DESIGN

Water and Civilisation

RAMBØLL

EDITION NO. 13
MARCH 2026

Prologue

Why water?

Trine Stausgaard Munk, Ramboll

We are in a time of planetary crises. Many of these crises are tied to water. But why is that? And what is the potential of water in healing our world?

This Ramboll DESIGN publication on water presents a collection of written perspectives with the purpose of activating a renewed curiosity, awareness, and empathy for water. By bringing these different writings together in a connected story, we hope their collective impact will be greater than the sum of their parts.

The publication follows a flow, from understanding our planetary water cycle, and how the human relationship with water has evolved over time, to the impacts of human intervention, to reimagine alternative design approaches that support planetary resilience and co-existence.

We hope this publication will inspire the reader to re-imagine waters.

> What we do in the next few years will profoundly affect the next few thousand.
>
> **David Attenborough**

Water and Civilization

Lai Wan Sing, Ramboll and Inês Soares, Atelier Geometria

Around 10,000 years ago
Early civilisations in Mesopotamia and Egypt transitioned from hunting-gathering to agriculture and permanent settlement. It increased dependence on land which has accessible water.

8000–7000 BC
Villages and towns formed around water sources. Waterborne diseases became a threat to early farmers. Jericho became the first known settlement near natural springs.

Early Bronze Age
Archaeologists have found hundreds of ancient wells, water pipes, and toilets from the early Bronze Age in Mohenjo Daro, Pakistan.

3000 BC
Traces of wells in Egypt and of canals in the Mesopotamian rocks have been reported since 3000 BC.

2000 BC
The earliest evidence of purposeful construction of water supplies, baths, toilets, and drainage facilities in Europe dates back to the Bronze Age of Minoan (and Mycenaean), in Crete (the oldest Minoan civilization in Europe) in the second millennium BC.

Ever since, ensuring freshwater for people has become a prerequisite for successful urbanization and government formation.

Ancient Egypt & Mesopotamia
Seasonal flooding of the Nile, Tigris, and Euphrates drove the development of canals to provide reliable irrigation and support agriculture. Communities drew drinking water directly from rivers, supplemented by rainwater harvesting and reservoirs during drier periods.

During floods, water could erase levees and land boundaries, prompting Egyptians, Sumerians, and Babylonians to develop geometry and land surveying to redraw and manage territory. As protection, communities built riverbanks and placed dwellings on higher ground or along the edges of rivers to reduce damage.

Ancient & Medieval
Humans developed advanced water systems, including deep wells, underground passages, canals, reservoirs, bridges, and aqueducts. These were low-energy, and place-adapted infrastructures. People near ice caps collected meltwater, while others recycled wastewater, extracted drinking water from seawater, and even captured it from the air using circular or elliptical staircases. These methods were crucial for survival, including during prolonged sieges in medieval castles, and wells remained a central feature of water management throughout history.

19th and early 20th centuries
The sanitation revolution redefined water as a public health system, separating potable supply from wastewater. This transformation increased life expectancy and enabled cities to grow taller, denser, and more resilient.

Modern Era
To this date, water remains the most efficient medium for transporting goods, underpinning global trade by moving large volumes over long distances with far lower energy use and cost than any other transport mode.

Modern water regimes have scaled through dams, reservoirs, pumps, which delivered remarkable reliability and service in many regions,but also introduced new challenges: single points of failure, energy dependence, ecological disruption, and social inequities. Climate change now intensifies these pressures through longer droughts, stronger storms, rising sea levels, and overdrawn aquifers.

Heavy industrial reliance on deep groundwater is accelerating depletion and pollution, especially in arid regions where reserves may become difficult to replenish, highlighting the need to shift from an extractive approach toward a more regenerative relationship with water.

Water, Culture, Civilization, and History. (2021)
Source: Hosseiny, S. H. et al. (2021). Water, Culture, Civilization, and History

