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Water Systems Design: Connecting and Developing Methods for the Value Case Approach

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Abstract
Water uses and practices are typically dissociated and considered separately: drinking water, sewage systems and shipping are often treated as distinct systems. Especially in a time of climate-related water systems change, a more holistic approach is needed. This article explores the background of and inspiration for for the value case approach developed and tested in several workshops for port city territories and water systems under my leadership as UNESCO Chair Water, Ports and Historic Cities and with the PortCityFutures Center of the Leiden-Delft-Erasmus (LDE) university consortium. The article first explores the selection of multiple and diverse methodologies for mapping spaces, stakeholders and cultures over time, and the rationale for the choice of models. It then briefly introduces the reasoning for the various approaches that come together to contextualize current spatial, social and cultural conditions and help guide the development of a shared mission and vision for sustainable and inclusive water futures through hands-on workshops and activities.

Policy Recommendations

- Policymakers and politicians should explore a broad set of contextual tools and diverse practices to fully understand the conditions in which their interventions take place, what the impact is on all stakeholders and to make sure that complex water systems are designed holistically.

KEYWORDS

PortCityFutures
Port city territories
Adaptive strategies
Water system design
Value case approach

WATER ICONS

< Fig. 1 Traditional boat navigating Venice (Source: Carola Hein, 2023).

Introduction

Water systems consist of a complex network of spatial, social and cultural patterns that change over time and across space. Understanding these patterns is an important prerequisite for new interventions. Conceptualizing past developments across multiple scales and stakeholders and in their specific cultural context allows for rethinking future approaches. To understand the role of values concerning water, including ones that have shaped practices of the past, the ones that have catalyzed transformations, and those values associated with material, economic and cultural flows, we need a broader, more contextual analysis, one that makes it possible to identify underlying values in space (landscape, cities and buildings), as part of networks (stakeholders and knowledge holders), cultural systems and values, through time (past, present and future) in an ecosystemic way.

Societies in the past have found ways to balance different needs and interests and get buy-ins. The study of historic buildings, cities, landscapes, institutions, policies and cultures that are the result of decades, centuries or even millennia of development can lead to decisions across multiple scales based on an approach that identifies shared values and brings them to the fore. It can even help to create buy-in from society, including interest groups and taxpayers. Clarifying diverse interests can help us make meaningful interventions regarding the structures that surround us, the ones we decide to preserve and those that can tell us a lot about the complex relationships between humans and water and the shifting roles of places, people and practices; it can also help us protect designated heritage. It can even help us identify the different disciplines and professions that engage with water and heritage themes.

To address contemporary challenges of climate-related water systems change and to preserve our heritage from the past, we need tools that allow new types of analysis across scales, taking into account the diversity of stakeholders and values, over time. Several tools, including some focused on mapping, have recently been developed to gain new insights into multiple scales and diverse stakeholders and to allow culture-led approaches. The article briefly introduces these methodologies. Many of these approaches are based on mapping. The following methodologies have inspired the value case approach presented here. The article briefly introduces these methodologies, including the Canvas tool developed by AGUR, the urban planning agency of Dunkirk, the World Inventory of the Global Network of Water Museums (WAMU-NET), a flagship initiative of UNESCO-IHP (Intergovernmental Hydrological Programme), the UNESCO Heritage Atlas, and the Connected River Flow Forward approach. Building on and connecting these methodologies has led to an advanced toolbox for holistic approaches. Such methods can include both desk research and hands-on workshops to develop new narratives and historiographies for systemic analysis and sustainable design.

Inspiration for the Value Case Approach

Mapping diverse water activities in space allows for a better, more holistic understanding of the spatial, social and cultural conditions of water systems. Several organizations have recently proposed methods focused on connecting isolated structures and identifying flows with the goal of creating new narratives for cross-sectoral and action-oriented approaches to water. These new narratives can enrich projects that are otherwise dominated by a technological and economic focus. They

can make room for social and environmental perspectives that are currently underdeveloped (Hein 2023). Identifying links and reciprocal relationships among different parts of ecosystems can lead not just to new water narratives, but also to new partnerships and sustainable action.

