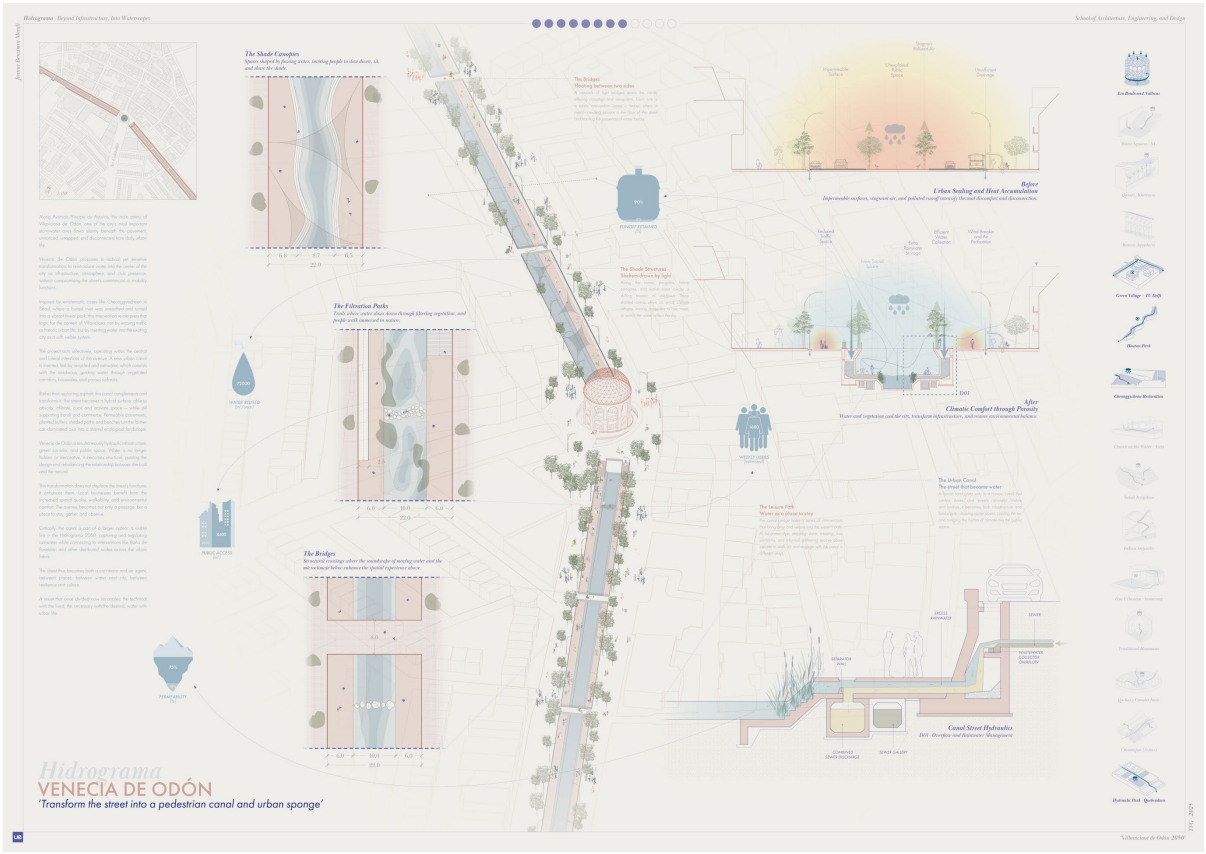


D. Venecia de Odón - *'Transform the street into a pedestrian canal and urban sponge'*

Along Avenida Príncipe de Asturias, the main axis of Villaviciosa de Odón, stormwater and treated wastewater flow just beneath the surface, hidden in pipes, out of sight and out of mind. What was once a vital hydrological line was paved over, compressed into infrastructure without presence, disconnected from nature and public life. Venecia de Odón proposes to resurface this flow, not metaphorically, but literally. A narrow, continuous canal reintroduces water into the street, reclaiming the logic of urban drainage and transforming it into spatial, social, and environmental value. The canal collects, filters, and transports a mix of rainwater and treated effluents, acting as visible drainage, cooling element, and passive reservoir. Rather than erase the street's function, the intervention works within it. The canal adapts to the avenue's geometry, weaving through the center and edges, preserving car access while shifting priority. Vehicle circulation is reduced, not removed, allowing for wider sidewalks, shaded areas, and vegetated strips that restore porosity and reduce heat. Asphalt becomes permeable. Water becomes visible. The street begins to breathe. Filtration gardens, bioswales, and gravel beds slow and purify the water while transforming the street's atmosphere, cooler air, softer sounds, greater comfort. Venecia de Odón reshapes the avenue into a space for walking, crossing, pausing. Shading structures and stone crossings create a rhythm of movement and rest. The canal stitches the street together instead of dividing it. Local businesses benefit from increased foot traffic and improved urban character. This is not a spectacle, but infrastructure made legible—subtle, calm, and part of daily life. Both practical and poetic, the project restores ecological function to a paved corridor while enhancing its civic quality. It captures runoff, channels water, and reveals what was buried, offering a new urban geography where environment and society align. Far from a rupture, Venecia de Odón is a reconciliation—between water and pavement, climate and city, flow and structure. A street that no longer hides its systems but lets them shape urban experience.

