

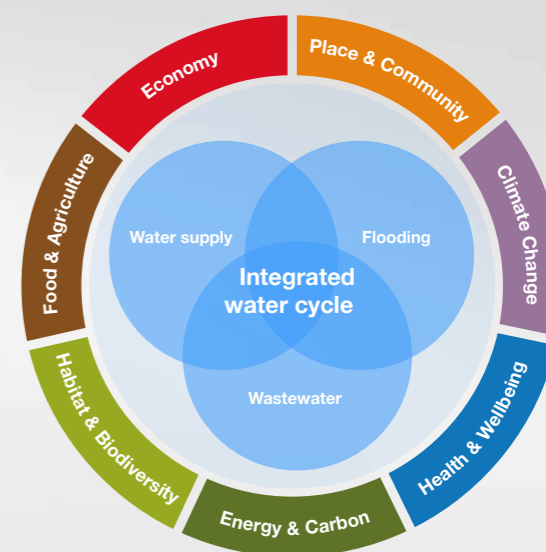
Design with water

Arup addresses critical issues relating to resilience, flood risk, water supply and wastewater treatment by placing a re-integrated water cycle at the heart of sustainable planning, design and delivery.

The ARUP logo is positioned in the bottom right corner of the slide. It consists of the word "ARUP" in a white, bold, sans-serif font. The logo is set against a background of a large, light blue circular graphic that features several overlapping circles and lines, creating a complex, geometric pattern. The overall background of the slide is a solid, medium blue color.

Design with water

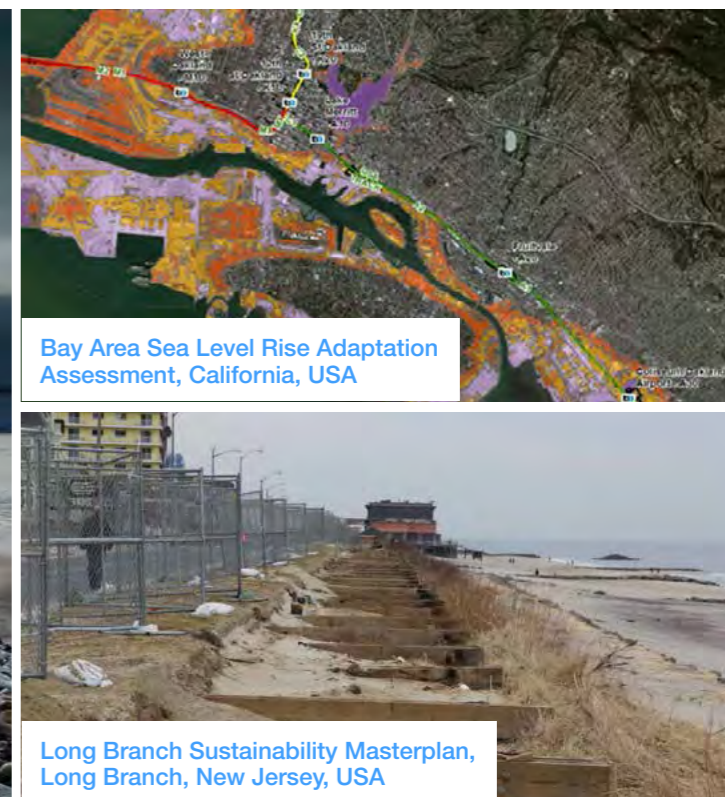
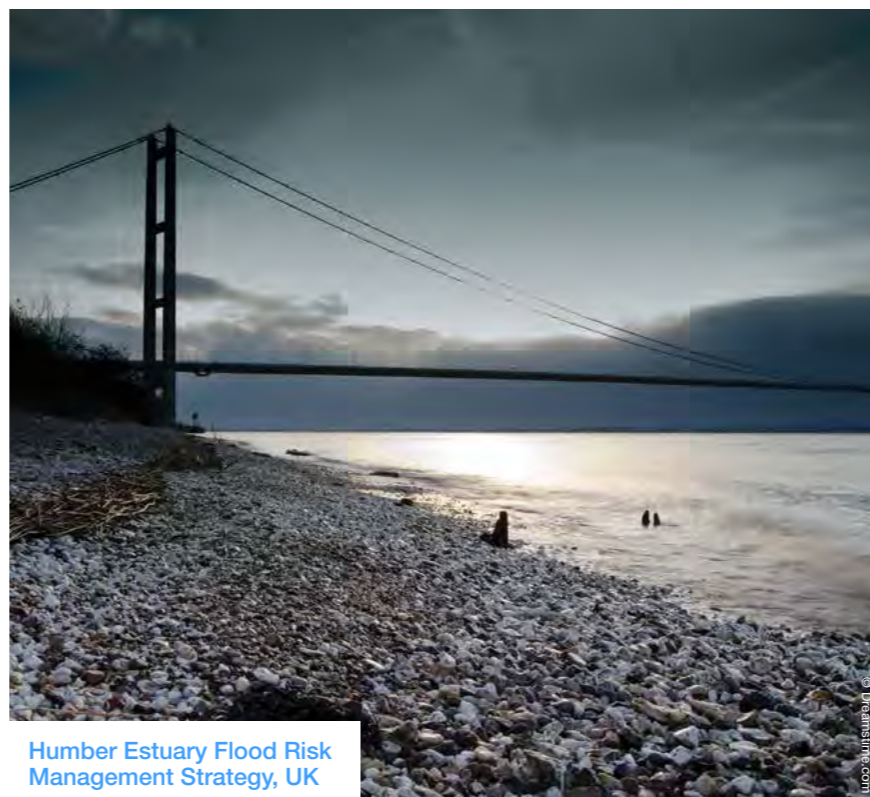
By aligning with, and supporting other socio-economic and environmental drivers, actions taken to protect and enhance the water cycle can deliver multiple wider benefits.



Coasts

Coastal zones are critical for trade and industry, habitat, tourism, health, and, increasingly, for energy. With forecasts of sea-level rise and changing weather patterns, low-lying coastal settlements are increasingly vulnerable to storms and flooding. Adaptable, robust coastal defences that work with natural systems can underpin sustainable development of coastal communities, as can schemes to improve bathing water quality.

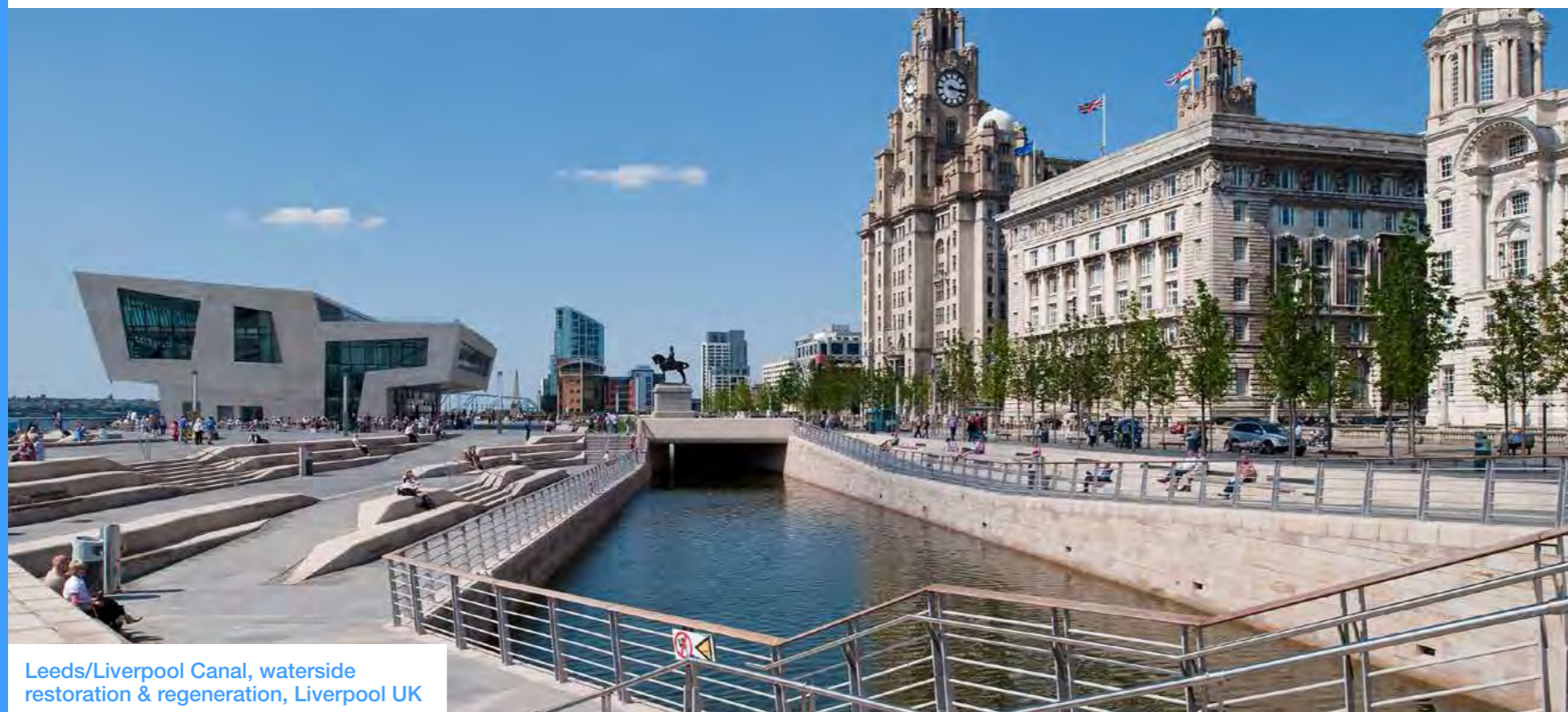
Selected projects:



Rivers and waterways

Understanding and living safely with rivers in drought and flood - as a benefit or a danger - is key to successful land use planning. Rivers and waterways support ecosystems and have shaped patterns of development over time. Protecting and re-vitalising these assets through improved water quality, habitat creation and high quality design is critical to successful urban and rural development.

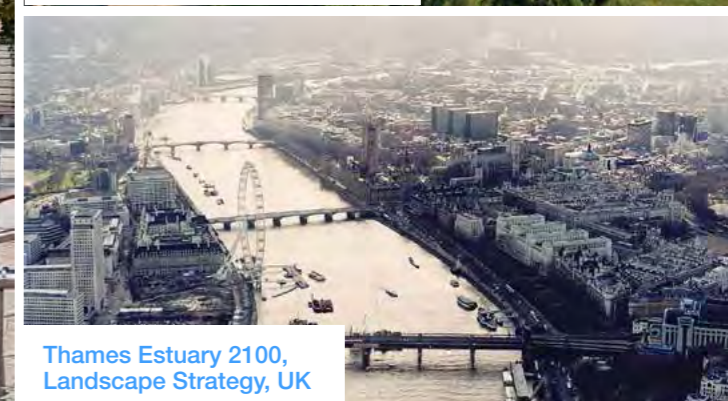
Selected projects:



Leeds/Liverpool Canal, waterside restoration & regeneration, Liverpool UK



Upper Raba spawning grounds, river restoration project, Poland

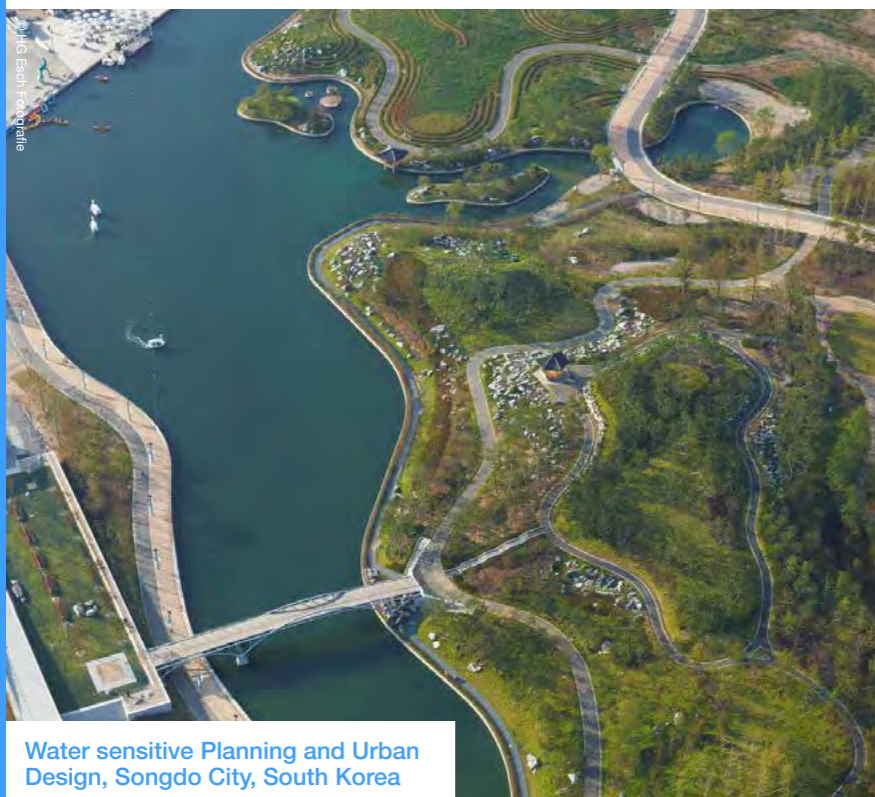


Thames Estuary 2100, Landscape Strategy, UK

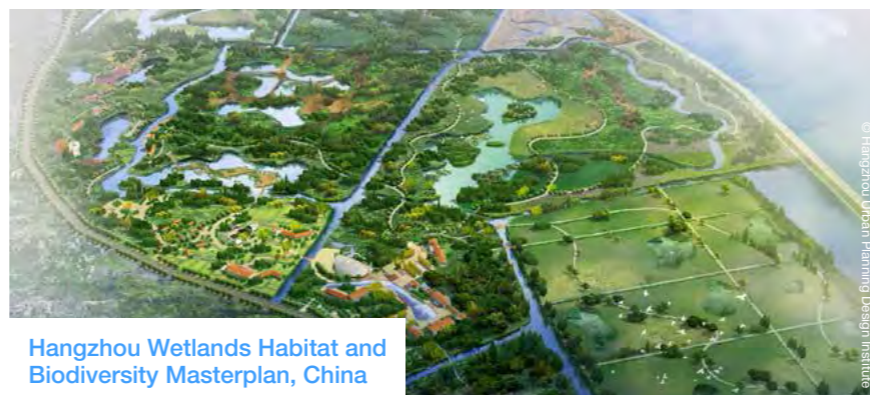
Planning and urban design

From regional scale to neighbourhoods and individual dwellings, water-sensitive land use planning and urban design creates a framework that balances effective water-cycle management with wider environmental drivers and other urban systems, including transport, housing, green space, industry, agriculture, health, education and economic development.