The Scarcity of Freshwater

Lai Wan Sing and Hossein Rezai-Jorabi, Ramboll

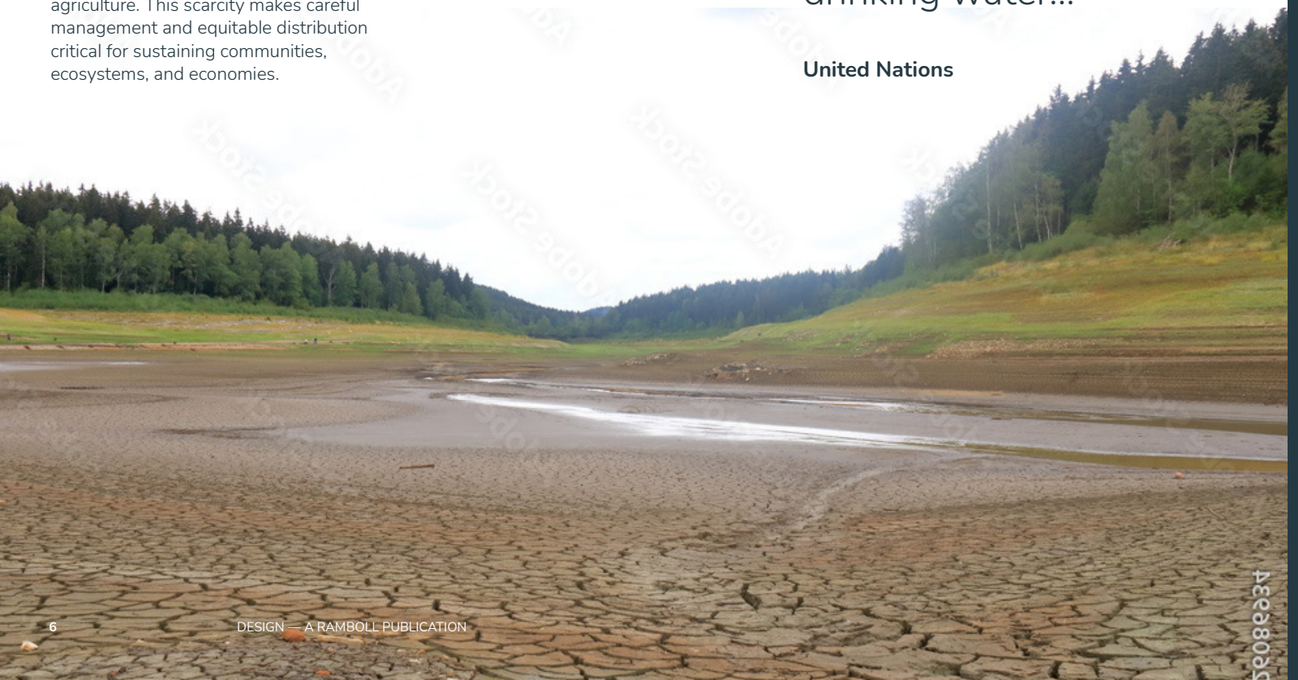
Earth is often referred to as “the water planet”. However, the coverage of water across 71 per cent of the Earth’s surface gives a misleading impression of abundance.

In reality, less than 1 per cent of the planet’s water is readily accessible for human use. The vast majority exists as saltwater in oceans, locked in glaciers, or buried deep underground, making it unavailable for direct consumption or agriculture. This scarcity makes careful management and equitable distribution critical for sustaining communities, ecosystems, and economies.

Water demand continues to grow with population, urbanisation, and industrialisation, placing increasing pressure on these limited resources.

Climate change further complicates availability, with shifting rainfall patterns, longer droughts, and more intense storms threatening both supply and quality. Protecting and using freshwater wisely is therefore essential for survival, resilience, and prosperity.

> 2.2 billion people still live without safely managed drinking water...
>
> **United Nations**



Earth Surface Coverage (%)

71% of Earth’s surface is water

29% land

Global Water Percentage (%)

97% salt water

3% fresh water

Freshwater Percentage (3%)

Glaciers and ice caps 68.7%

surface water 1.2%

Ground water 30.1%

Surface Water (1.2%)

Lakes 87%

Rivers 2%

Swamps 11%

Distribution of Earth’s Water
Credit: U.S. Geological Survey, Water Science School.
Data source: Igor Shiklomanov’s chapter “World fresh water resources” in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World’s Fresh Water Resources. (Numbers are rounded).

Water as Eternal Cycles

How might we relearn the complexities of water?

By: Jennifer Cherrier, The City University of New York (CUNY)

Water connects everything and everyone on our blue planet - across both time and space. It connects Earth's spheres, and landscapes, fresh water to salty water, and the microscopic to macroscopic. It connects humans to each other across international boundaries, cultures, politics, and generations. It connects us with all other living beings, systems, and to the resources our entire existence relies on.

Water is cyclical in process, but variable in form, scale, and time. The three forms of water (solid, liquid, and gas) can reside in several reservoirs, depending on their phase.