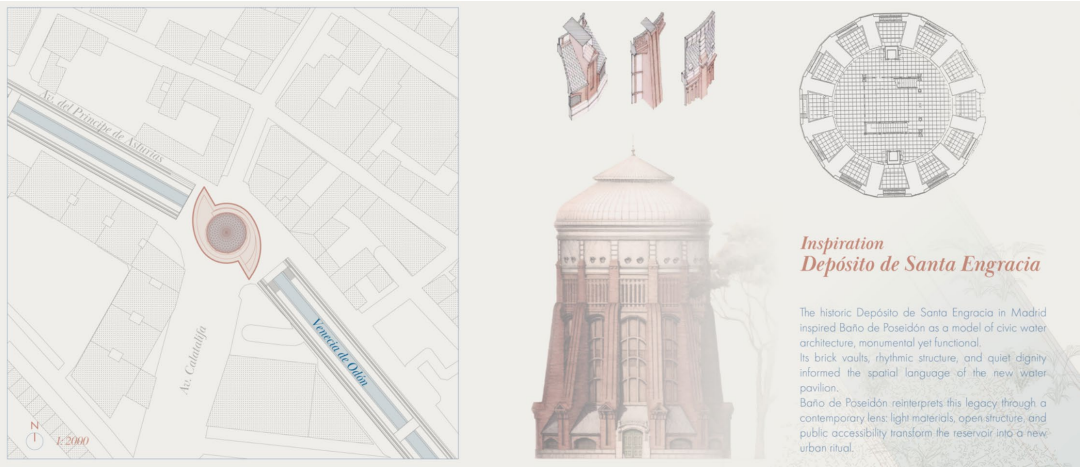


Before/After diagrams of the Canal Street Intervention

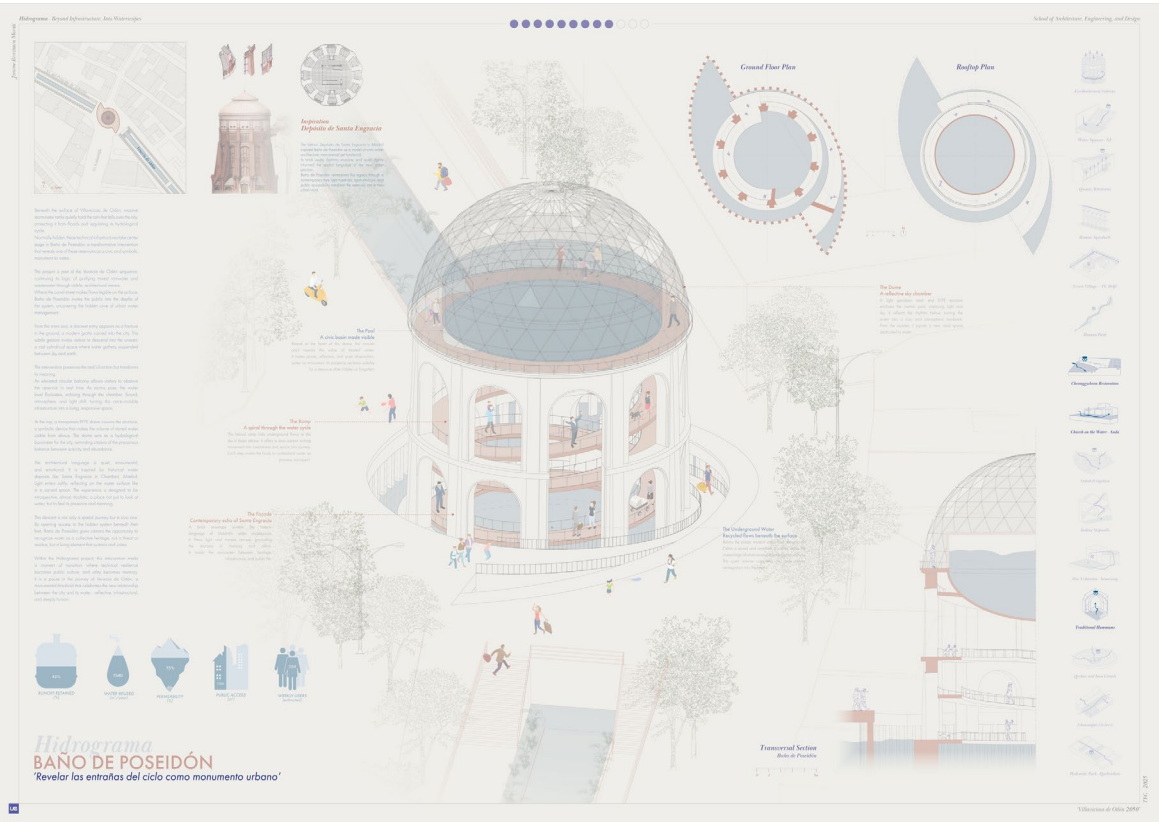


E. Baño de Poseidón - *'Reveal the depths of the cycle as an urban monument'*

Beneath the surface of Villaviciosa de Odón, large stormwater tanks quietly collect rainfall, protecting the city from floods and regulating its hydrological cycle. Normally hidden, these infrastructures take center stage in Baño de Poseidón, a transformative intervention that reveals one of these reservoirs as a civic and symbolic monument to water. The project continues the logic of Venecia de Odón, making urban water management visible through architecture. While the canal brings flows to the surface, Baño de Poseidón invites the public to descend into the depths of the system, unveiling its core. From the main avenue, a subtle entry appears as a fracture in the ground, a contemporary grotto carved into the city. This gesture leads visitors into a vast cylindrical chamber where water accumulates, suspended between earth and sky. The tank maintains its technical function but gains a new role. A raised circular walkway allows real-time observation of the water's fluctuations, with changes in sound, atmosphere, and light turning the space into a living, responsive environment. Above, a transparent EFTE dome reveals the water volume from street level. Like a hydrological barometer, it signals the city's delicate balance between drought and excess. The architecture is quiet yet monumental, inspired by historical cisterns like Santa Engracia in Chamberí. Light filters in gently, reflecting on the surface and creating a contemplative atmosphere. The space evokes a ritual quality, encouraging not just observation but connection. This descent becomes a civic act. By opening access to what lies beneath, Baño de Poseidón reframes water as a shared heritage and vital presence rather than a hidden utility. As part of Hidrograma, the intervention signals a shift. Technical resilience becomes public culture. Infrastructure becomes memory.



Site Plan of Bano de Poseidon on the center of Venecia de Odon and Inspiration of the historical Deposito de Santa Engracia