Selected projects:



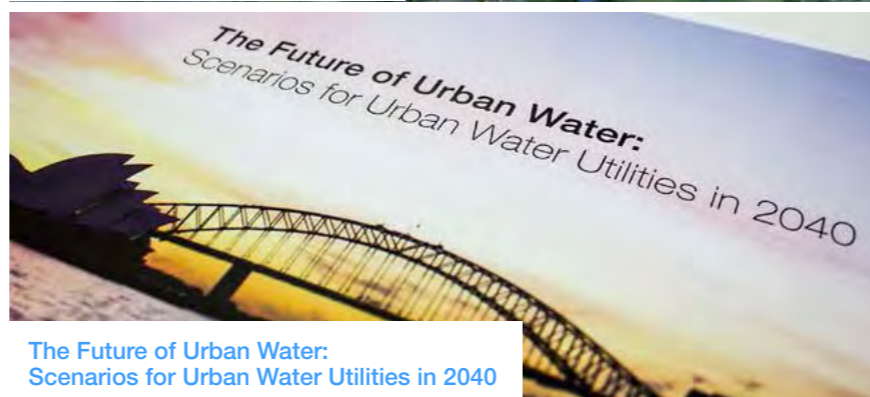
Water sensitive Planning and Urban Design, Songdo City, South Korea



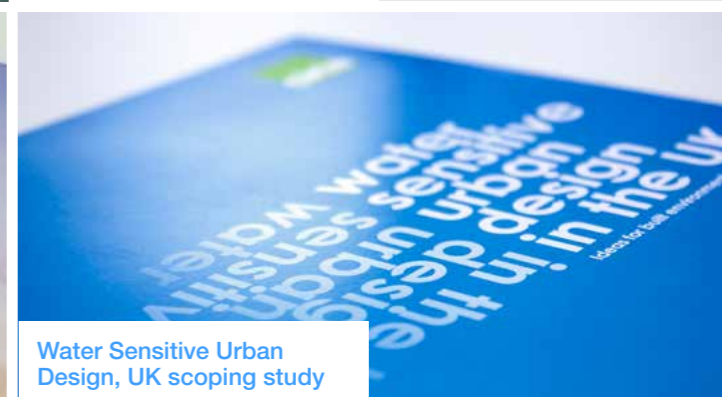
Hangzhou Wetlands Habitat and Biodiversity Masterplan, China



Thanlyin Star City Water Strategy, Yangon, Myanmar



The Future of Urban Water: Scenarios for Urban Water Utilities in 2040



Water Sensitive Urban Design, UK scoping study

Resilient infrastructure

Built infrastructure should be designed to accommodate current and potential future hydrological extremes, whilst preserving and enhancing aquatic ecosystems. Accommodating climate change, by making precautionary allowances for future change or through adaptive management, will ensure resilient infrastructure systems that survive and perform well in an increasingly uncertain future.

Selected projects:



Rehabilitation of Ulley Reservoir following damage during the June 2007 flood event, UK



New York City Transit Flood Resiliency, USA



Enhancing Climate Resilience of Gorakhpur City, India



Climate change assessment & flood resilient design for High Speed 2 Rail, UK project

Urban retrofit

In addition to planning new development, retrofit of existing environments is a critical issue facing city authorities, water managers and other stakeholders. From improved buildings services, urban greening and retrofit of SUDS within urban landscapes, water can play a key role in transforming urban environments.

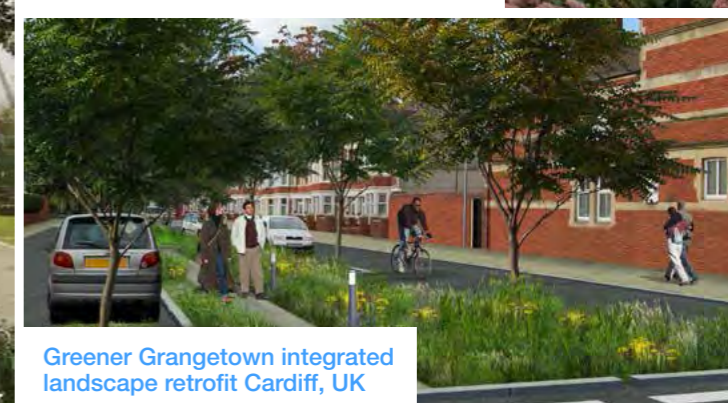
Selected projects:



Melbourne main outfall sewer rehabilitation, Australia



Retrofitting green Infrastructure for water management, New York City, USA



Greener Grangetown integrated landscape retrofit Cardiff, UK

Green infrastructure

Water can be a powerful integrator and a catalyst for change. Designing for water can play a key role in delivery of improved green infrastructure - the networks of woodlands open spaces, wildlife habitats, waterways and other natural assets that underpin healthy and successful places.

Selected projects:



Hunters Point public realm & green infrastructure, USA



CITIES ALIVE - Rethinking Green Infrastructure, Can nature help restore harmony in our Cities?



Llanelli & Gowerton water strategy and green infrastructure retrofit, UK



Business improvement district green infrastructure toolkit, UK

Buildings and public realm

Water can play a key role in place-making through integration of water and green infrastructure to revitalise public realm, improve microclimate and enhance connectivity for people and wildlife. Designing new buildings and retrofitting existing ones for water and energy efficiency is also critical. Strategies include use of water efficient fixtures and fittings, rainwater harvesting and treatment, grey water recycling and integration of green roofs and walls.

Selected projects:



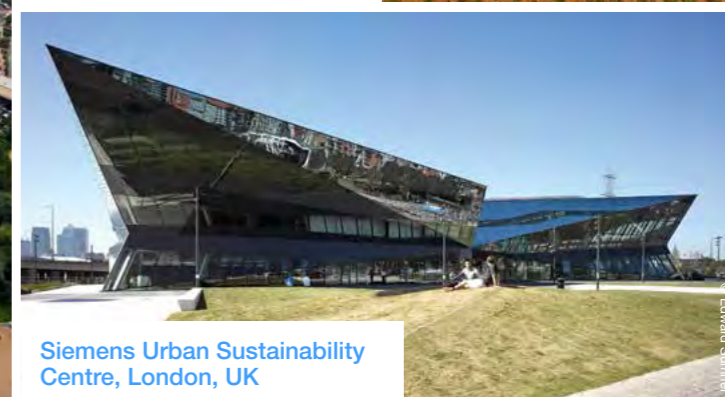
City Park water infrastructure,
and public realm, Bradford, UK



London 2012 Olympic Park water
infrastructure design, UK



Newport Beach Civic Centre
and Park, California, USA



Siemens Urban Sustainability
Centre, London, UK

Water resources

Sustainable use of water resources against a background of climate change, urbanisation and population growth requires an integrated catchment-wide approach. Whole-life assessment of water supply, treatment and storage options from surface water and groundwater, to sea water, rainwater harvesting and grey water must be coupled with demand reduction through behaviour change, smart infrastructure and water efficient design.

Selected projects:



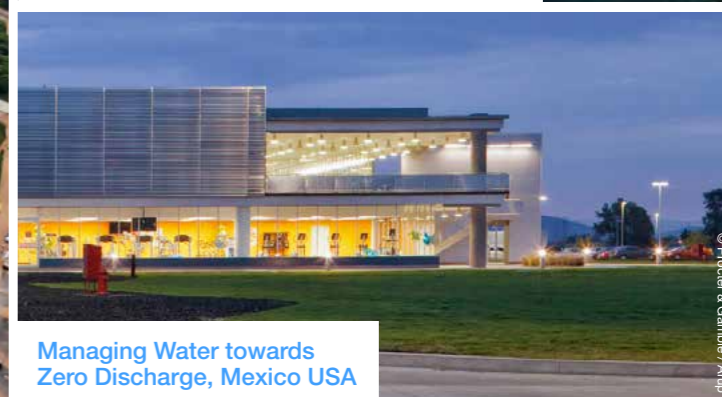
Managing Water Use in Scarce Environments - WRG 2030 Global Study



London 2012 Olympic Park water re-use strategy, UK



Water strategy, site development and regeneration of Robben Island, South Africa

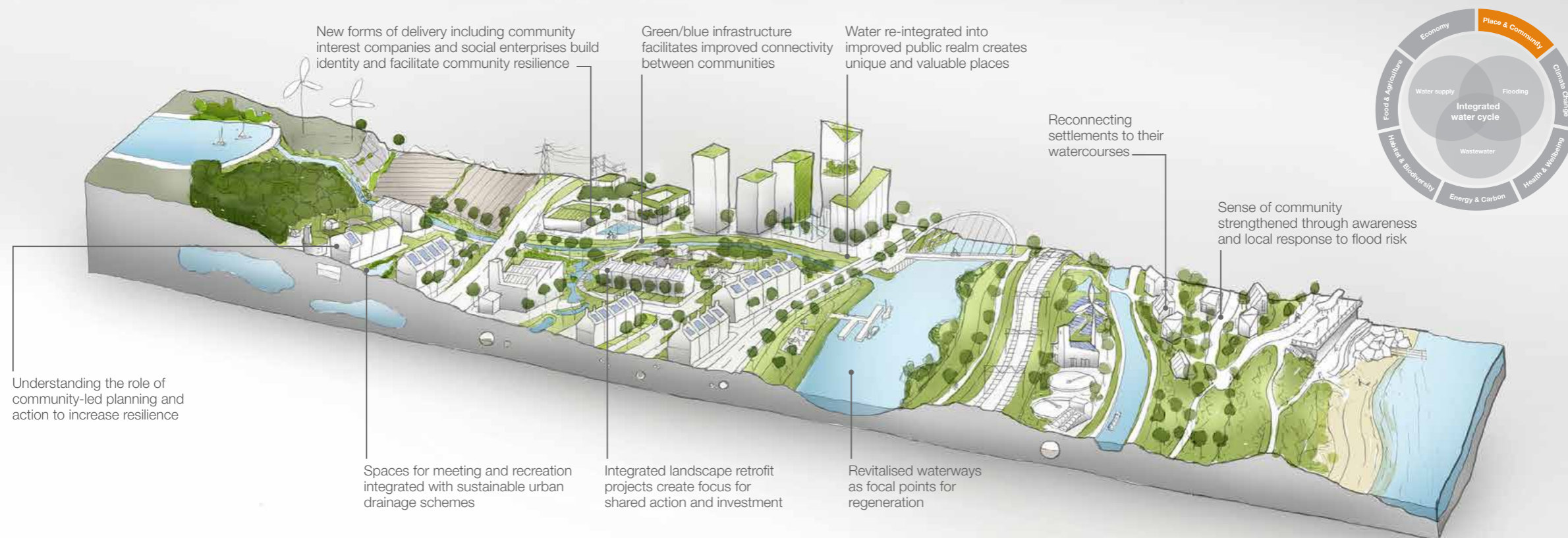


Managing Water towards Zero Discharge, Mexico USA

Place and community

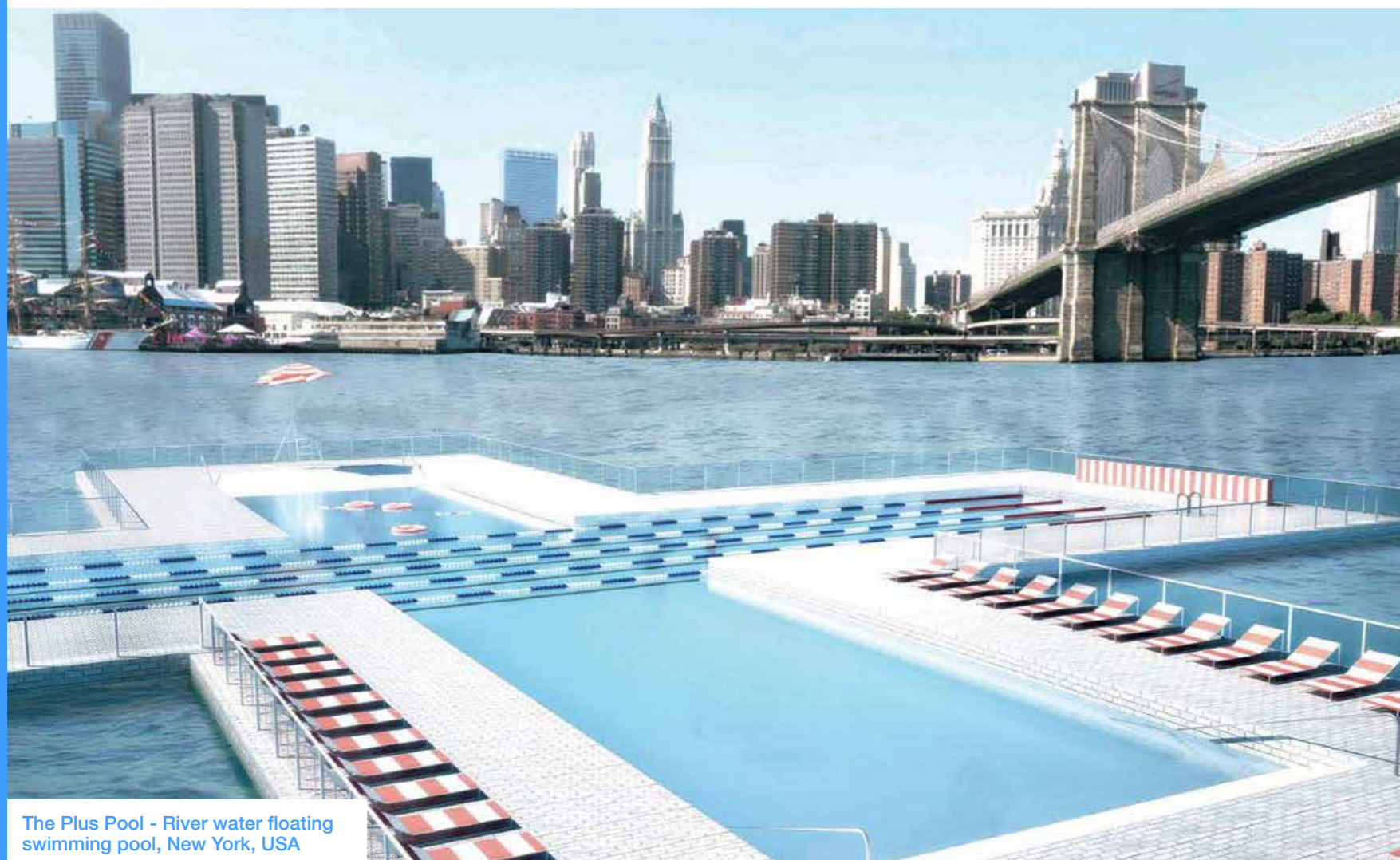
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Access to and engagement with water can play a significant role in creating better places with a strong sense of identity. Making space for water can open up and reconnect people and places. Water is an integrator which can facilitate partnership and collaboration.