Several institutions have adopted spatial mapping as a tool. WAMU-NET developed an inventory to identify museums located alongside a body of water (Eulisse 2023a, 2023b). As Eulisse explains, connecting various museums, their exhibitions and capacity-building tools along a water body can help raise water awareness. Museums along a river could collectively share knowledge on a shared water-related theme, such as river shipping. Advanced knowledge of the requirements of shipping in terms of water speed and flow, of transshipment from land to sea, or of the impact of maritime flows on quay walls and river edges can help facilitate discussions among citizens regarding other water-related practices, such as swimming, kayaking and canoeing.

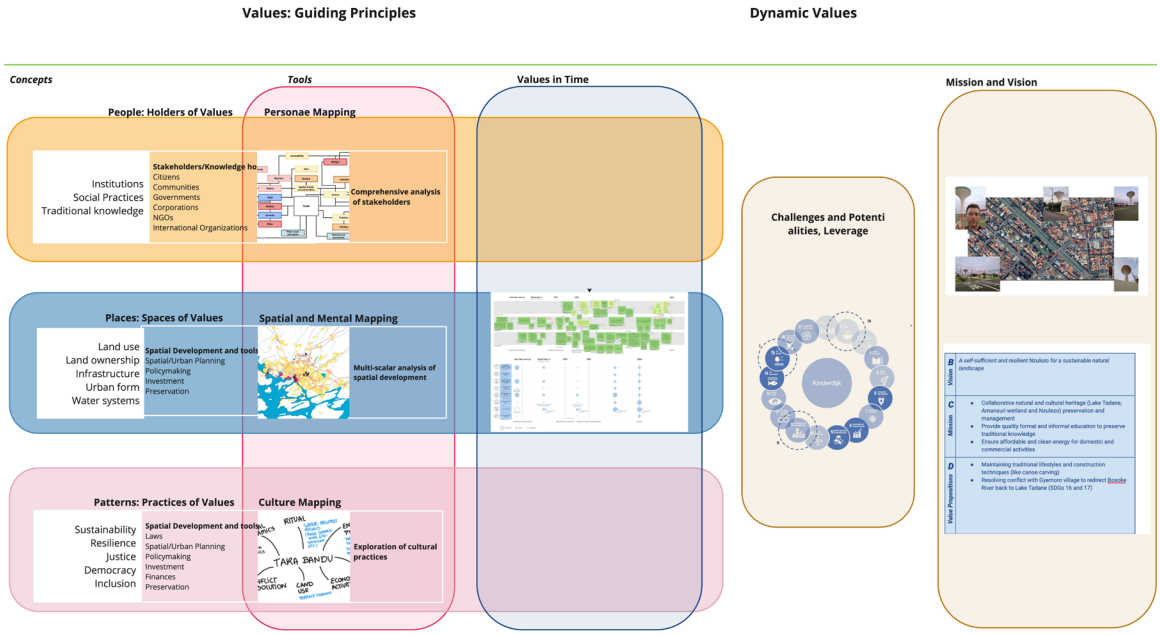
Mapping economic and material flows is another way of contextualizing water systems. The Flanders-Dunkirk Urban Planning and Development Agency AGUR, under the leadership of Jean-Francois Vereecke, developed the Canvas tool to reveal material and financial flows (Vereecke and Hein 2022). The original Canvas focused on the extensive network of the petroleum refinery. AGUR used Canvas mapping to demonstrate the impact of the closure of the refinery on other activities in the region, given that many financial and material streams were fully directed toward the facility. Later Canvas projects identified four different water systems and potentially overlapping systems of use (Vereecke and Deveycx 2022). Such a rethinking of flows and networks can provide insights into the multiscale implications of changing networks.

The UNESCO World Heritage Center has proposed cultural mapping as a tool that allows a more comprehensive understanding of historic cities. The UNESCO Urban Heritage Atlas offers a platform that provides comparable insights regarding traditional building practices, architectural heritage and historical urban forms from around the world.[1] Using analytical maps, the UNESCO Urban Heritage Atlas makes it possible to recognize specific attributes and heritage values in their spatial context. Through the identification of urban heritage characteristics and the Outstanding Universal Value (OUV) of World Heritage properties, the Atlas also allows recognition and better management of historic urban heritage as it positions the heritage sites in their spatial context. The presence of a river in a World Heritage property, for example, invites reflection on environmental and urban dynamics and the potential of applying the UNESCO Historic Urban Landscape Approach.