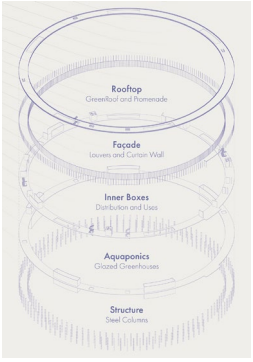


F. Agua de Ida y Huerta - *'Closing the water cycle by connecting the city to the productive territory'*

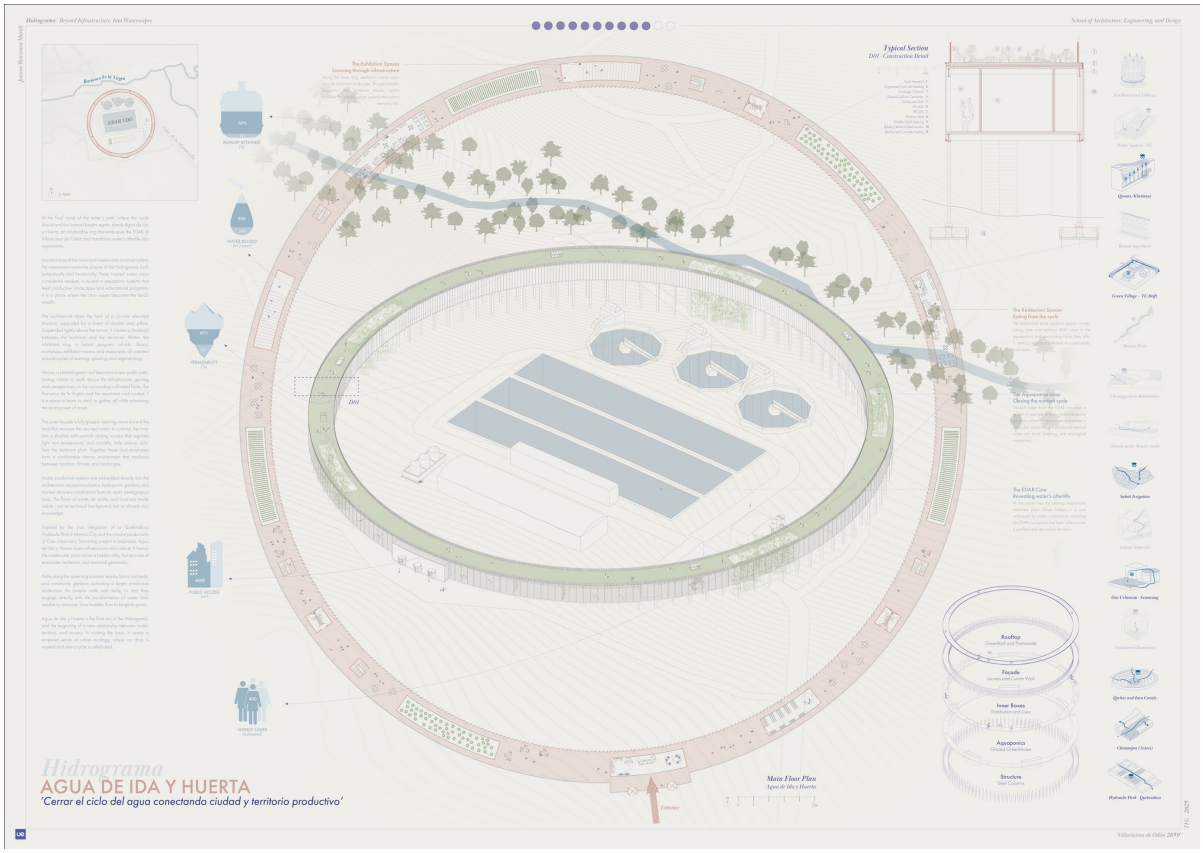
At the final curve of water's journey, where the cycle seems to end but instead begins anew, stands Agua de Ida y Huerta: an inhabitable ring that embraces the EDAR of Villaviciosa de Odón and transforms water's afterlife into opportunity. Surrounding the municipal wastewater treatment plant, the intervention closes Hidrograma both symbolically and functionally. Treated water, once considered waste, is now reused in aquaponic systems that feed productive landscapes and educational programs. The city's residue becomes the land's resource. The circular architecture, inspired by El Anillo by José María Sánchez García, is elevated on

slender steel columns and lightly touches the terrain, creating a civic threshold between infrastructure and landscape. Inside the ring, a mixed-use program unfolds library, workshops, exhibitions, and restaurants, all revolving around cycles of learning and regeneration. Above, a planted green roof becomes a public walkway with views of nearby orchards and fields. The outer glazed façade opens to the rural context, while the inner skin, shaded by rotating louvers, regulates light and temperature and helps control the odor. Productive systems are integrated throughout: aquaponics, hydroponics, and nutrient recovery loops are not hidden, but part of the public experience. Inspired also by La Quebradora in Mexico City and One Urbanism's Semarang project, the intervention turns utility into shared knowledge. Paths extend from the ring, linking farms and gardens into a wider landscape network. As visitors walk, eat, or learn, they engage with the transformation of water, from waste to resource, from invisible system to civic heritage. Agua de Ida y Huerta is both closure and beginning. It marks the final act of Hidrograma, and the opening of a new urban ecology where every drop is valued and every cycle celebrated.

Site Plan of Agua de Ida y Huerta around the EDAR



Exploded Axonometry of the Building Structure



3.6 THE PROBLEMS SOLVED

3.6.1 Embálséate

- Problem

The San Juan reservoir is essential to the region's water supply but remains completely detached from public life. Fenced and isolated, it is seen as a distant utility, not as a place of memory or collective experience.