Place and community

Selected projects:



The Plus Pool - River water floating swimming pool, New York, USA



Sewer outfall retrofit as a driver for Regeneration, Melbourne Australia



Newport Beach Civic Centre and Park, California, USA



Stebonheath School landscape design and SudS retrofit, Llanelli, UK

Climate change

Design for water helps to mitigate and adapt to climate change. Greening of urban areas, including large tree planting, new habitats and creation of open water bodies directly contribute to improved microclimate and reduce water demand. Locally managed water can increase resilience to water scarcity and drought.



Climate change

Selected projects:



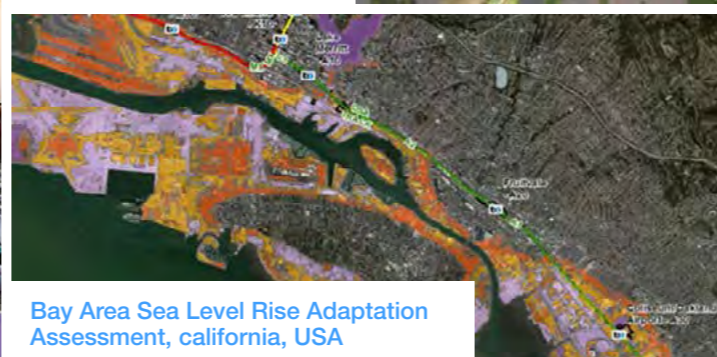
C40 UrbanLife Workshop
Ho Chi Minh City, Vietnam



Climate change assessment & flood resilient design for High Speed 2 Rail, UK project



CIRIA Flood Risk & Critical Infrastructure Study, UK



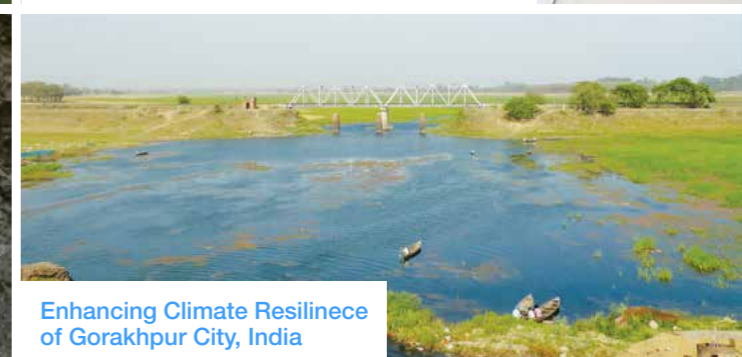
Bay Area Sea Level Rise Adaptation Assessment, California, USA



Guide on climate change resilience of Urban Water, Wuhan, China



City Resilience Framework - global study with Rockefeller Foundation, New York



Enhancing Climate Resilience of Gorakhpur City, India

Health and wellbeing

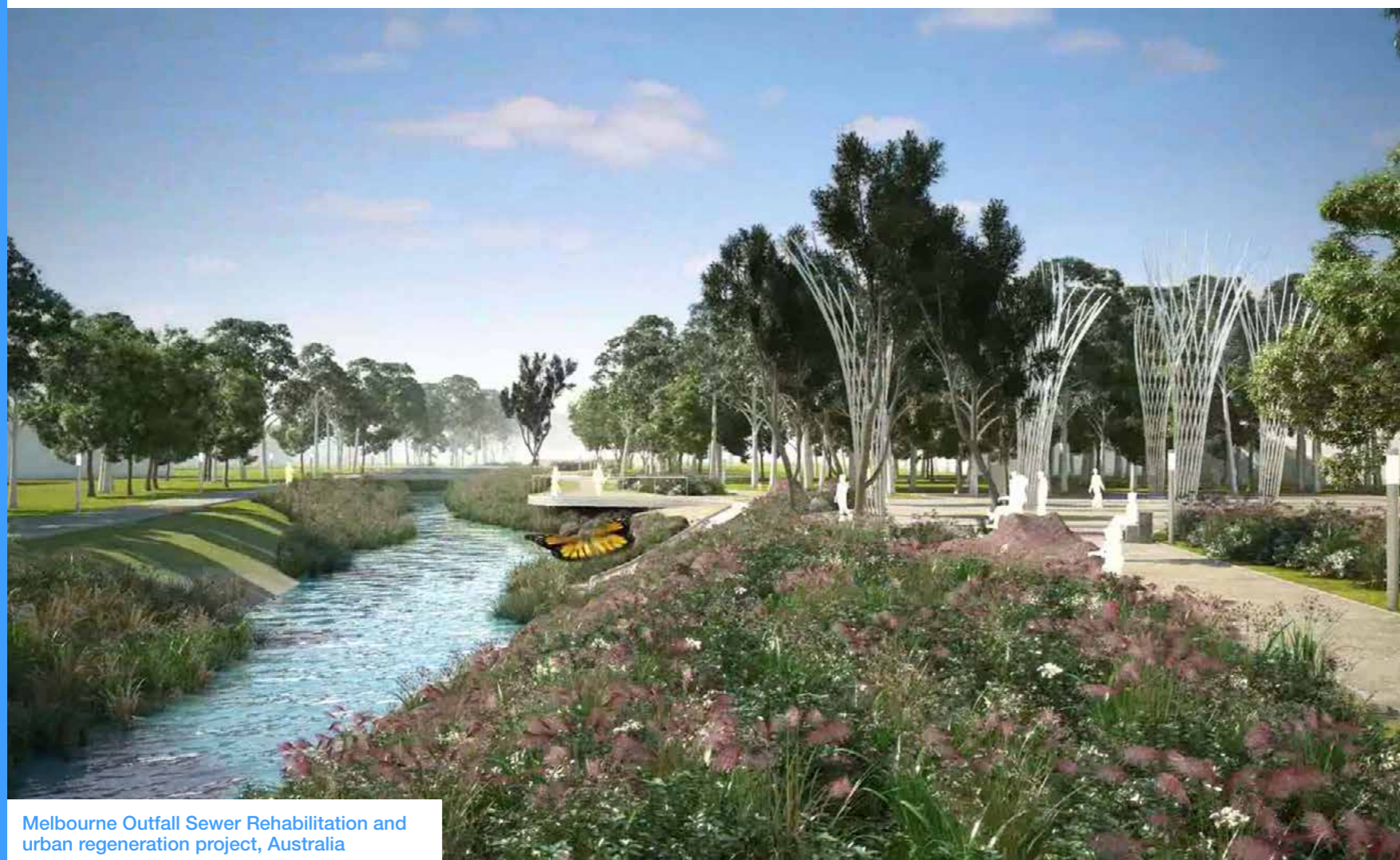
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In addition to provision of the basic human need for water and sanitation, water-related infrastructure can help to improve overall living environments and provide opportunities for community engagement: increasing connectivity, absorbing air pollutants, improving microclimate and providing opportunities for recreation, exercise and education.



Health and wellbeing

Selected projects:



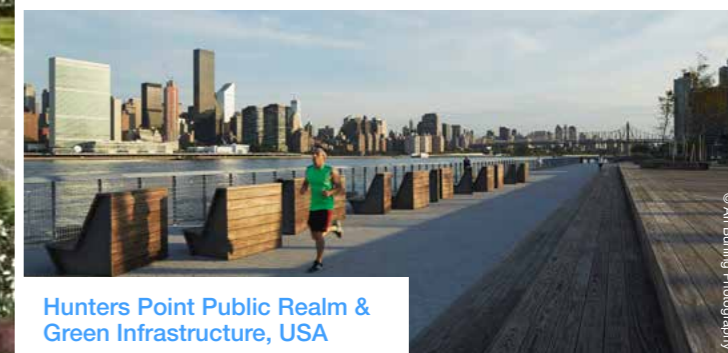
Melbourne Outfall Sewer Rehabilitation and urban regeneration project, Australia



Recreational Masterplan of Dobczyce Reservoir, Poland



Stebonheath School landscape retrofit, Llanelli, UK



Hunters Point Public Realm & Green Infrastructure, USA

© Art Burling Photography

Energy and carbon

1

Removal and sequestration of greenhouse gases as a result of urban greening. Reduction in energy demand due to shading/insulation, reduced pumping and treatment of water and wastewater. Potential for renewable energy generation from hydro and waste.



Energy and carbon

Selected projects:



Design of a sludge incinerator for efficient energy and carbon consumption, Hong Kong



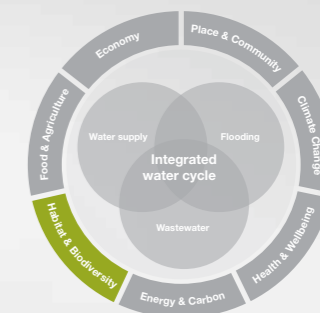
Vistula Dam Hydro Power project - feasibility & environmental impact assessment, Poland



Green Infrastructure retrofit for energy & carbon saving, Llanelli & Gowerton, UK

Habitat and biodiversity

Delivery of new and improved habitats through making space for water within green infrastructure networks, provision for natural treatment of water and wastewater, improving water quality, undertaking river/wetland and coastal restoration, creating wildlife corridors and provision of woodland, green roofs and walls.

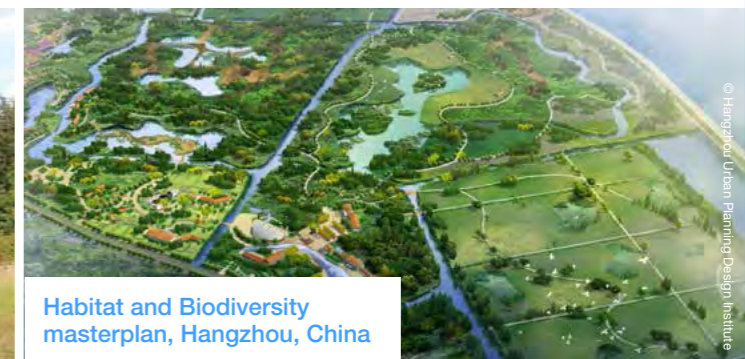


Habitat and biodiversity

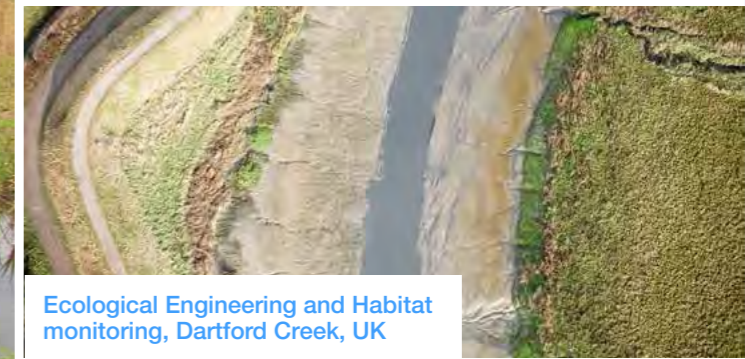
Selected projects:



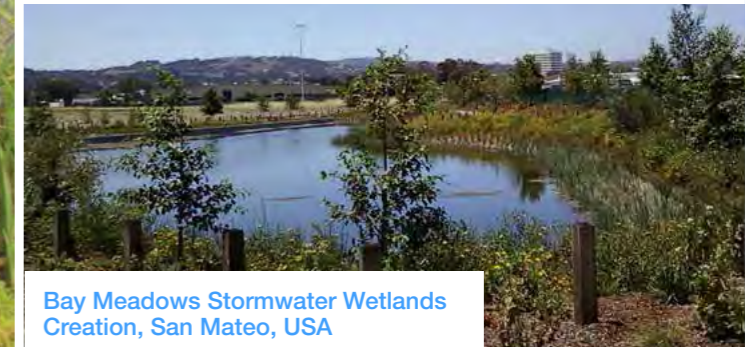
Planning and landscape design for Beam Parklands - a habitat creation and flood storage project, London, UK



Habitat and Biodiversity masterplan, Hangzhou, China



Ecological Engineering and Habitat monitoring, Dartford Creek, UK



Bay Meadows Stormwater Wetlands Creation, San Mateo, USA

Food and agriculture

1

Agriculture uses around 70% of the world's freshwater supply and impacts on water quality and ecosystem health. Improved water efficiency in agricultural practice alongside new models of production, such as urban agriculture, can increase food security and support water-sensitive landscape retrofit.



Food and agriculture

Selected projects:



© Brendan J Menev Architects

Alice Springs Wastewater re-use for irrigation, Australia



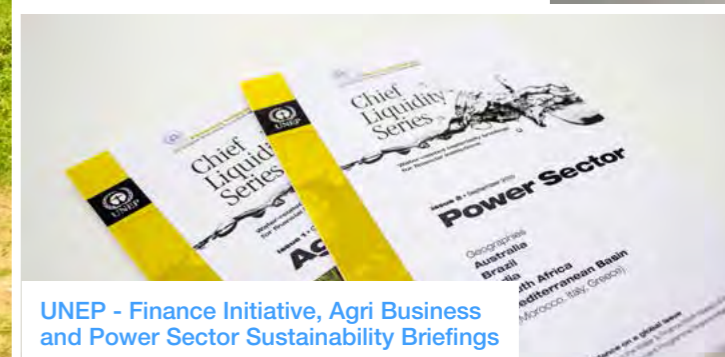
Water Risk & Sustainability Assessment, River Rwizi Catchment, Uganda



Design and construction of a new treatment plant for Diageo's Guinness Plant in Nigeria



Managing Water Use in Scarce Environments - Global Study for WRG2030



UNEP - Finance Initiative, Agri Business and Power Sector Sustainability Briefings

Economy

Water sensitive design can deliver direct returns through water-related investment in infrastructure, associated new technologies, partnership with small enterprise and so on. Indirect benefits include enabling development through reduce flood risk and water-resilient design, uplift on land and property values, attracting inward investment, improving connectivity and better labour productivity.