Other tools can also provide a broad understanding of spatial, social and cultural contexts. The Flow Forward approach, currently under development as part of the Interreg project Connected River, offers a variety of hands-on tools for communication and collaboration with a focus on boosting innovation, user-centric experimentation and fast upscaling.[2] Existing tools can be complemented by spatial, social and cultural mapping to

1. UNESCO World Heritage Convention, UNESCO World Heritage Atlas, https://whc.unesco.org/en/activities/1211/&msg=login_success.

2 Flow Forward: https://flow-forward.eu/.



^ Fig. 2 Visualization of the value case methodology (Source: Carola Hein, 2025).

facilitate the creation of new narratives and the generation of new knowledge. For example, mental maps and mind maps can lead to a better understanding of people's perceptions of space. Such tools have been developed, including ones presented as part of the open, online courses Water Works and (Re)Imagining Port Cities and professional education courses such as Water Systems Design.[3] The making of a serious game, Water Values, which reflects a palimpsestic approach to multiple spatial layers of nature, human interventions, institutions and values has helped refine value deliberation approaches and the value case methodology for water.[4]

I propose creating a toolbox of these approaches, connecting, for example, the World Inventory promoted by WAMU-NET and the UNESCO Heritage Atlas, in a way that can lead to new insights for heritage preservation.

Elements of the Value Case Approach for Water Systems

I have taken the first step toward establishing such a toolbox, working with Matteo D'Agostino, Lea Kayrouz and Bea de los Arcos in the UNESCO Chair Water Ports and Historic Cities and the PortCityFutures Center. We have start-

3. Water Works: https://www.edx.org/learn/water/delft-university-of-technology-water-works-activating-heritage-for-sustainable-development.
(Re)Imagining Port Cities: https://www.edx.org/learn/urban-planning/delft-university-of-technology-re-imagining-port-cities-understanding-space-society-and-culture?index=product&queryID=35a7639331f36b35b9b51c93ed0954e0&position=1/
Water System Design: https://online-learning.tudelft.nl/courses/water-systems-design-learning-from-the-past-for-resilient-water-futures/.

4. Water Values, serious game, https://www.portcityfutures.nl/unesco-chair/water-values-a-serious-board-game.

ed to develop a methodology that consists of five steps, the order of which can be changed, to encourage reflection on water values in institutions, across space and over time. The methodology can be used in desk research and in hands-on workshops that help participants gain a better understanding of their context and encourage the development of a new historiography – or make it possible to read existing histories "against the grain." Initial applications of the methodology in the context of Nijmegen, Timor-Leste and Paris have led to refinements.

Such a broad understanding can help activate values for shared goals (Hein 2025). The value case approach therefore proposes parallel steps that aim at (re)thinking and (re)contextualizing the context of a specific water theme or place, The order in which the steps -specifically related to places (space), patterns (society), and practices (culture) and their transformation over time- are undertaken can vary (see fig. 2 in Hein, "Toward a Value-Case Approach for Designing Sustainable Water Systems," this issue). This approach is intended to serve as a foundation for the development of a vision, mission and strategies for design and interventions.

^ Fig. 3 Paris mapping activity at a workshop of the Connected River project in Nijmegen (Source: Carola Hein and Lea Kayrouz, 2025).

downstream port of Le Havre, from which food is transported to the capital city. Recently, the goal of a swimmable Seine for the Paris Olympics required curtailing water pollution from agriculture, industry and sewage upstream. Applying water icons and discussing them in the context of Paris (fig. 3) as part of a workshop of the Connected River project has helped identify potentially competing and supporting activities.

Step 1: Places – Mapping Spaces of Values

Much understanding can be gained from placing water functions in space. In particular, it makes it possible to see how needs and interests are interconnected. Water is always in movement, connecting different functions and stakeholders. Cities, often located downstream, require access to fresh water, and metropolises like Paris have taken control of river sources. Simultaneously, Paris's interests have long shaped the form and function of the

Step 2: Patterns – Mapping Holders of Value

Changes to water systems are made by people in line with their specific values. Network analysis is a much-used tool to represent this phenomenon, yet it is often framed as part of a "business case" (focused on the pursuit of economic outcomes) rather than a more-encompassing "value case." Placing a person or object – personae – at the center of such a network and exploring specific interests and needs associated with values, and their po-

^ Fig. 4 Mapping of personae for the Seine at a Connected River workshop in Nijmegen (Source: Carola Hein and Lea Kayrouz, 2025).

tential conflicts (e.g., as in the research conducted by Matteo D'Agostino and Lea Kayrouz for Nijmegen with Rijkswaterstaat, the executive agency of the Ministry of Infrastructure and Water Management). Exploring flows and networks among institutions within a water system can help uncover challenges that result from good intentions but conflicting perspectives. This became evident in a hands-on mapping exercise during a workshop for the Connected River project in Nijmegen (fig. 4), where specific water practices were connected to relevant water stakeholders.