All of Earth's water reservoirs are linked via evaporation and precipitation in eternal cycles and processes. When water heats up, it evaporates from surface waters or is transpired from the biosphere, entering the atmosphere as gaseous water vapor. As a low-density gas, it rises to higher altitudes, where it cools and condenses to form clouds, eventually returning to earth's surface as precipitation. As the water reconnects with the land it will either infiltrate permeable surfaces into groundwater systems or flow downhill across natural flow paths, finding its way into streams, lakes, and rivers many of which ultimately drain into the oceans.

As a universal solvent, water dissolves and transports essential nutrients when moving across the landscape, delivering them to adjacent terrestrial and aquatic ecosystems. In natural systems unperturbed by human activities, these nutrients, along with the water itself and sunlight, are what drive ecosystem productivity via photosynthesis. Plants (terrestrial) and algae (aquatic) form the base food webs in any given ecosystem and ultimately define how the rest of an ecosystem will evolve. They are adapted to specific nutrient, water, and light levels and if any of these three factors are changed, it will alter the entire dynamics and function within the ecosystem itself as well as any connected systems.

Wetlands, for example, serve as a dynamic interface between land and water. They have unique plant, soil, and food web systems that are adapted to fluctuating water conditions. If water flows were to be diverted (i.e. by a beaver) the dominant plant species would shift, fundamentally changing the ecosystem type and function. It would also impact systems connected to and dependent upon the wetland. For instance, the wetland's purifying function as a kidney of the landscape for down-elevation aquatic systems would be lost with subsequent cascading effects throughout the ecosystems. Similarly, the 'sponging' capacity of wetlands protecting up-elevation terrestrial systems from flooding would be lost as well.

Water by Humans

How might we start our journey of transformation?

Trine Stausgaard Munk, Ramboll

We are increasingly rethinking our water approaches and testing new ways.

Partners, colleagues, and clients show courage in challenging business as usual, as we collectively question our water design practices. We see projects embrace complexity, rather than ignore it. Design for continuity and connectivity, rather than isolated, optimized parts. To steward water as a whole, rather than manage water as a decoupled and extractable resource.

We see nature weave itself into the heart of infrastructure. Of design. We move from “green infrastructure”, to “nature-based solutions”.

To nature? Because what is more adaptable, flexible, and resilient than nature itself?

Because we are not at war
with climate. With water.
Or with nature.
We are water.
We are nature.

We move from language that separates towards language that connects.
We move from control to custodianship.
From managing to cultivating.
From maintenance to care.

Because even our greatest attempts at controlling water fail. They exacerbate the very issues we are hoping to fix. Maybe not at first, but eventually. Working with water creates more resilience, more life, than working against it.

Questions help guide our exploration:

- How do we start differently?
- How can our projects give more than they take?
- What do we need to let go of to inspire new design paradigms?
- How can nature be our ally in cultivating resilience?

Our designs are increasingly nature-based, co-created, and co-financed. On these pages we present a few examples.

However, we know that we have much to let go of, and much to let come to start embracing life-affirming design paradigms.

Benjakitti Forest Park (Turenscape)
Bangkok, Thailand

A former tobacco factory transformed into a landmark sponge city park that absorbs up to 200,000 m³ of stormwater, filters polluted canal water, restores habitat and creates central Bangkok's largest public green space.

Bishan-Ang Mo Kio Park
(Henning Larsen)
Singapore

Bishan-Ang Mo Kio Park is one of the most popular parks in the heart of Singapore. Its popularity came after community improvement plans upgraded the park, including transforming its 2.7 km straight Kallang concrete channel along the park's edge into a semi-natural winding river.

Paya Lebar Quarter
Singapore

Integrating water-sensitive urban design features within a highly complex urban landscape, this project enhances stormwater quality and provides effective stormwater attenuation in Singapore's largest mixed-use development. It achieved the first-ever Active, Beautiful, Clean (ABC) Water certification for a privately funded mixed-use development.

Birkerød Groundwater park
Birkerød, Denmark

Birkerød Groundwater Park, designed to secure clean drinking water for future generations by protecting key groundwater recharge areas from pollution. The project maps abstraction zones, identifies current and potential contamination sources, and outlines targeted interventions to safeguard groundwater quality and enhance biodiversity.

Sibu Cloudburst Masterplan
Sibu, Malaysia

Located in a low-lying delta area prone to intense rainfall and tidal flooding, Sibu faces increasing climate-related impacts. Ramboll's masterplan integrates flood-risk assessment, cloudburst design options, and blue-green infrastructure to enhance existing systems and create multifunctional urban spaces. Reducing flood risk through a comprehensive cloudburst masterplan.

Vitens Drinking Water Living Lab
The Netherlands

Developing a semi–full-scale drinking water 'living lab' – the facility, to be completed in 2028, will drive innovation by testing new water landscapes and treatment technologies. It will act as a modular, scalable blueprint for future-proof drinking water production.