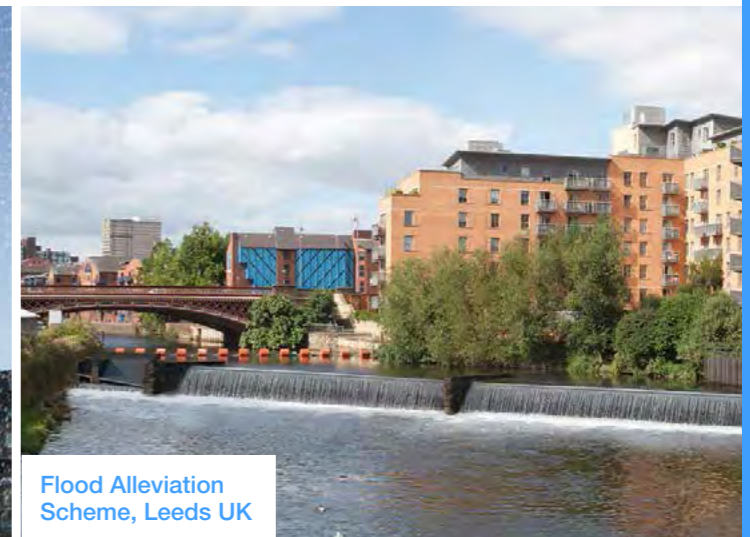


Economy

Selected projects:



City Park, Bradford - high quality public realm underpinning economic regeneration, UK



Flood Alleviation Scheme, Leeds UK



Catchment Investment Efficiency Framework, Queensland, Australia

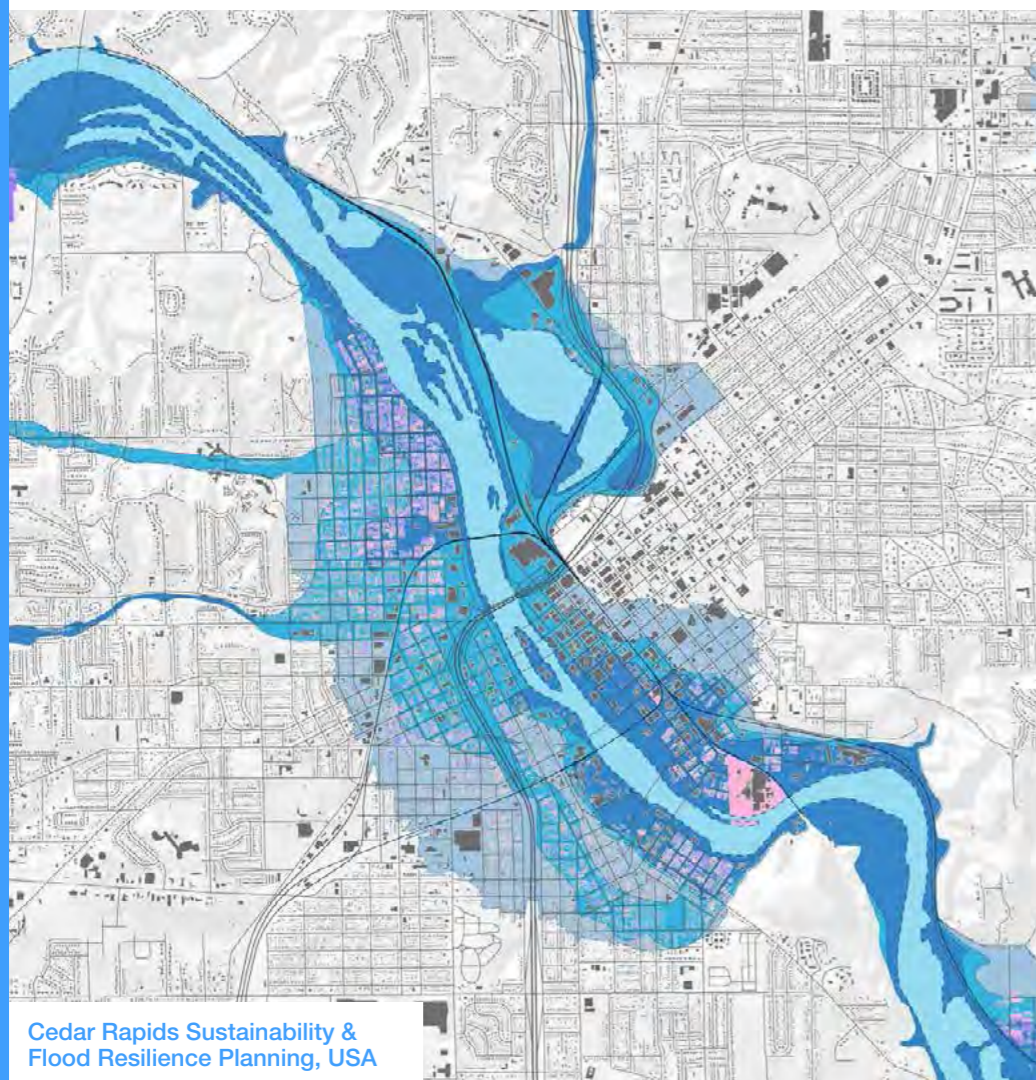
Flooding

Reducing risk and increasing resilience by integrated catchment management and improved management of surface water within cities. Design and planning of infrastructure, buildings and landscapes to be more adaptable to flooding. Understanding and reducing flood risk to enable development.

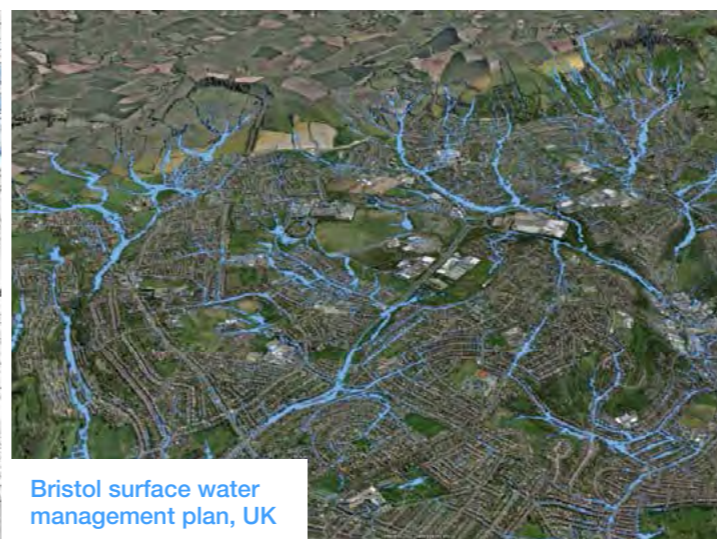


Flooding

Selected projects:



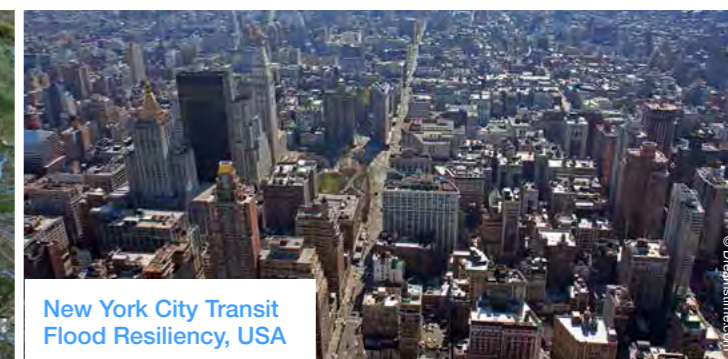
Cedar Rapids Sustainability & Flood Resilience Planning, USA



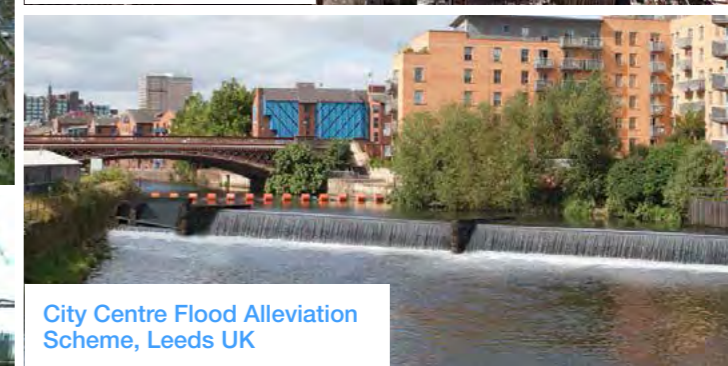
Bristol surface water management plan, UK



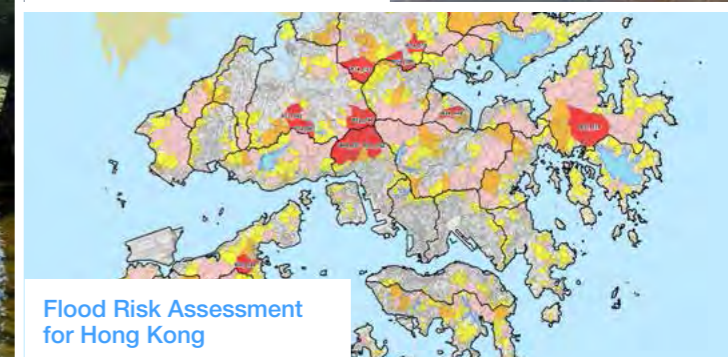
Czarna Staszowska and Nida Rivers Flood Programmes, Krakow, Poland



New York City Transit Flood Resiliency, USA



City Centre Flood Alleviation Scheme, Leeds UK



Flood Risk Assessment for Hong Kong

Wastewater

Reduction of surface water volume to sewers, extends network asset life, improves water quality (fewer spills to rivers from combined sewer overflows), and reduces treatment costs and carbon emissions. There is increasing opportunity to recycle and re-use water through decentralised treatment.



Wastewater

Selected projects:



The Harbour Area Treatment Scheme, Hong Kong



East Coast European Bathing Water Directive for Yorkshire Water, UK



Thames Tideway Tunnel, London, UK



Bursa Wastewater Project II, Turkey



Upgrade of Melbourne Cricket Ground, Australia



Genting Sewage Treatment Plant, Malaysia

Water supply

Planning and design for potable water supply and treatment can reduce overall capital investment, generate whole-life cost savings and protect valuable water resources. Strategies include demand reduction through behaviour change and use of water efficient fixtures and fittings, and integration of alternative decentralised water supplies, including groundwater, rainwater and greywater.

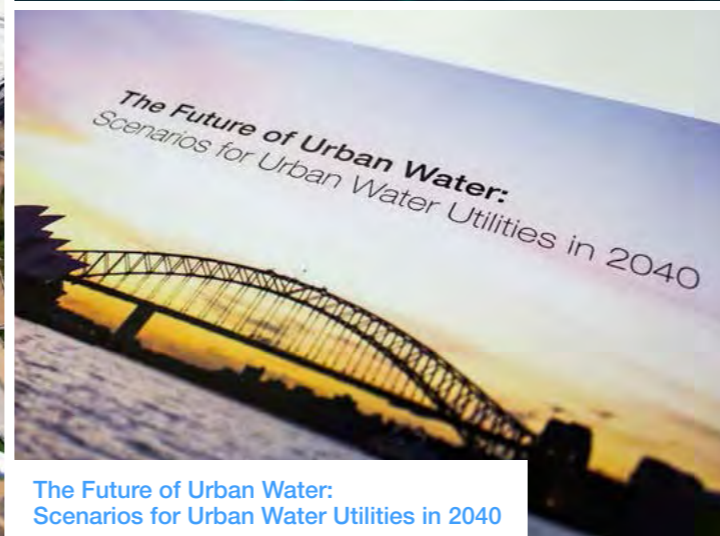
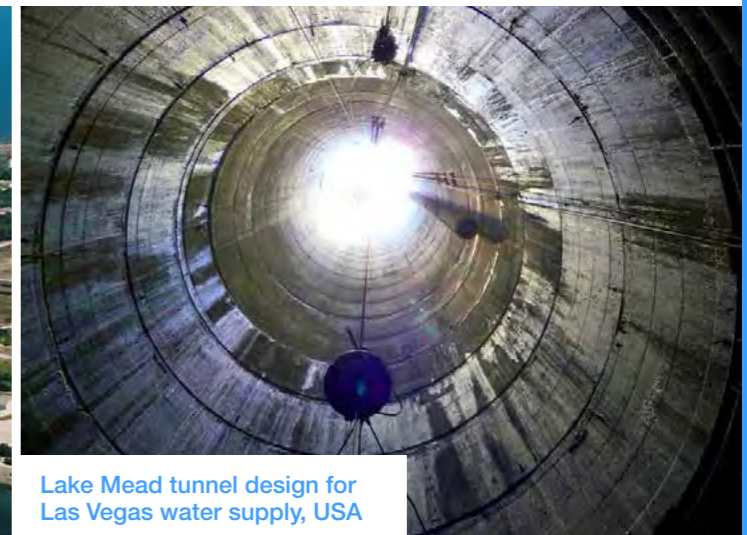


Water supply

Selected projects:



London 2012 Olympic Park Water Infrastructure design, UK



The Future of Urban Water: Scenarios for Urban Water Utilities in 2040



New Water Storage Reservoir, Cheddar, UK

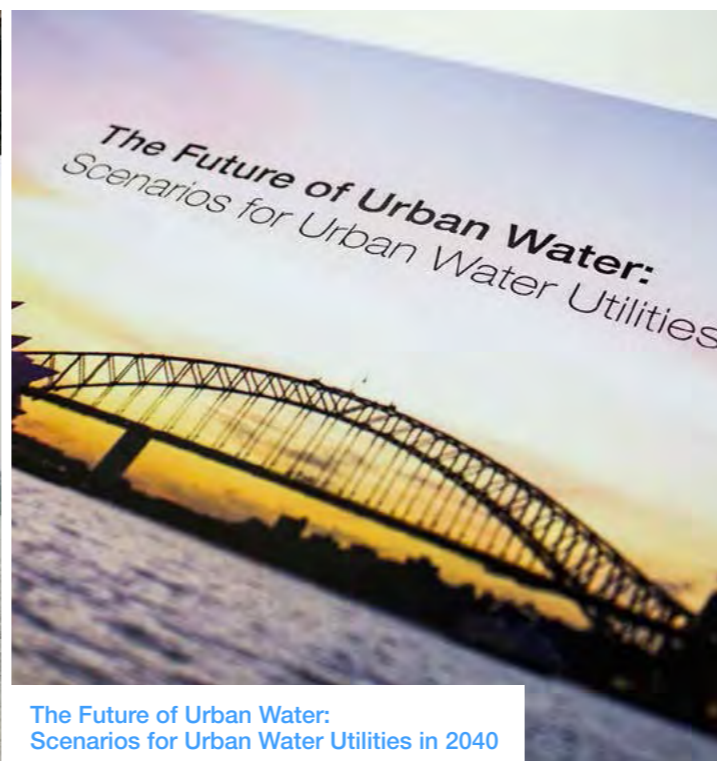
Asset management

Asset management clarifies whole life considerations for both natural and engineered assets that may have complex and vastly differing life cycles. Consideration of context, stakeholder priorities and organisational objectives feed into the decision making process allowing the balancing of costs, opportunities and risks against desired asset performance and outcomes.