Step 3: Practices – Mapping Culture

In any cultural context, there may not be unanimity regarding values, but some can be identified as especially important. Sometimes the importance is prominently underlined in public life –commitments, for example, to the rule of law, filial piety, or in Timor-Leste, the principles of Tara Bandu (see fig. 5). But some important values can be less obvious: consider the role of speed for contemporary design in Europe or the notion of ecological civilization that is currently driving interventions in China.

Step 4: Time and Temporality

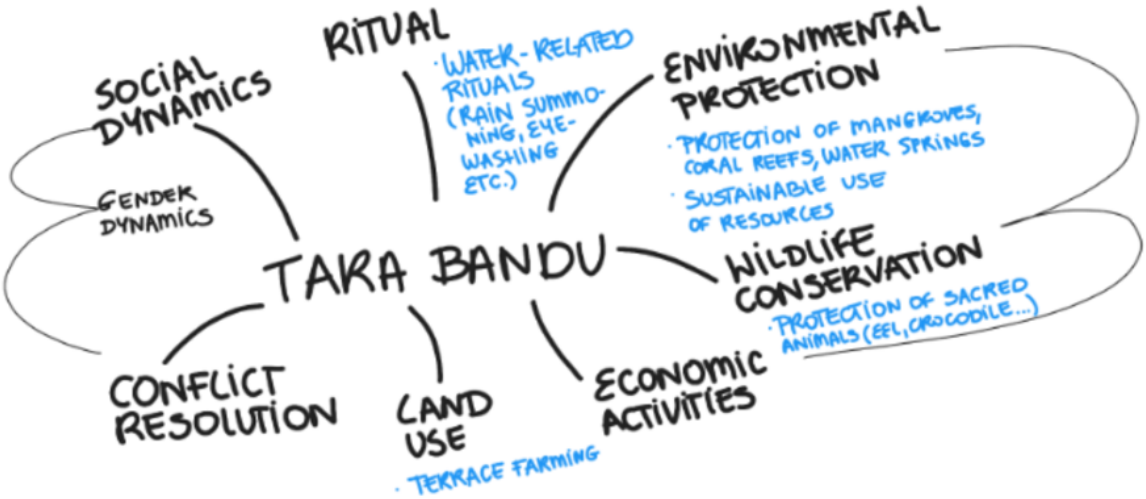
Spatial, social and cultural practices change over time. A fourth line of inquiry is therefore a historical timeline, focused both on time and temporality. There are three important ways in which the past, history and heritage are relevant for the design of the future (Hein et al. 2023):

1. History can serve as a mirror for water system thinking.
2. The past must be recognized as the foundation for future development.
3. Select spaces and practices can be identified and protected as heritage.

Taking a long-term approach requires awareness of water value timelines that capture the predominance of certain values over others where water is concerned: For example, a drinkable river needs to be accessible, whereas an industrial river can disappear underground. The current practice of river daylighting demonstrates the importance of change. Understanding how water bodies were used historically can revive old narratives and generate new ones (see fig. 6).

Step 5: SDGs – A Tool for Identifying and Activating Values

Rethinking the UN SDGs from a holistic, sociocultural, long-term ecosystem perspective can illuminate how water and culture are interconnected and aid the design of a more comprehensive approach to sustainable development (Pellegrom 2023). Considering the SDGs as part of a value case approach to sustainable living can promote transformative actions. Many institutions today refer to the SDGs as part of their environmental, social and gov-



^ Fig. 5 Visualization of Tara Bandu in Timor-Leste (Source: Zuzanna Sliwinska, 2024).

ernance (ESG) agenda. To familiarize learners with the SDGs and their ecosystemic basis, we ask them to first identify relevant SDGs, and then select one SDG that they don't work with and reflect on how their practice would change if they engaged with it. Fig. 7 provides an example of such an approach as used by Rodrigo Manzione, a learner in the professional education course Water Systems Design (Manzione 2024).