Blue-Green Regenerative Approach:

Assessing and Improving Urban Water Systems for Enhanced Health & Wellbeing

Stanislava Boskovic, Imperial College London and LRL Space

In the face of climate change, enhancing urban water management is essential for strengthening public health and environmental resilience. This study, based on preliminary findings from a multidisciplinary project, euPOLIS, funded by the European Union's Horizon 2020 program, focuses on the methodology for assessing Blue-Green Regenerative Approaches (BGRA) by integrating environmental and health indicators to evaluate their effectiveness. Using in-situ sensor monitoring and hydrological modelling, the environmental assessment focuses on key aspects of the urban water cycle:

In parallel, health impacts are analysed through clinical and nonclinical methods, with a particular emphasis on chronic disease groups. By bridging these assessments, the study provides a comprehensive framework for understanding the interplay between urban water management and public health, supporting evidence-based interventions for healthier and more sustainable cities.

The research investigates pollutant migration across urban catchments, including modelling its relationship with waterborne diseases. It also explores surface water pollution management strategies that incorporate Nature-Based Solutions (NBS), such as biofilters, wetlands, and swales.

The euPOLIS project fosters holistic water management solutions and further develops strategies for evaporative cooling, enhancing urban climate resilience through groundwater modelling, hydrodynamics, and water quality analysis. By linking evaporative cooling technologies with urban green space irrigation and water pollution control using reclaimed greywater and stormwater. By restoring the natural water cycle through blue-green infrastructure, these solutions enhance biodiversity, improve stormwater infiltration, and promote human well-being through direct interaction with nature.

All of the project's case studies highlight the multifunctional benefits of NBS in the urban environment. Specifically, in Gladsaxe, Denmark, a key intervention involves the implementation of small-scale decentralised wastewater treatment plants (WWTPs) as part of Metabolic Network Reactor (MNR) technology in the form of a floating island designed to maintain water quality in a retention pond. The MNR island functions as a biofilm-rich habitat, supporting beneficial microorganisms that treat and inoculate the water, thereby sustaining a healthy aquatic ecosystem. This system is further supported by aeration and circulation mechanisms that enhance oxygen levels, ensuring optimal water conditions.

Additionally, the EuPOLIS project explores the application of the Urban Water Optioneering Tool (UWOT) to assess various NBS interventions, enabling a systematic comparison of design alternatives from an urban water perspective. By incorporating decentralised water sources and evaluating environmental sustainability, the tool facilitates data-driven decision-making to optimize the integration of NBS within urban planning frameworks.

Through this holistic approach, the study demonstrates how BGRA can enhance urban water management, mitigate climate risks, and improve public health outcomes. The findings contribute to a growing body of research advocating for nature-based, regenerative solutions as key components of regenerative cities.

Set of Nature-based solutions used in euPOLIS cities

Water as Change

How can we design with constant change?