Selected projects:



Guide on climate change resilience of Urban Water systems , Wuhan, China



The Future of Urban Water: Scenarios for Urban Water Utilities in 2040



Climate Change Adaptation of Interconnected Water Infrastructure, NSW, Australia

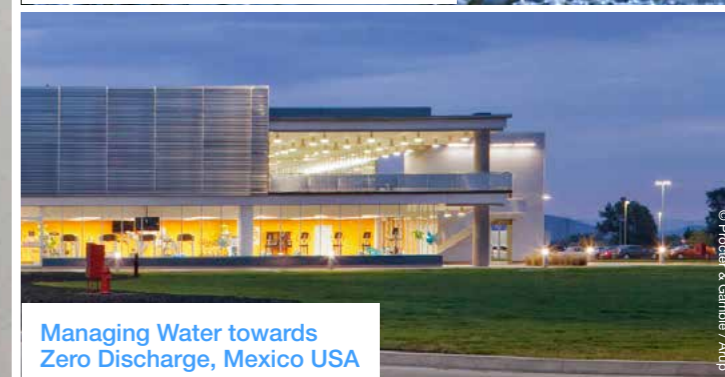


City of Rialto Water Due Diligence Performance Monitoring, California, USA

Demand management

Demand-side management measures result in reduction of the expected water usage or water demand. Demand management plans are essential for ensuring efficient use of valuable water resources and are key components of integrated water management strategies and water cycle planning.

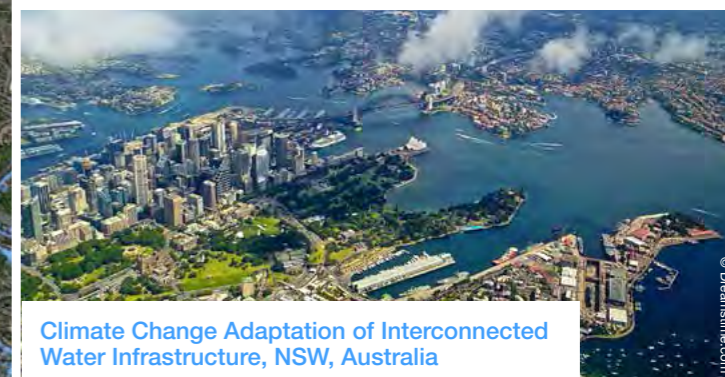
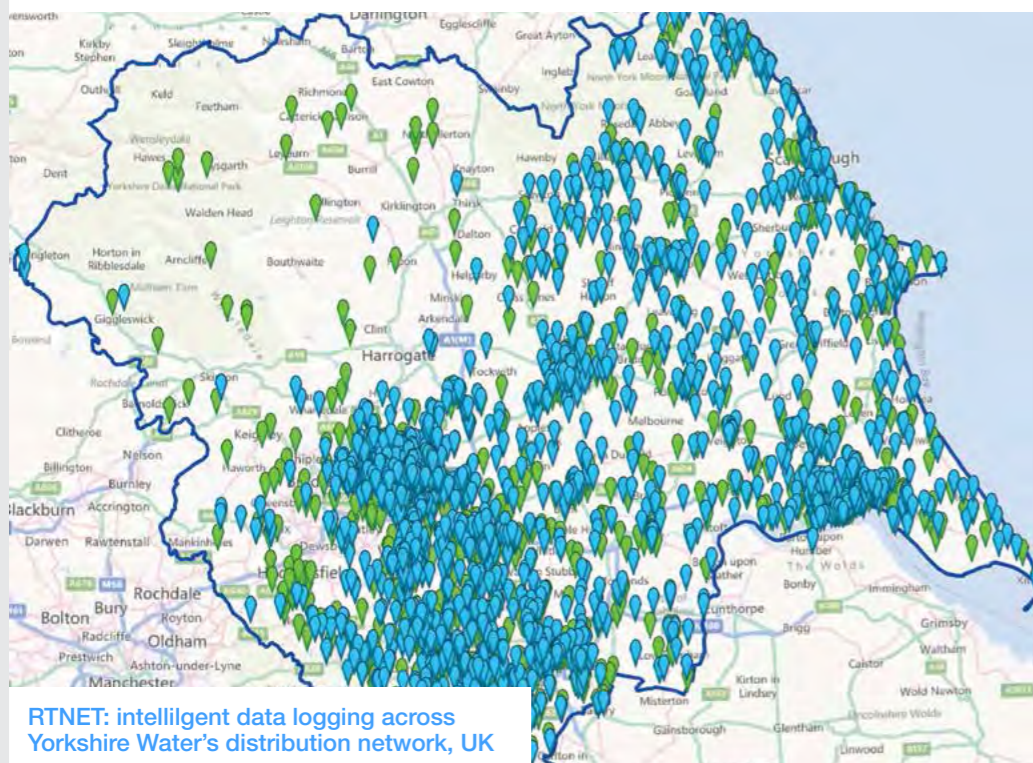
Selected projects:



Catchment management

A catchment-based approach to managing the water environment looks at activities and issues at catchment scale. By aligning water-cycle needs with other development drivers water can act as facilitator, bringing together people from different sectors and disciplines into effective water stewardship partnerships.

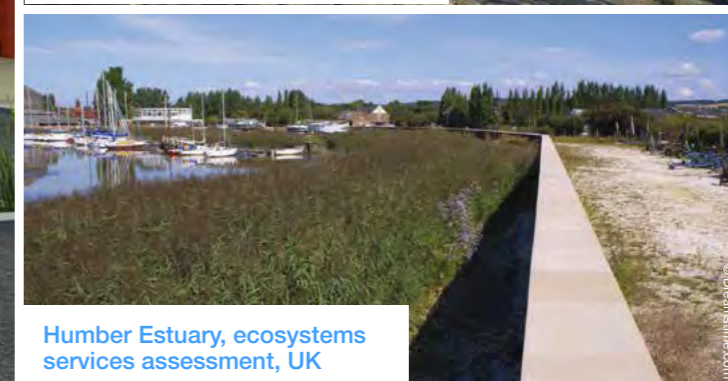
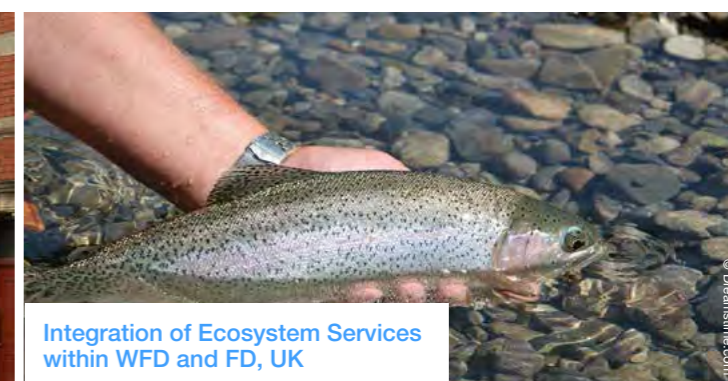
Selected projects:



Ecosystem services

Ecosystem Services (ES) underpin the fundamental aspects of economic, environmental and social wellbeing. Investment in green infrastructure leads to cost savings, creates business opportunities and - if appropriately planned and implemented – can provide win-wins for both water management and biodiversity

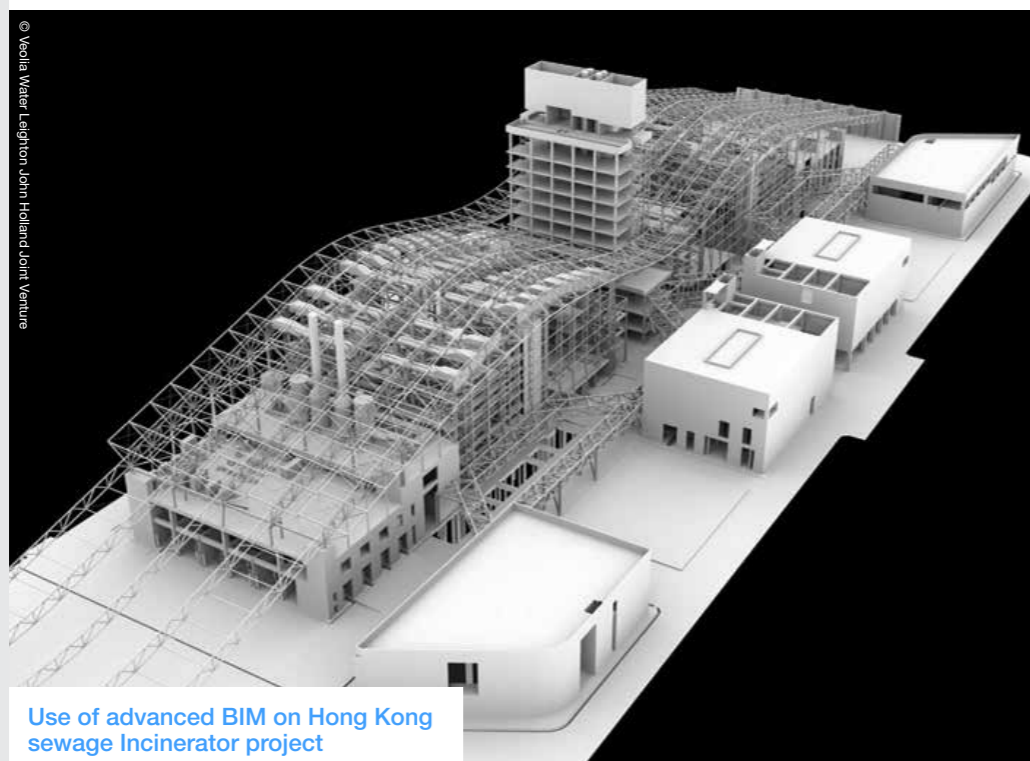
Selected projects:



Smart infrastructure

The 21st century has seen unprecedented technological advances and availability of data covering all aspects the natural, and built environment. City managers, communities, businesses and infrastructure providers are learning how to use data to better manage assets, improve designs, inform local policy and implementation and identify partnership delivery opportunities.

Selected projects:



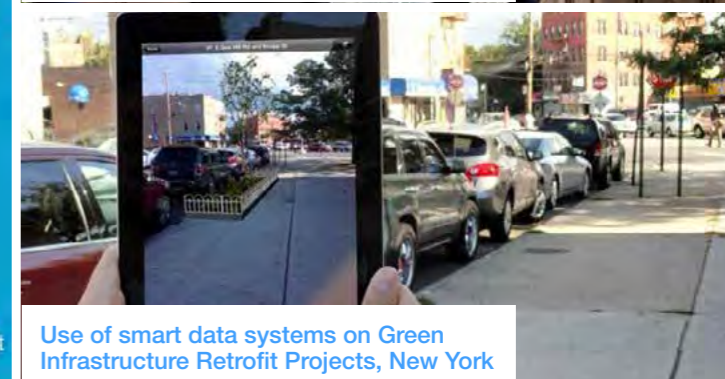
Use of advanced BIM on Hong Kong sewage Incinerator project



SEQ Smart Water Grid – Development of a Decision Support System, Qld, Australia



Designing with Data: Shaping our Future Cities Arup/RIBA Report, London, UK



Use of smart data systems on Green Infrastructure Retrofit Projects, New York

© Veolia Water Leighton John Holland Joint Venture

© Neoh Shafiq Julian Richards

Wider Arup services

Arup has designed many of the world's most prominent projects in the built environment and across industry. With 90 offices in 38 countries our 11,000 planners, designers, engineers and consultants deliver innovative projects with creativity and passion.

Selected projects:

Strategy

Catchment science
 Masterplanning and urban design
 Surface water management plans
 Water cycle studies
 Planning policy and spatial planning
 Water resilience strategy and planning
 Carbon management & climate change studies
 Landscape and green infrastructure strategy
 Economic assessments
 Sustainability assessments
 Asset management
 Smart infrastructure

Project development and funding

Feasibility studies
 3D city modelling and visualisation
 Community and stakeholder engagement
 Development of partnerships and funding
 Commercial strategy and management
 Ecosystems services assessment
 Analysis of social return on investment
 Health Impact Assessment

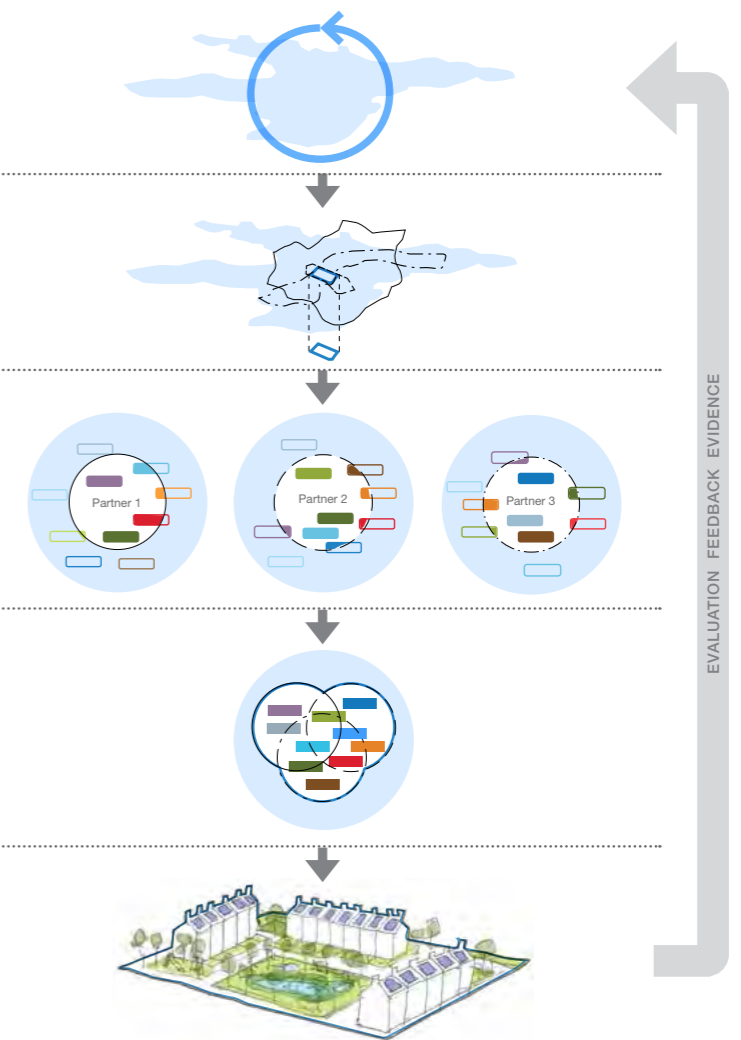
Project design and delivery

Water efficient buildings
 Green roofs and walls
 Water re-use networks
 Coastal management