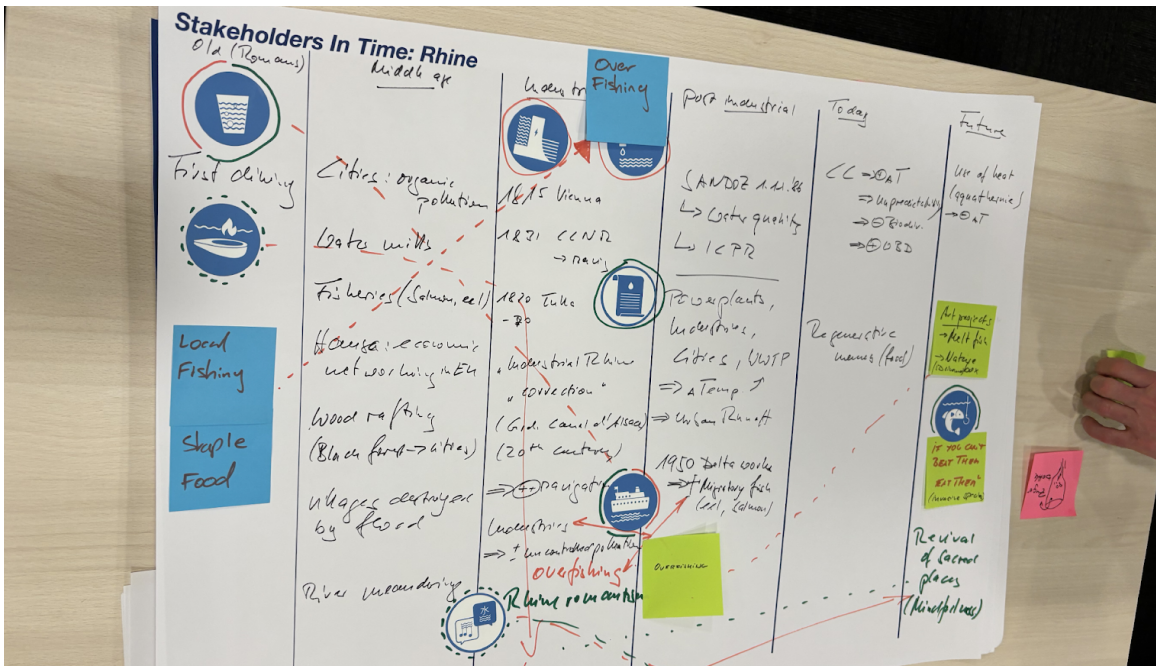
Design Thinking for Future Water Heritage

As a value, in recent years nature has experienced a resurgence. Humans have created water systems, often imposing their own needs and desires, without respect for natural systems. The disconnect between culture and nature has been anchored in institutional frameworks. Recent attention to biodiversity and nature has resulted in activities such as giving voice to a river, as promoted by the group advocating for a Parliament of the Loire.[5] Such attention to nature can conflict with cultural heritage concerns: freeing up rivers to allow for seasonal flooding or to facilitate fish migration may require the removal of historic water mills. The current institutional separation between natural and cultural heritage properties and between tangible and intangible practices can make comprehensive action and protection difficult. Connecting water and heritage can also help integrate nature and culture. Rethinking water systems may provide an opportunity for finding new spatial and organizational models that bring non-human life into governance. The Zoöp concept, which proposes a form of organization that engages human as well as nonhuman life in decision making, can facilitate sustainable development for the benefit of all.[6]