- Design Strategy

Reimagine the reservoir edge as a public landscape for contemplation, leisure, and education, turning the catchment point into an emotionally resonant civic space.

- Temporal Resilience

Designed to adapt to varying water levels, with natural pool and water collecting steps.

3.6.2 Camino al TratArte

- Problem

The path water takes from purification to distribution is completely buried and abstract. Citizens walk over it daily without knowledge of its presence.

- Design Strategy

Create a didactic urban promenade that provides extra drinkable water to the system through natural purification.

- Temporal Strategy

Usable in all seasons, with shading for summer and passive water elements. Designed as a new path between the University and Villaviciosa de Odon.

3.6.3 Las Antipiscinas

- Problem

Urban plazas are sealed, underused in summer, and flood-prone during heavy rains. They are visually dry but structurally impermeable.

- Design Strategy

Reprogram these squares as "anti-pools", spaces that collect water when it rains and transform into playful civic places when dry.

- Climate Logic

Reduces heat island effect; increases infiltration; creates shaded microclimates and seasonal memory.

3.6.4 Venecia de Odón

- Problem

Streets are the main conveyors of runoff yet remain designed for vehicles, with impermeable surfaces and heat-absorbing materials.

- Design Strategy

Transform one street into a sponge corridor using green infrastructure, water-slowing devices, and seasonal water presence. A hybrid between street, park, and canal.

- Resilience Contribution

Reduces urban flooding; cools microclimate; enhances biodiversity. It can be replicated elsewhere.

3.6.5 Baño de Poseidón

- Problem

Stormwater tanks are large, expensive, and invisible. They have no civic presence, no memory, no interface with the public.

- Design Strategy

Reclaim the underground as a sacred and civic space, using architectural language to create a performative descent into hydrological mystery.

- Climate Performance

Captures peak runoff; educates public; doubles as museum or summer cooling space.

3.6.6 Agua de Ida y Huerta

- Problem

The EDAR treats wastewater, but treated water is rarely reused locally. Agriculture remains disconnected from the urban metabolic cycle.

- Design Strategy

Establish a productive interface between the EDAR and nearby agricultural land as well as a public space.

- Circularity Impact

Closes the loop; supports local food systems; transforms a technical site into a civic landscape.

Each intervention is deeply rooted in site and system, yet designed to evoke emotion, provoke participation, and build resilience. Together, they compose a new hydrographic urbanism: a town that learns, remembers, and celebrates water.

4. DISCUSSION

Hidrograma emerges from a central ambition: to shift the status of urban water infrastructures from hidden technical systems to visible, spatial, and collective actors within the fabric of the city. By breaking the division between utility and public space, the project reimagines each phase of the urban water cycle not as a background process but as a lived, civic experience. In doing so, it raises key questions, not only architectural or ecological, but cultural, political, and ethical.

The work challenges the long-standing logic of concealment in infrastructure design. Pipes, tanks, and treatment plants are traditionally buried, isolated, or placed at the margins. This invisibility fosters disconnection: citizens forget the origins and destinations of water, and with that, lose a sense of care, stewardship, or even curiosity. *Hidrograma* proposes a different scenario: what happens when infrastructure is made visible, habitable, even beautiful? Can such visibility foster a deeper ecological awareness? Can it create new forms of public interaction and shared responsibility?

This reframing opens a series of questions that extend beyond the scope of this academic project and suggest future lines of inquiry:

- **Can civic infrastructure shift cultural narratives?** By transforming utilitarian systems into collective rituals (bathing, walking, observing, learning), *Hidrograma* suggests a city where infrastructure is not just used, but experienced. But how deeply can spatial strategies alone influence attitudes and behaviors toward water conservation and climate adaptation?
- **How can such infrastructures be co-designed with the communities they serve?** While the project works through design speculation and research-by-design, future iterations must be developed through participatory methods, co-design workshops, public consultations, and interdisciplinary collaboration, to ensure relevance, legitimacy, and usability.
- **What are the governance and maintenance models that support such civic infrastructures?** Making water visible is one thing. Managing it over time is another. How do we ensure that these spaces do not degrade into under-maintained remnants? What new alliances between municipalities, environmental agencies, and citizens are needed to sustain them?
- **How does this model scale to other urban contexts?** While rooted in Villaviciosa de Odón, the principles explored in *Hidrograma*: reconnection, porosity, ecological legibility, could be adapted to other towns or regions. Yet each site has its own hydrological, climatic, and social particularities. What are the variables that make this model transferable? Where are its limits?