Flood risk management
 Natural flood management
 Integrated drainage modelling
 Mechanical, Electrical and ICA design (MEICA)
 Resource efficiency and waste management
 River design and management
 Water supply and treatment
 Wastewater treatment
 Water resources management
 Hydrogeology and groundwater
 Hydropower and ground energy
 Planning applications
 Environmental services
 Post-project appraisal
 Managing Health & Safety

Partnership delivery

1. Understand the water cycle at catchment scale
2. Align with other drivers and development needs
3. Identify partners and understand their priorities
4. Build a shared case for investment and action
5. Delivery, maintenance, evaluation, feedback

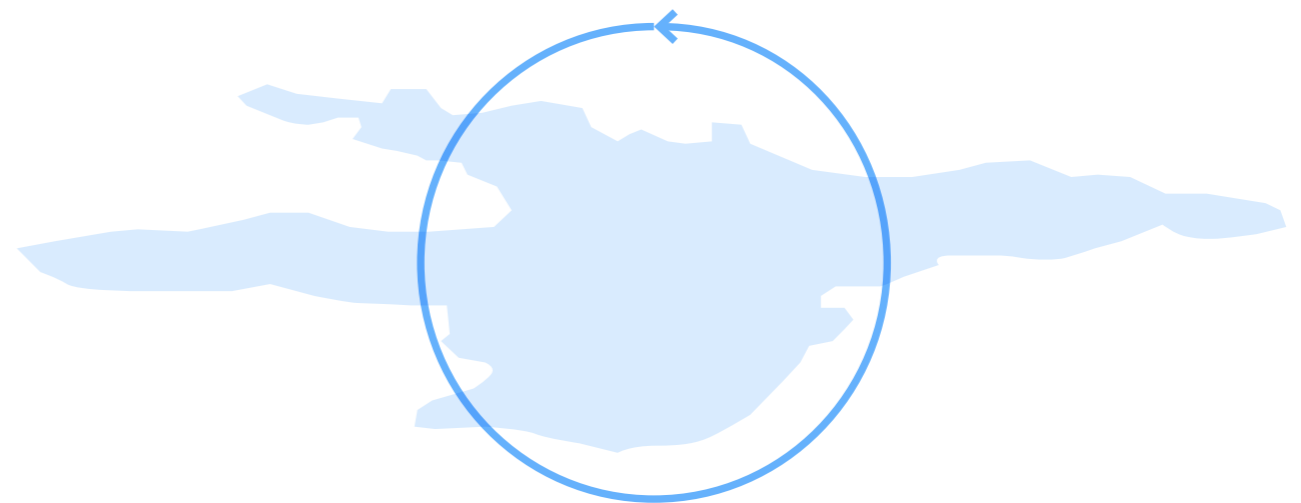


Partnership delivery

1. Understand the water cycle at catchment scale

The water cycle is a natural system, usually heavily modified by human socio-economic activity, such as agriculture, urbanisation and the wider impacts of climate change.

Analysis of the existing water cycle at catchment scale will identify high-level risks and benefits associated with its protection and enhancement.

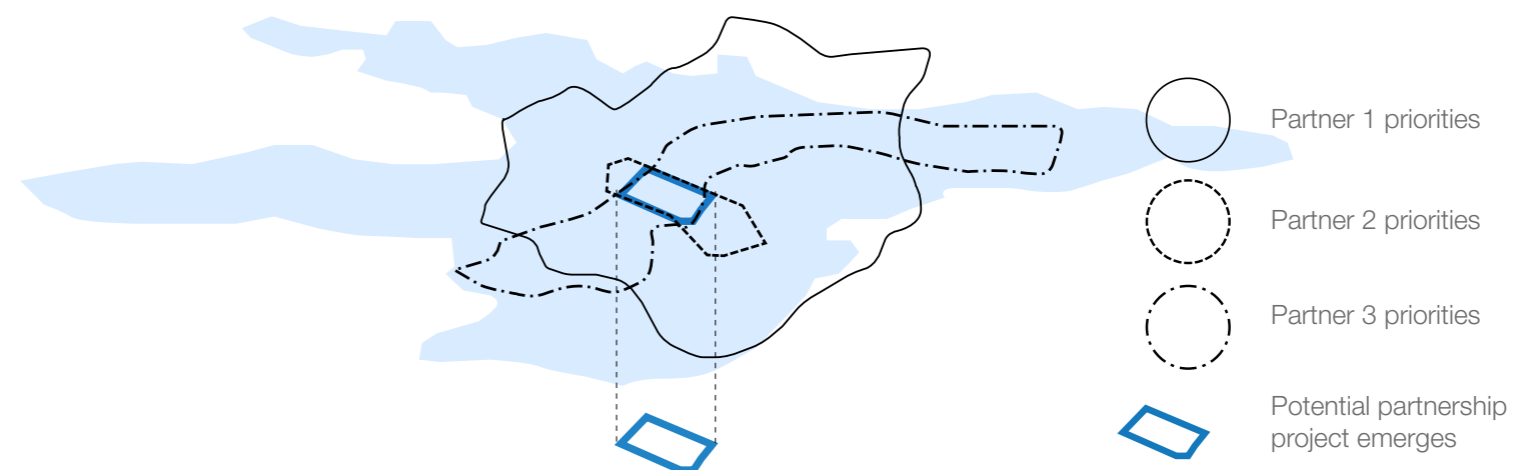


Partnership delivery

2. Align with other drivers and development needs

Water may not be the primary driver for all stakeholders. Water-related actions may come forward as a result of other priorities, such as delivery of green infrastructure, improved amenity or climate change adaptation.

Aligning the water cycle with other drivers, community priorities and potential investment/funding programmes will help to bring forward projects that are deliverable and maximise benefits to investors, the environment and wider society.

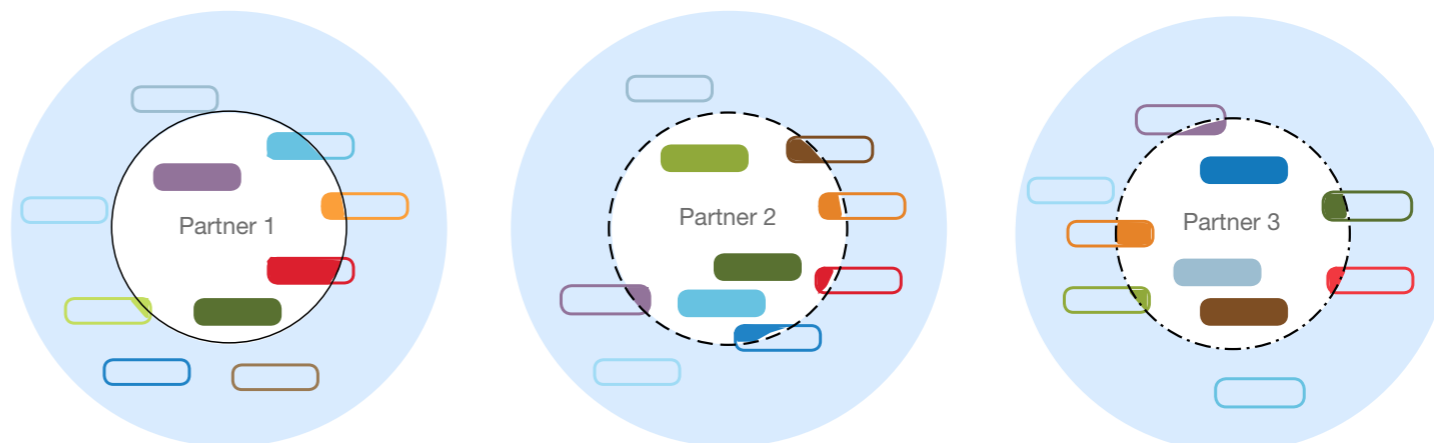
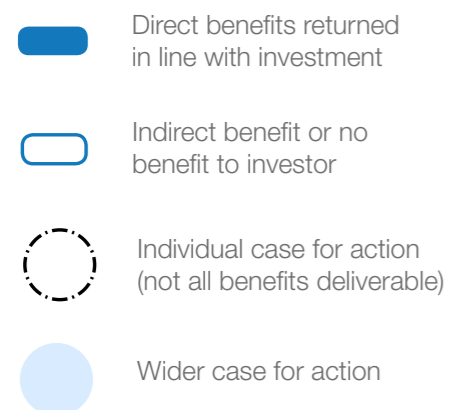


Partnership delivery

3. Identify partners and understand their priorities

Having identified areas where agendas overlap, potential partners can be identified. It is important to understand the priorities of each partner.

It is likely that each partner will have a partial case for action based on the direct benefits returned to their organisation. However, none is likely to be able to justify investment to deliver all of the potential benefits of a multifunctional water-related project. At this stage, predictive valuation of wider benefits using Payment for Ecosystem Services (PES), and Social Return on Investment (SROI) can help various partners to build a case.







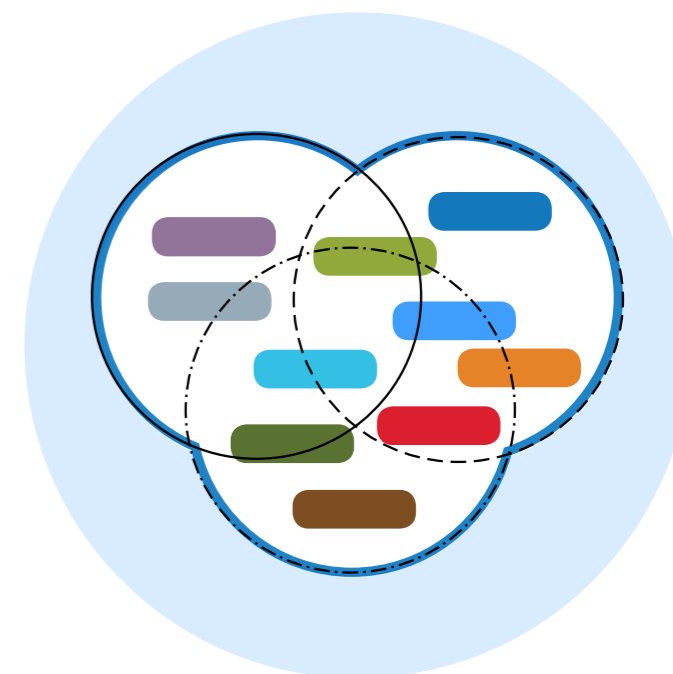
Partnership delivery

4. Build a shared case for investment and action

By formulating a joint project it is possible to develop a scenario where objectives are aligned and costs are shared in proportion to the benefits returned.

At this point it may be necessary to adjust the project objectives and scope and bring in other partners to bring expertise, share risk and investment costs. Through this process of collaboration and joint-working, an overall shared case for action and investment is created.

-  Direct benefits returned in line with investment
-  Individual case for action (not all benefits deliverable)
-  Wider case for action
-  Shared case for action - objectives, costs and benefits aligned between partners

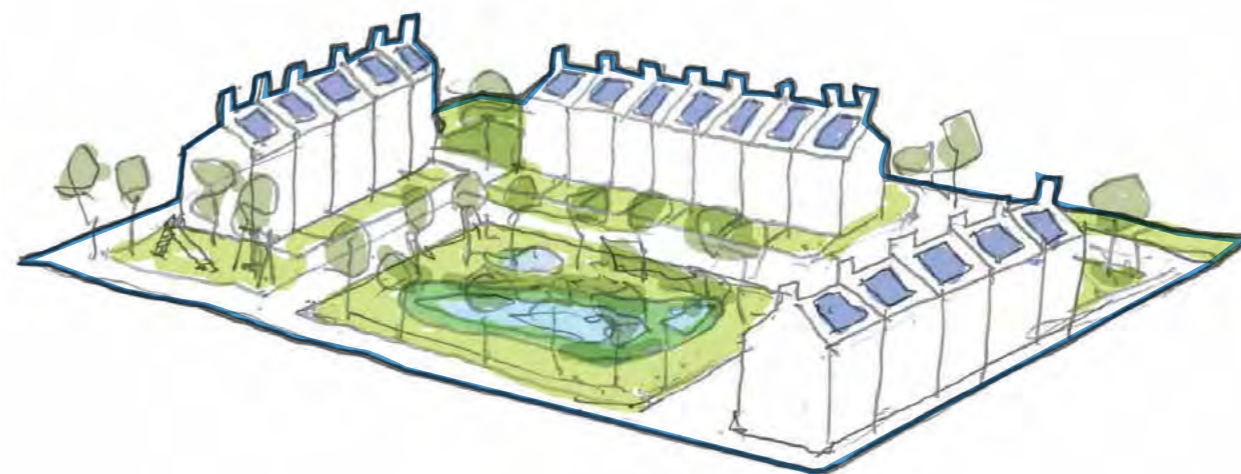


Partnership delivery

5. Delivery, maintenance, evaluation, feedback

It is important that whole life costs are considered when formulating projects and investment plans to ensure adequate budgets for ongoing maintenance. Delivery of projects on the ground will build an evidence base for multi-functional infrastructure projects.

Predictive and post-project evaluation is important. Alongside analysis of water management benefits, post-project evaluation of wider benefits using techniques like PES and SROI can help to build an evidence base for future projects..