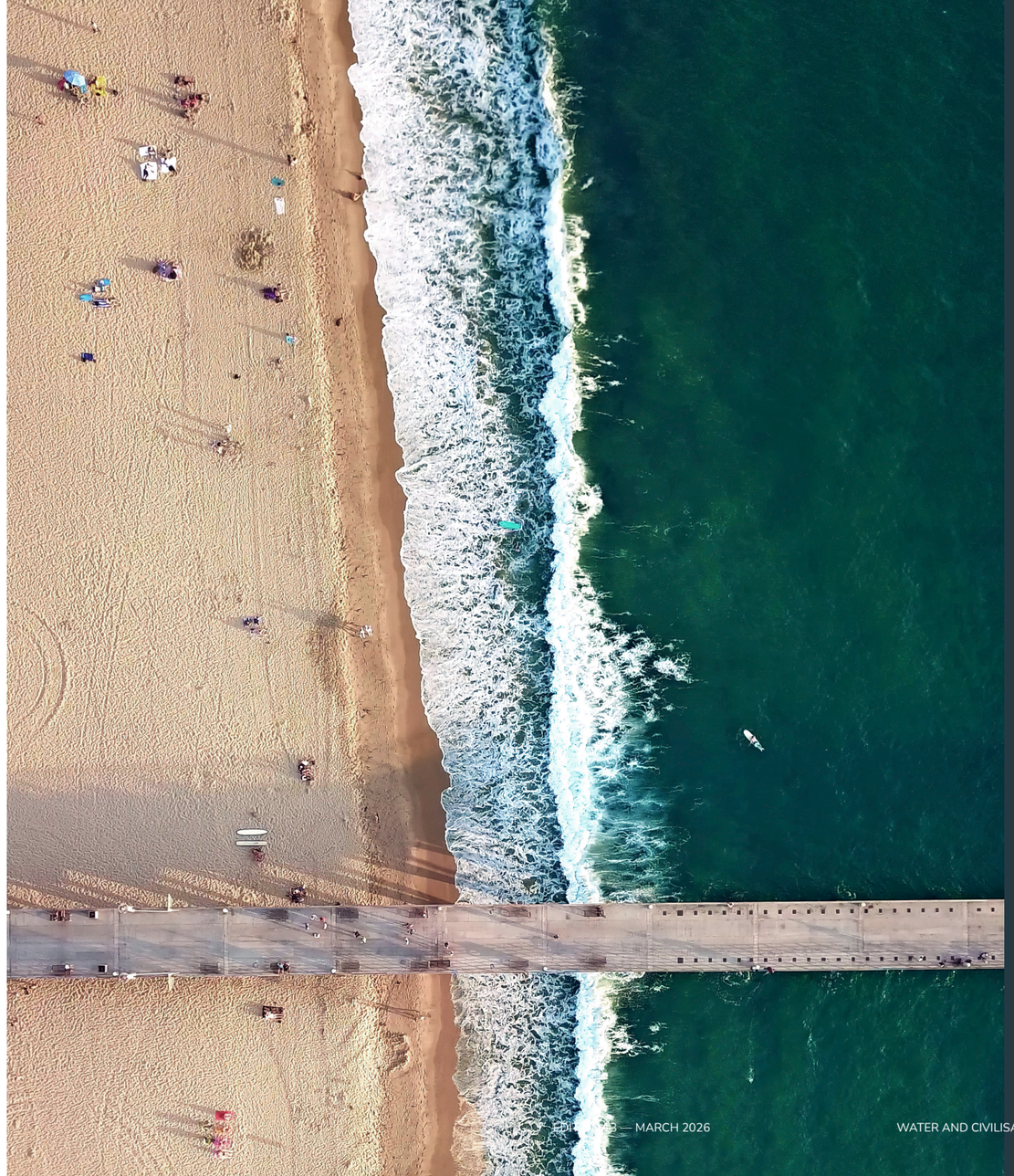
Anna Hochhalter, Ramboll

When we embrace water, we are embracing constant change. As designers, how would our projects change if we placed this idea of constant change at the core of our design process and made it central to our design criteria?

In the built environment, the relationship between water, building materials, vegetation, and land is an ever-changing dance. Water will change the conditions of the materials around it no matter the context. For example, a river will change its channel banks' meander over time as the power of the water slams against one side of the bank and then another. This pattern of geomorphology is well-acknowledged and often sought to be contained in order to build structures and communities in fixed locations. Our development practices through human history have responded to our understanding of how water moves and our material capacity to control it or not.

Today, sea level rise is happening, and future sea level rise is a significant threat to communities throughout the world. In designing coastal waterfront projects with sea level in mind, it is best practice to consider the current water levels (often mean high water) and future water levels for a variety of scenarios based on the design goals, for example, different storm sizes or types and future points in time for 10, 50, and 100 years from now.

We use design flood elevations based on probabilities and statistics to try to estimate the most likely and worst-case water levels. We design a little above that threshold of acceptable destruction. This allows us to design shoreline edges, walkways, vegetation and habitats, buildings, and infrastructure in ways that reduce the likelihood of flood exposure in a defined time period.



How well are these methods accounting for the process of change?

If we look closely at daily tidal fluctuations, the change and variation in water level is impressive. This is why we use statistical predictions to help us design. Along the Eastern Seaboard of the U.S, the predicted highest tide level occurs at a different time each day, and each day that highest level is slightly different from the height the day before, shifting with the moon cycles and gravitational pulls. In contrast to the predicted water levels, the observed wave conditions vary far more wildly, with each single wave forming at a unique elevation along the shoreline. Many designers do consider change as a part of their practice. For example, the change in daily sun exposure, change in routine water saturation, seasonal weather, and size and shape of vegetation growth across multiple years are all normal change factors considered when designing landscapes. Similarly, the routine friction of water and wind, various lateral and gravitational pressures, and sheer stresses are all normal factors of change that are considered when designing retaining walls or bulkheads.

What if we focused on designing for active change in our projects in response to water's dynamic forces? What would our designs look like if we embraced a paradigm of constant change into our material choices, plan layouts, and discussions with property owners and city leaders ?