- **Could water become a new axis of urban identity?** Just as some cities are shaped by boulevards, ports, or plazas, could future cities be shaped by the visible flow of water? Can hydrological infrastructure define the rhythm and atmosphere of urban life, acting as a shared commons rather than an abstract system?

From a methodological perspective, the project has embraced a design-research approach rooted in mapping, referencing, spatial invention, and speculative proposal. It is strongest when it brings together layers like historical, hydrological, ecological, social ones into coherent spatial narratives. Yet it also acknowledges its speculative nature: some proposals are more conceptual than feasible, more illustrative than resolved. Technical detailing, legal constraints, and long-term financing models remain underdeveloped but open for future exploration.

More than a masterplan or a finished solution, *Hidrograma* offers a framework or a set of strategies, spatial languages, and temporal rhythms that could guide the transformation of other cities. It proposes a city where water flows above ground, where streets are porous, where tanks become temples, and where care for infrastructure becomes a shared civic culture.

Ultimately, the question is not just what kind of water systems we need, but what kind of urban relationships we want to cultivate through them. *Hidrograma* imagines a future where water is no longer a hidden utility or a looming risk, but a connective tissue, between people, places, and the planet.

5. CONCLUSIONS

Hidrograma did not begin as a solution, but as a question: what would happen if water, usually confined to pipes, basins, and hidden networks, was allowed to return to the surface, not just physically, but symbolically, socially, and architecturally? This project explored that question not through a single intervention, but by unfolding an entire urban cycle, one where water is treated as both infrastructure and narrative, as both a necessity and a civic possibility.

What emerges is not only a vision of future Villaviciosa, but a broader proposal for how cities might live with water in more expressive, adaptive, and ecological ways. Each intervention, whether it is a pavilion, a canal, a plaza, or a productive landscape, takes part in this transformation, revealing the potential of hydraulic systems to shape urban experience beyond their utility. This approach situates water as a visible and participatory element of daily life, challenging the invisibility that often surrounds infrastructure.

At the heart of the project is a deep fascination with infrastructure, not just as a technical necessity, but as a cultural and spatial system that expresses how we relate to nature, technology, and one another. Personally, it is this duality that fuels my practice: the ability to dive into complex technical systems such as hydraulic mechanisms, stormwater tanks, and filtration processes and gain a level of understanding that turns research into design. Every phase of this project became an opportunity to acquire a kind of micro expertise in hydrology, ecological engineering, and material behavior. This technical curiosity was not secondary to the architectural process; it was a driving force behind it.

Rather than designing static buildings, *Hidrograma* proposes infrastructural frameworks that evolve, adapt, and educate. The temporal structure, organized between 2035 and 2050, allowed for testing gradual transformations, starting with soft interventions and leading to more integrated systems of reuse, purification, and civic engagement. These stages reflect not only the evolving needs of the urban context, but the iterative nature of knowledge itself: designing became a way to learn and teach at once.

Still, the speculative nature of the project reveals some limits. Without direct participation from residents or institutional actors, the interventions cannot claim to reflect lived experience. A future iteration should integrate co-design, dialogue, and local expertise, not to replace the architectural proposal, but to strengthen it with the richness of real voices.

However, this methodological strength also reveals a core limitation: as it is currently proposed, *Hidrograma* flirts with a degree of spatial fantasy. The scale, complexity, and logistical demands of

certain interventions, such as transforming roads into canals, or integrating aquaponic infrastructures into public buildings, require not only further technical development but significant political, economic, and social coordination. These ideas, while grounded in existing references, cannot yet be built without radical shifts in institutional will and public policy.

The project also opens larger questions: How can infrastructure become a platform for collective awareness, not just function? What forms of governance, care, and maintenance are needed when technical systems become public spaces? Can we design urban landscapes where climate adaptation and civic culture truly reinforce each other?

In its essence, *Hidrograma* is both a research method and a spatial manifesto. It argues that infrastructure should not be hidden or passive, but open, legible, and loved. It suggests that through design, technical systems can become poetic systems, where pipes are paths, tanks are temples, and every drop of water is a shared responsibility.

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