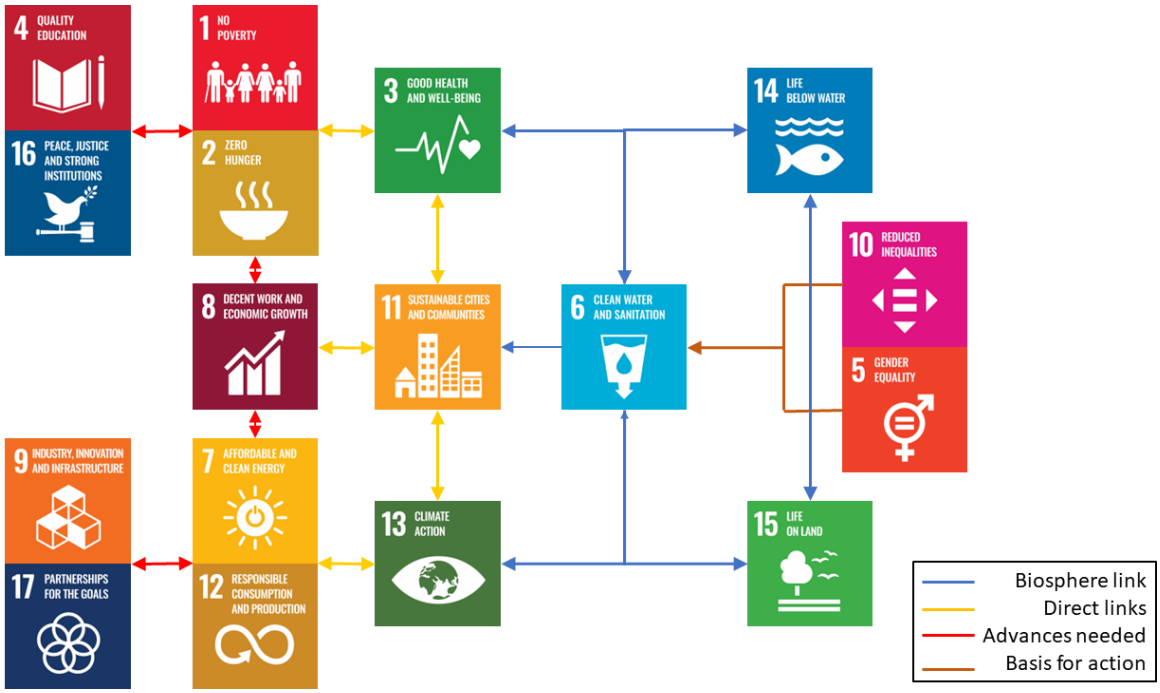
Examples of value-based approaches include the revitalization of the Dutch Waterlinie as a multi-stakeholder endeavor encompassing heritage preservation, nature conservation and spatial development (Netherlands) (Luit-

5. Vers un Parlement de la Loire, https://www.parlementdeloire.fr/.

6. HNI, Zoop, https://nieuweinstituut.nl/projects/zoop.



^ Fig. 6 The historical development of space, society and culture can lead to value conflicts and opportunities as illustrated by a discussion of stakeholders over time on the Rhine, developed at a Connected River event in Nijmegen. (Source: Carola Hein, 2025).



^ Fig. 7 Example of an exercise to activate the SDGs and identify potential values that can inspire design (Source: Rodrigo Manzione, 2024).

en and Kayrouz 2024). An application of the steps of the value case can be seen in a value case proposal for Brazil, where the author used water towers as landmarks and sites for water education (Manzione 2024). Another example of a value case, albeit without the label, is the transformation of the Seine in Paris and the Ile de France.[7] The value case approach provides a methodological framework to consider relevant stakeholders, multiple scales and long-term developments with the goal of establishing a vision and mission for shared approaches to sustainable development. Salzinger (2025) and others have built upon what they learned in the course Water Systems Design.[8] (Re)connecting the isolated elements of water spaces and practices to a larger water body helps us take natural ecosystems into account.

Conclusion

At a time of changing water conditions – more rain, less rain, flooding, drought, sinking and rising groundwater levels – we must think urgently about how water managers and heritage experts, as well as future architects and urban and environmental designers, can collectively shape water systems. We need new tools for capacity building, from serious games to open-access courses. Through conversations and negotiation, we can tease out shared values together. The game Water Values, for example, is designed to help promote understanding of long-term development across scales with a systems approach to design (Hein et al., 2025).

Designers play a key role because they can help sketch potential futures. To develop sustainable water systems, we need to employ system design approaches based on culture and values. Such approaches require multidisciplinary collaboration, connecting water management-related heritage – such as qanats, windmills and dikes – to water-related heritage more generally – including natural heritage sites like the Wadden Sea or even intangible practices like water festivals – to different types of engagement with the past and heritage, including the analysis of historical systems, large-scale territorial changes and the impact of climate change on our historical sites and heritage to encourage greater water awareness in a wide range of disciplines.

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7. (Re)Connecting River and City: The Seine in Paris and the Ile de France, took place March 2025 at the IAS Paris, https://www.paris-iea.fr/fr/evenements/re-connecting-river-and-city-the-seine-in-paris-and-the-ile-de-france-a-model-for-nature-positive-approaches-in-world-heritage-cities-for-climate-resilience?thanks=Inscription_evenement.

8. Water Systems Design https://online-learning.tudelft.nl/courses/water-systems-design-learning-from-the-past-for-resilient-water-futures/.

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