This applied paradigm is seen in projects that design for floodable places and landscapes, such as Bishan-Ang Mo Kio Park in Singapore, where the river and park are understood as dynamic places to capture and filter floodwaters when needed and at the same time provide community recreation and gathering.

What else could our urban landscape look like if the design for disassembly mindset guided our shoreline designs?

Resilience is a complex collaboration between policy, resources, habitats, communities, economics, and determination and endurance. Increasing our ability to design for constant change may help us support a stronger symbiosis between water and our societies.

Water as Resilience

How to design with the flow of life?

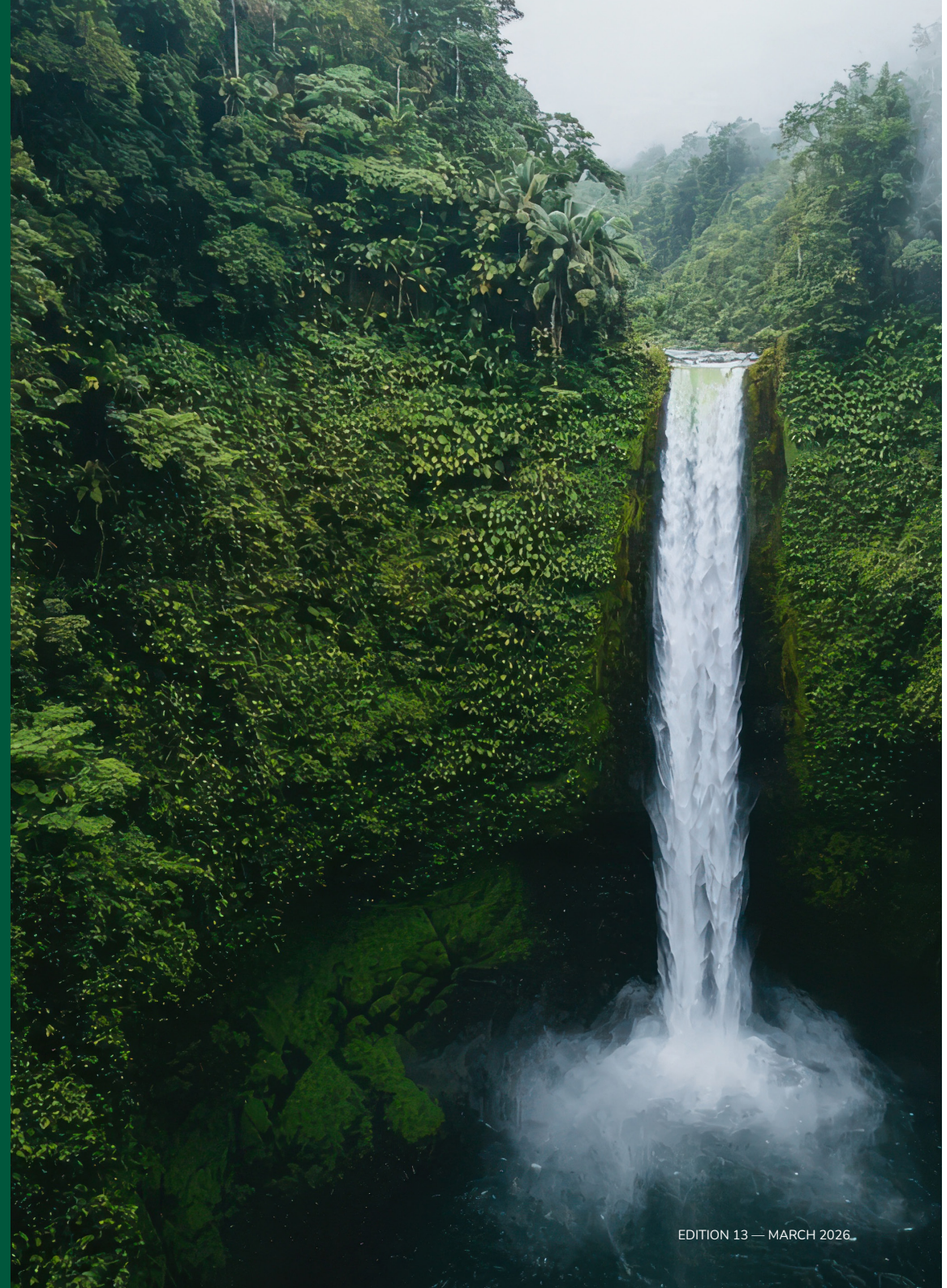
Ellen Braae, University of Copenhagen

Water is the planet's circulatory system; a pulse that connects mountains to oceans, soil to air, and bodies to landscapes, linking ancient times to the present day. Across cultures, water has always carried meaning: it cleanses, divides, nourishes, and remembers. Every civilization has been shaped by its proximity to water, every settlement formed through its rhythms of scarcity and abundance.