Partnership delivery

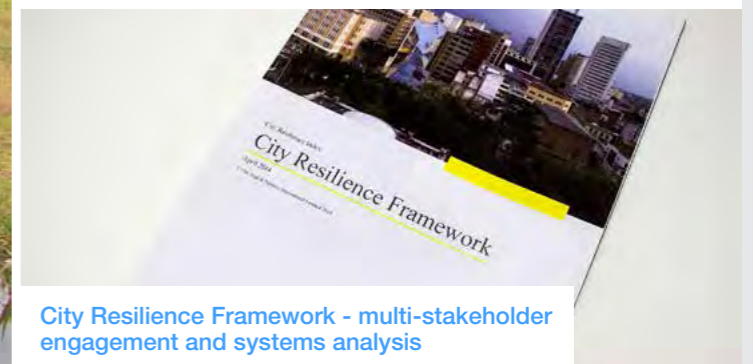
Selected projects:



Beam Parklands Habitat Creation - cross sector partnership funding & delivery, London



Cross-sector multi-stakeholder engagement for Sewer Rehabilitation, Melbourne, Australia



City Resilience Framework - multi-stakeholder engagement and systems analysis



Partnership Delivery of City Centre Flood Alleviation Scheme, Leeds UK

Selected projects – Africa

Project	Location	Read more
Guinness effluent treatment plant	Nigeria	
Site development and regeneration of Robben Island	South Africa	-
Water Risk & Sustainability Assessment, River Rwizi Catchment	Uganda	
UNEP Agri Business & Power Sector Sustainability Briefings	(Global)	



Case study

Guinness Effluent Treatment Plant, Benin, Nigeria

To assist Diageo in meeting their sustainability objectives and satisfying their local environmental commitments, Arup developed a strategy for treating the effluent discharging from five brewery sites across West Africa. Three of the sites are in Nigeria at Ogba, Benin and Aba. One site is in Cameroun and the fifth site in Kumasi, Ghana. Each of these sites produces a range of fermented and non-fermented drinks.



Client
Diageo plc

Case study

Site development and regeneration of Robben Island, South Africa

Robben Island, Cape Town, is a World Heritage Site, National Monument and National Museum. In order to support and accommodate the projected number of visitors, various infrastructure services, including water, needed to be upgraded. Arup conducted a feasibility study for this project, concluding that a range of works could be carried out.

A plan to rationalise the water system from a combination of groundwater, seawater and imported potable water from the mainland was devised. This would be accompanied by an alternative method of sewage treatment and disposal to replace the existing system of septic tanks and sea outfalls. The collection and disposal of solid waste was assessed and improved, including the upgrade of an existing waste incinerator. The road network was also addressed, repairing and reconstructing the existing roads for anticipated vehicle usage. As a result of the feasibility study, the upgrading was prioritised into two phases, the first of these tackling water and waste infrastructure, reservoirs and desalination. The second phase of the project was focused on road rehabilitation and stormwater drainage. Additionally, a sewer and pump stations were constructed along with septic tanks and a marine outfall and diffuser.

Client
Department of Public Works



Case study

Water Risk & Sustainability Assessment, River Rwizi Catchment, Uganda

The Uganda Ministry of Water and Environment, in partnership with GIZ Uganda and The Coca-Cola Africa Foundation are funding a project to improve community livelihoods and sustainable water management in the water-stressed River Rwizi catchment in western Uganda. Under this project, Arup carried out a 'shared water risk assessment' for the industrial, municipal, agricultural and domestic stakeholders.

The main economic activities are subsistence and commercial crop agriculture, livestock rearing, fish farming, tourism and local industry. 90% of the population is involved in subsistence farming, and commercial farming and irrigation are increasing. The National Development Plan 2040 aims to increase irrigation acreage nationally by up to 50%. If the plan is implemented, agricultural water demand in the catchment could increase from 20 million m³ each year to in 2011 to about 63 million by 2035. Arup identified the need for catchment-wide agricultural land management and farmer education programmes to mitigate the risks.

Client
GIZ Uganda



Case study

UNEP Agri Business & Power Sector Sustainability Briefings, (Global)

Arup was appointed by the United Nations Environment Programme Financial Initiative to develop, in conjunction with financial specialists across the globe, a risk assessment framework to support the management of water scarcity related risk associated with the agribusiness and power sectors. The commission encompassed a sector review of the characteristics of water consumption and trends, geographic review of the state of the water environment and identification of key local water challenges. Furthermore, we identified local current water use profiles in selected regions, highlighted case studies demonstrating best practice in water management and developed a performance framework to assist in understanding water scarcity risk.

The overall aim was to provide a standardised framework of water-related information-gathering while emphasising the need for a differentiation between different geographies and their respective local water and crop conditions to decision makers within financial institutions.

Client
UNEP FI



Selected projects – Americas

Project	Location	Read more
Bay Area Rapid Transit Sea Level Rise Adaptation Assessment	California	
Bay Meadows Stormwater Wetlands Creation	California	-
City of Rialto Water Due Diligence Monitoring	California	
Newport Beach Civic Centre and Park	California	-
Cedar Rapids Sustainability and Flood resilience planning	Iowa	-
Long Branch Sustainability Masterplan	New Jersey	
City Resilience Framework with Rockefeller Foundation	New York	
Hunters Point Public realm & Green Infrastructure	New York	
Newtown Creek Green Infrastructure Retrofit Projects	New York	-
New York City Transit Flood Resiliency	New York	
The Plus Pool - River water floating swimming pool	New York	-
Lake Mead water supply tunnel design	Nevada	-
Managing Water towards Zero Discharge	Mexico	-



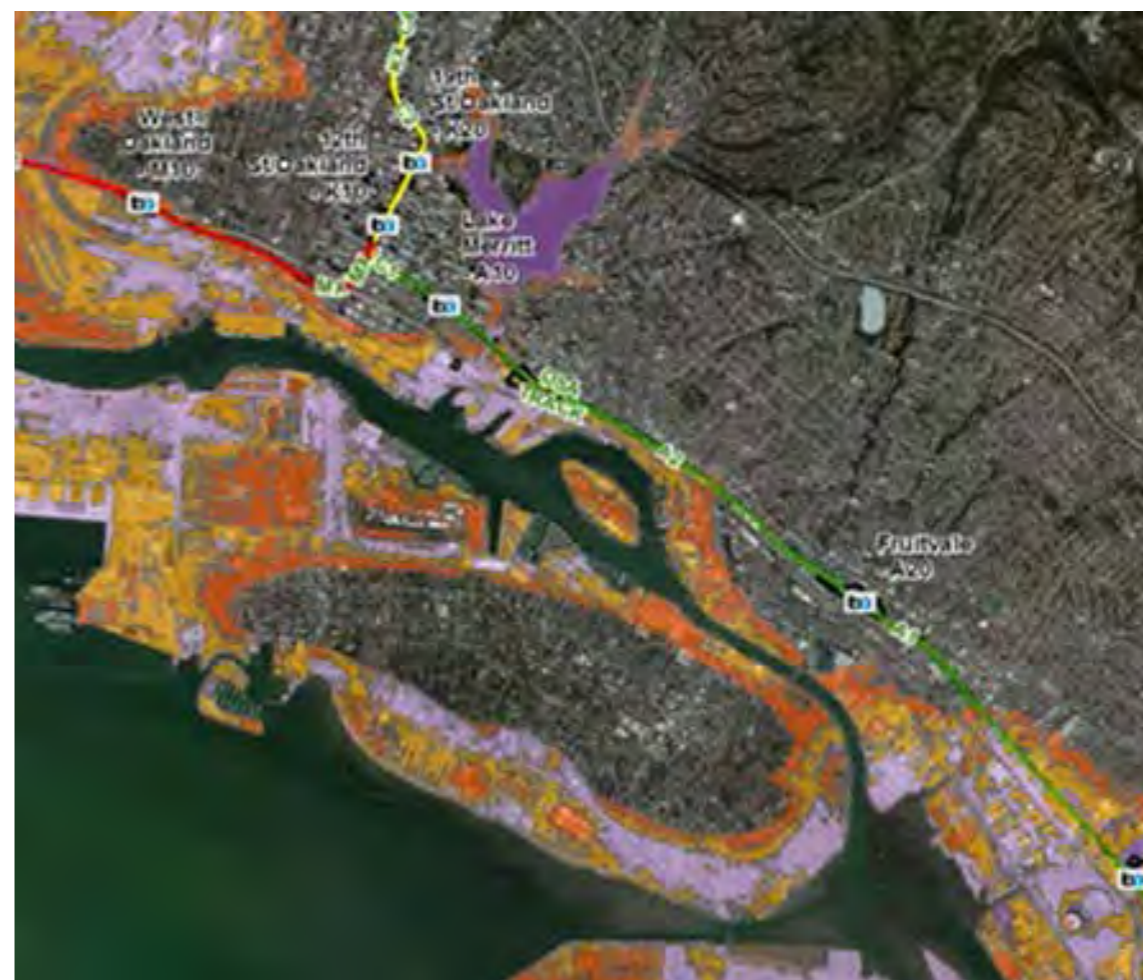
Case study

Bay Area Rapid Transit Sea Level Rise Adaptation Assessment, California

In a study funded by the Federal Transit Administration, we assessed the risk and developed adaptation strategies for climate change in the Bay Area for four Bay Area Rapid Transit (BART) assets.

We researched downpour, flooding, and sea level rise trends; assessed condition of BART assets; determined pathways of vulnerability; determined the risk of the climate hazards at each location; and produced and ranked adaptation strategies. This set of adaptation strategies will eventually be integrated with the existing BART asset management, infrastructure rehabilitation and facilities standards.

Client
Bay Area Rapid Transit District



Case study

Bay Meadows Stormwater Wetlands Creation, California

With sustainability at the front of the design, this previously impenetrable private property is transformed into a transit-oriented development. Arup's stormwater management strategy features a pond that does more than just detain and clean the stormwater.

Richly landscaped to create a passive recreation element within a 12- acre park, the pond also provides 600,000 gallons of year-round water storage vital to southern San Mateo's ability to respond to fires. Floodable recreation fields are integrated into the adjacent park to safely accept and shed detained water during and shortly after major storms without compromising the playing surfaces.

The new street grid provides greatly needed connectivity and alternative routes to relieve the existing congested road network. By listening, informing and learning, our team's credibility in sustainable design advanced the entitlements process and gained endorsements from the Sierra Club and the Greenbelt Alliance.

Client
Bay Meadows Land Company



Case study

City of Rialto Water Due Diligence Monitoring, California

Our initial scope was to advise equity investors in this landmark water P3 deal in California. Our unique mix of technical, commercial and financial specialists worked with the client to make a number of adjustments to the Concession that will ensure the highest quality project with minimal risk to bondholders. Our work enabled the project to gain a positive bond rating, raise the required debt financing and meet an aggressive financial close deadline. It is one of only a handful of successful water and wastewater P3s in the USA.

We continue to play an important role in making the project successful over the long term. Rialto should be a template for other similar deals in the near future.



Client
Table Rock Capital

Case study

Newport Beach Civic Centre and Park, California

The Newport Beach Civic Center and Park includes the new city hall building, community room building, council chambers building, parking structure, an extension to the existing library, and a pedestrian bridge all set within a new 20 acre park.

Our civil engineering team worked closely with the landscape architect, Peter Walker Partnership, to develop a series of vegetated bioswales and infiltration basins, which remove pollutants from stormwater runoff before it enters the city storm drain. These low-tech, low-maintenance solutions provide sustained treatment of stormwater, protecting both the onsite wetlands and Lower Newport Bay. All told, Arup provided structural, mechanical, electrical, plumbing, and civil engineering services, as well as lighting and telecom design, sustainability consulting, and stormwater quality management for the Newport Beach Civic Center and Park.



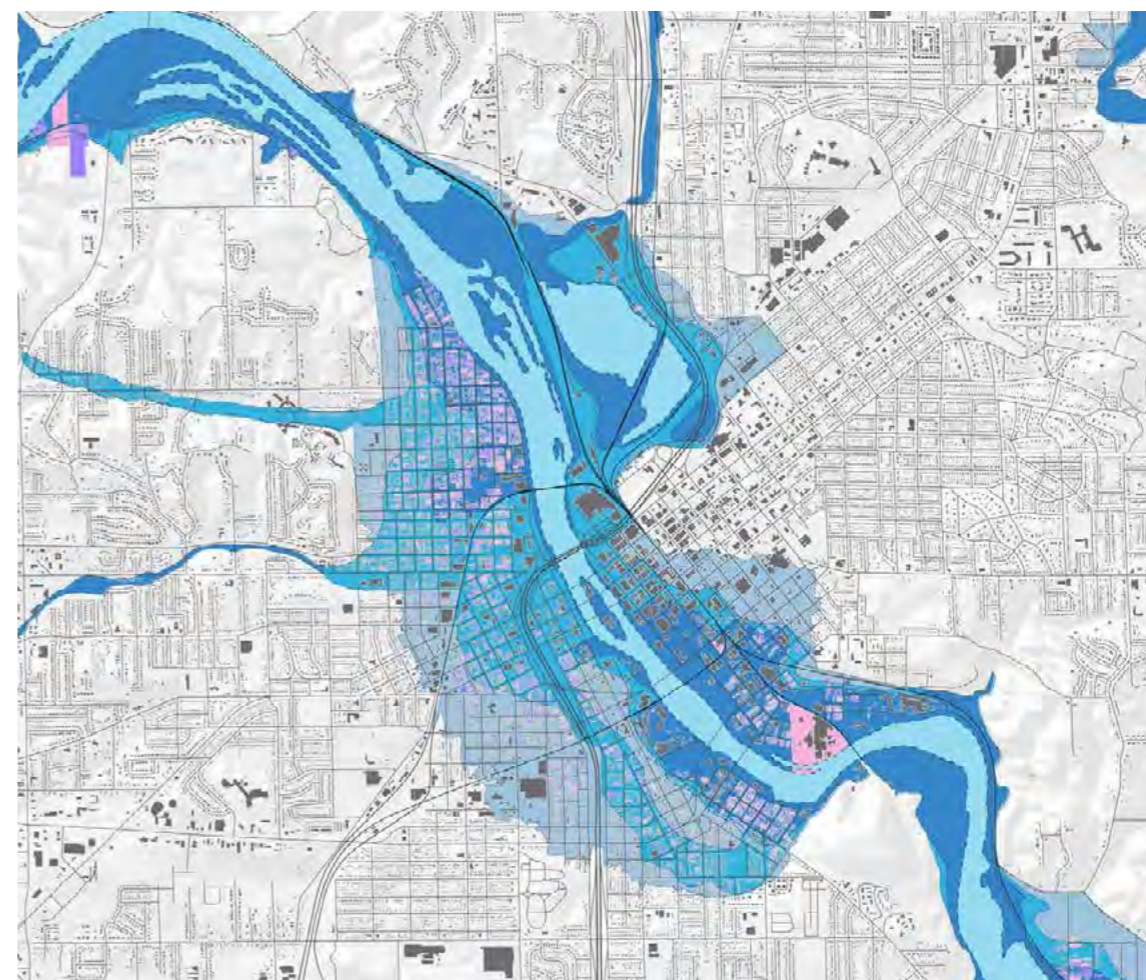
Client
City of Newport Beach

Case study

Cedar Rapids Sustainability and Flood resilience planning, Iowa

This is the first time Arup evaluated the sustainability performance of an existing city in the United States. In June 2008, Cedar Rapids, Iowa was badly damaged by flooding from heavy rains that caused the Cedar River to overflow beyond the 500-year flood plain. More than 7,000 homes, hundreds of businesses, community facilities and infrastructure were damaged or destroyed. Arup worked with the team to develop a series of plans to respond to the disaster.