To think of water as resilience is therefore both ecological and cultural. It is an acknowledgment that the future of life depends not on mastering water, but on living and designing with it.

Designing for water begins with recognizing its dual presence as material and medium of connection. It is rainfall and runoff, groundwater and humidity, river and coast, but also ritual, myth, and memory. Each place holds its own hydrological and cultural patterns: a way of reading and relating to water.

Modern planning, however, has often obscured these relationships. By channeling rivers underground and sealing the ground beneath our cities, we not only disrupted ecosystems but also erased the sensory and symbolic presence of water from daily life. A resilient approach restores both ecological function and cultural connection. It allows water to infiltrate, collect, and circulate. In doing so, reopens the conversation between people and place.



To design with water is to design with time, change, and uncertainty. It requires spaces that are flexible and multi-layered rather than fixed and final. A retention basin might host festivals when dry and hold stormwater after heavy rain. A promenade along the coast can double as a protective edge and a public gathering space. Such spaces translate climate adaptation into cultural practice: landscapes that perform technically while remaining open to use, interpretation, and renewal. Resilience is not only the capacity to withstand disturbance, but also the ability to evolve with it.

Designing for water also changes how we collaborate. Water ignores property lines and jurisdictions; it flows through fields, neighborhoods, and political boundaries alike. Working with it demands new forms of partnership between engineers and artists, planners and citizens, and scientists and local stewards. Together they can create living systems: wetlands that filter water while becoming habitats and community spaces, coastal parks that protect and invite, and agricultural lands that flood in rhythm with the seasons. These are shared infrastructures (both ecological and cultural) that bind communities through collective maintenance and care.

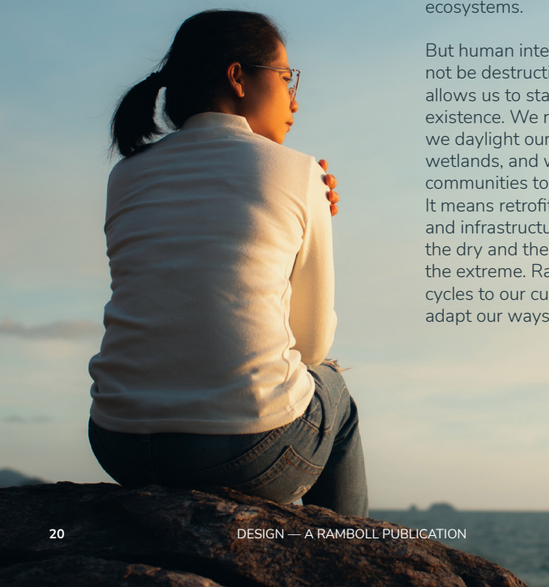
When water is visible, audible, and accessible, it becomes part of public life again. Open canals, reflective pools, and seasonal wetlands remind us that resilience is not only an environmental goal but a cultural condition, a way of sustaining meaning and connection through change. Cities that expose their water systems become more self-aware: they learn from their landscapes and from the stories that flow through them.

Ultimately, designing for water is designing for coexistence. It accepts that stability is temporary, that the ground will shift and the tides will rise. The task is not to fix but to adapt, to guide rather than to control. Water as resilience is thus not a singular outcome, but a continuous, collaborative practice, one that weaves together natural processes, cultural memory, and collective imagination to create landscapes capable of thriving within the flow of life.

Water for the Futures

How can we steward ecosystem health?

Trine Stausgaard Munk, Ramboll



Over time, we have altered our relationship with water, from a place of co-existence to a need for control.

But water cannot be tamed. It flows, it seeps, it evaporates, it transforms.

When we hide water, control it, extract it, or commodify it, we are limiting its ability to sustain healthy and resilient ecosystems.

But human interventions in nature need not be destructive. Starting with water allows us to start at the core of life's existence. We reclaim space for water, we daylight our streams, we retreat from wetlands, and we adapt our lives and communities to be in harmony with water. It means retrofitting our communities and infrastructure to the ebb and flow, the dry and the wet, the everyday and the extreme. Rather than adapting water cycles to our current ways of living, we adapt our ways to water.

Our health is connected to the health of our surrounding aquatic environment. Not just because we are more than 60% water – a body of water. But also because of that.

How do our roles as designers change if, instead of identifying ourselves as an engineer or architect, we see ourselves as a body of water?

Connected to all other bodies of water – the plants, the jellyfish, the sea, the cloud, the birds. As a water family, we are also connected to our ancestors. Our descendants. When we drink a glass of water, when we submerge ourselves in water, we are interacting with the same element as those before us and those after, united across time by water.

By identifying firstly as a body of water, with water stories transcending our own timelines, we bring in a watery awareness. We embody the wisdom of water passed on for generations.

We learn from the natural and softer qualities that water embodies. Just like water, we evolve and learn, we adapt and flow, and we embrace our purpose as designers to sustain life itself and design conditions conducive to life.

As a body of water, we find inspiration in the patterns we see in our watery world and activate biomimicry in our design. Just like water, we challenge the spatial boundaries and business-as-usual design briefs.

Our role is no longer to control, manage, or direct water. Instead, water becomes our teacher and our relative. We advocate for "human rights" for our more-than-human water bodies.

Our role is more than a gardener cultivating natural habitats as human commodities. Our role becomes that of a care-taker, custodian or steward - nurturing conditions for water to thrive and facilitate life. A dedicated facilitator giving voice and agency to water.

Starting from this place, with water as our guide, we can relearn how to design for diverse interconnectivity and long-term health without "powering over". Nurturing the roots of place, physically and metaphorically, can help grow resilience from below.

Humans play an important part in our planetary ecosystem. It is time we relearn our role as care-takers of the blue planet.

- Because what could feel more purposeful, than to care for the waters that are to sustain all future life?
- Which role could be more meaningful than that of a water steward?
- How will you give thanks to our water?

The future seems distant. But the future is also now. What you do now matters. Action is also imagining. How might we reimagine water together?

> "We need acts of restoration, not only for polluted waters and degraded lands, but also for our relationship to the world.
>
> **Robin Wall Kimmerer**

Epilogue

Water, Then and Now

Hossein Rezai-Jorabi, Ramboll

Water has always shaped where and how we live. In the years ahead, it will do so more intensely and more visibly. Through flood and through drought, water will reveal the strengths and fragilities of our societies.

In places of excess, rising seas and heavier rains will press against rigid edges. Flooding will become a recurring reality rather than a rare disruption. Resilience will depend on our willingness to make space for water, to create landscapes that can hold, slow, and release it safely. Rivers may need room to meander. Coastlines may need to flex and shift. Designing for permanence will give way to designing for adaptation.

In places of scarcity, prolonged drought and depleted aquifers will test systems of supply and fairness. Water reuse, careful stewardship of watersheds, and regenerative land practices will become the foundations of stability. Here, resilience will be measured by how wisely we share, replenish, and protect what is limited.

Living close to natural water sources has long been associated with quality of life, but in the modern era this relationship is increasingly understood as regenerative rather than merely scenic. Access to water supports biodiversity, improves air quality, and provides restorative psychological benefits that enhance well-being and productivity. Proximity to rivers, wetlands, and coasts invites ecological richness and social connection, strengthening both environmental health and human resilience.

Is water a commodity? It carries a price in markets and balance sheets. Yet it is also a shared inheritance, a living system that sustains ecosystems and communities alike. To see water only as a product is to narrow its meaning. To recognise it as both resource and relationship expands our responsibility.

The emerging stories of resilience are, at their core, stories about water. Communities that endure will be those that understand their hydrological realities and align design with natural cycles. Adaptation will not be an act of resistance, but one of partnership.

The invitation is simple, though not small.

Work with water's rhythms rather than against them.
Reveal and restore the systems we have hidden.
Design for change, not just for control.
Share stories, knowledge, and responsibility across boundaries.

Each decision we make shapes our collective water future.
The path ahead asks for imagination, humility, and care.

Water will guide what comes next.
Our task is to listen and to act.

Ramboll is a global engineering, architecture and consultancy company founded in Denmark in 1945. Across the world, our 18,000 experts create sustainable solutions.

We combine local experience with a global knowledge base to create sustainable cities and societies, driving positive change for our clients, stakeholders and society. We enable our stakeholders to realise their goals and navigate the transition to a more sustainable future.

Bright ideas. Sustainable change.

DESIGN is a publication by the Design Excellence Board (DEB) within the Buildings Global Business Area in Ramboll.

The publication promotes and articulates the latest ideas on matters relating to design, technology, environment and ethos within the design industry and the built environment, at large. It aims to address key issues facing contemporary design professionals, including our evolving relationship with the natural environment; as well as pressing political and social agendas for the built environment.

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Design and layout by
Ramboll Global Design Centre