The team, with significant community input, created plans including a Framework for Reinvestment and Revitalization, a series of Sustainable Neighborhood Plans for each of the affected areas and an overall Sustainability Plan for the City. Arup also developed a Sustainability Assessment Matrix booklet for the design team to provide preliminary guidance on integrating practical, actionable strategies into the planning process.



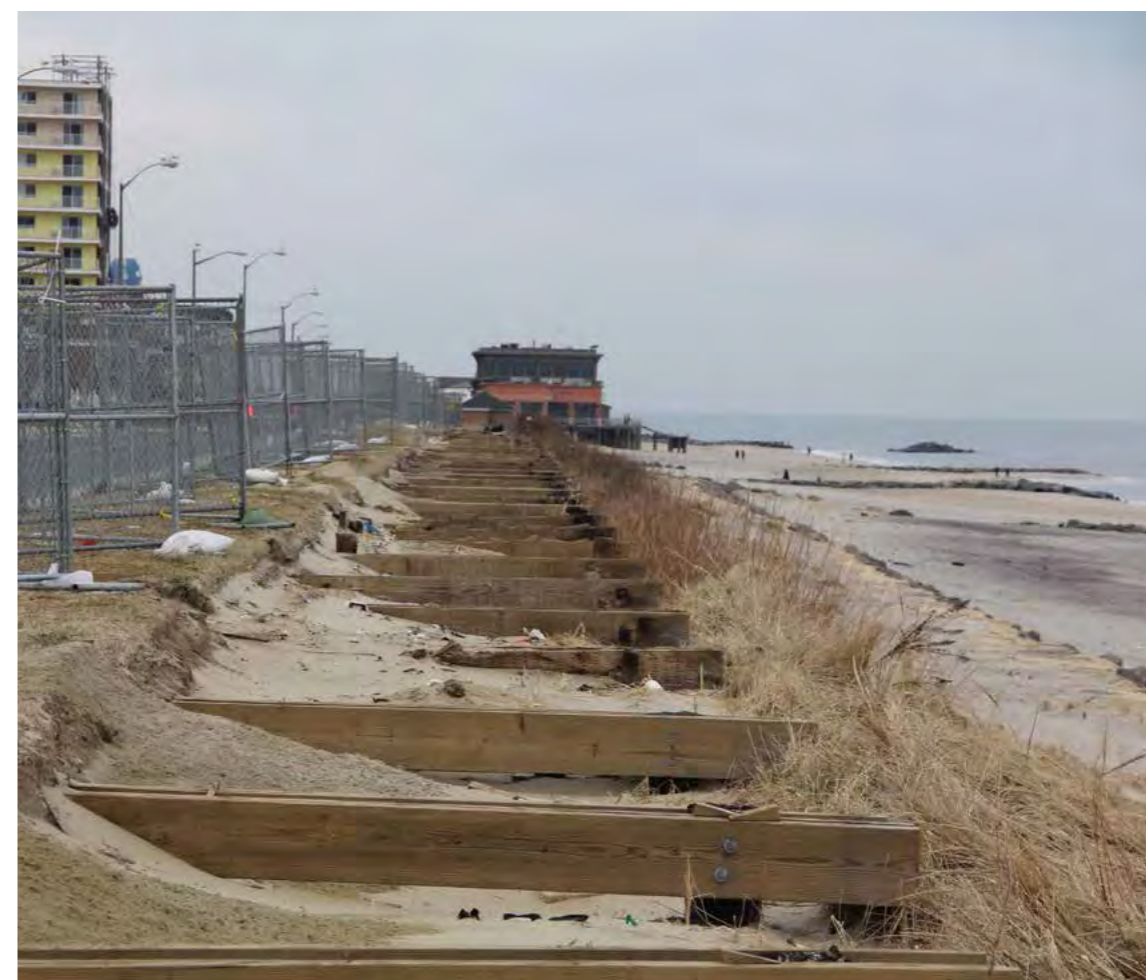
Client
Sasaki Associates, Inc.

Case study

Long Branch Sustainability Masterplan, New Jersey

Superstorm Sandy severely damaged the City's "first line" of coastal protection, namely, the Bulkhead, Seawall, and Bluff. Combination of storm surge and swell imposed impact damage and extensive scour which undermined the boardwalk, roadway, and promenade elements as well as the utilities supported by them. The City engaged Thompson Design Group, teamed with Arup, to study and design necessary Oceanfront Adaptation. The design team's initial step was to enumerate the extent of storm damage and develop a coastal defense strategy in order to "hold the line".

The study was based upon preliminary site observations after Sandy, a collation of non-survey data, and pertinent best practice measures from around the world to mitigate storm damage. As part of this work a preliminary condition evaluation of the shoreside structures and defensive was undertaken for the full two miles of shoreline. This included both detailed observations and recommendations for repair and hardening of the affected structures and infrastructure. The plans seek to engage FEMA in discussions and plans for the greater coastal defense strategy of New Jersey which will result in a sustainably restored waterfront amenity for Long Branch.



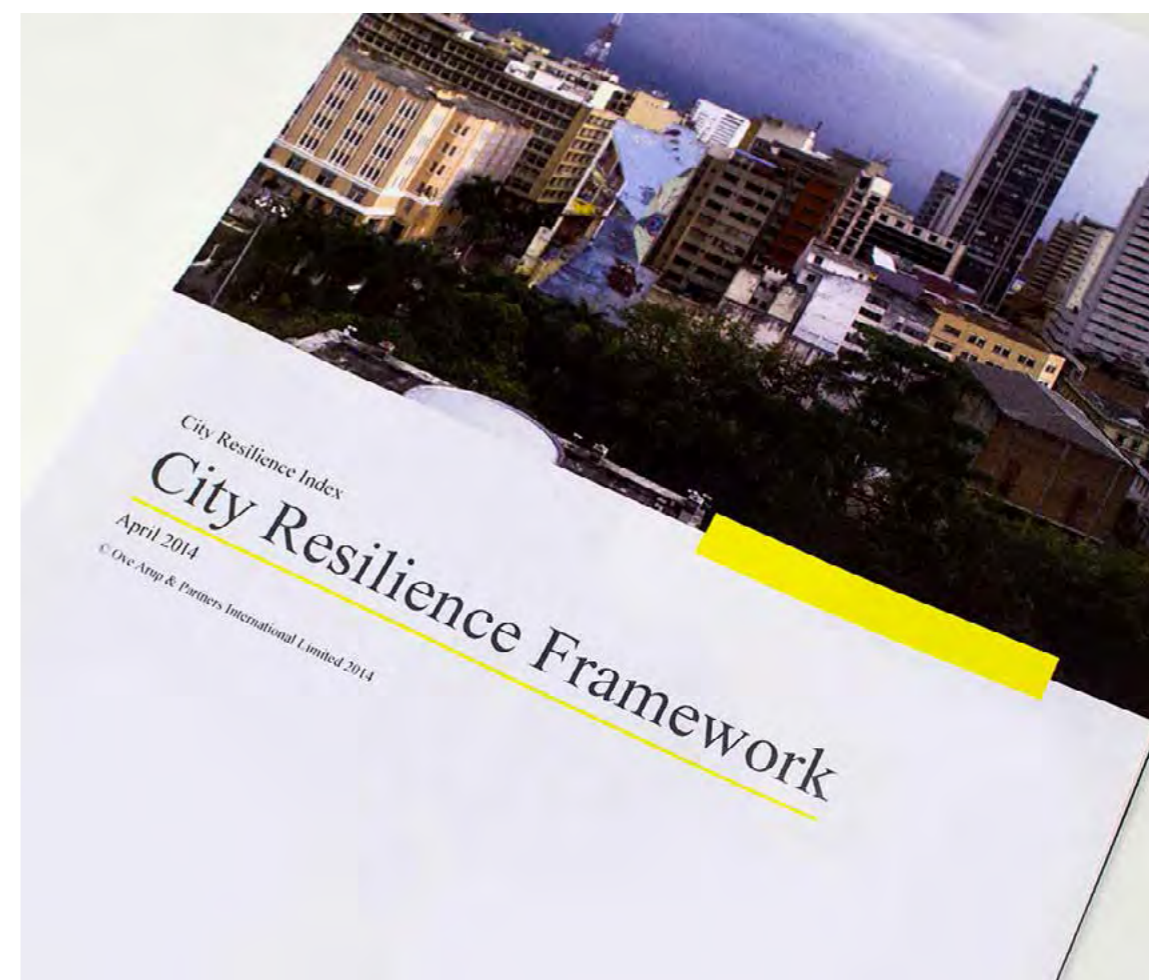
Client
Thompson Design Group

Case study

City Resilience Framework with Rockefeller Foundation, New York

At the seventh World Urban Forum (WUF7) in Colombia, Arup launched The City Resilience Framework, a tool to understand the complexity of cities and the factors which contribute to resilience can be understood and measured in order to shape urban planning, practice and investment.

This initiative, supported by The Rockefeller Foundation comprises 12 indicators that equate to a city's immune system. Collectively, they enable people to survive and thrive, and businesses to prosper whichever shocks and stresses may occur. We developed this tool after thorough fieldwork in Cali, Colombia, and Santiago, Chile.



Client
Rockefeller Foundation

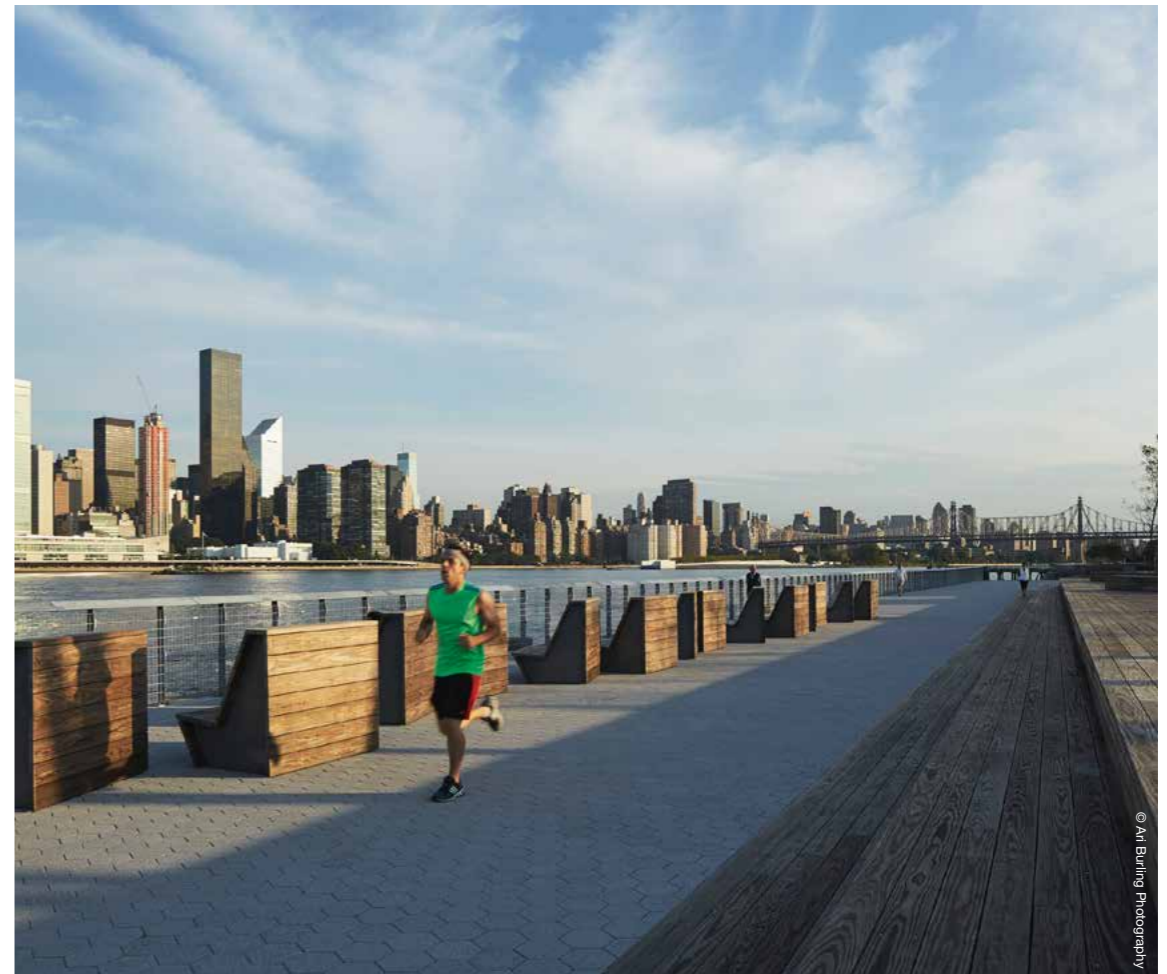
Case study

Hunters Point Public Realm & Green Infrastructure, New York

As one of the most ambitious waterfront projects in New York City's history, New York City Economic Development Corporation (NYCEDC) has rejuvenated and transformed Hunter's Point South into a prominent piece of the City's waterfront. Located on the East River in Queens, this new 12 hectare mixed-use neighbourhood development incorporates a waterfront park as well as housing, retail, schools and community space.

As prime infrastructure engineer on the development, Arup provided civil, structural and geotechnical engineering, sustainability consulting, lighting design and project management services. In consultation with over 70 independent entities, including multiple New York City agencies, Arup has implemented pedestrian-friendly streets, a network of bike lanes, and an urban landscape promoting public space. Through continuing coordination with these agencies, Arup was able to achieve consensus and deliver pilot water sensitive urban design interventions in the public rights of way, including sidewalk stormwater planters, porous pavement covering 33% of all sidewalks, and bioswales in the waterfront park.

Client
NYCEDC



© Art Buring Photography

Case study

Newtown Creek Green Infrastructure Retrofit Projects, New York

Arup is contracted to retrofit the public right-of-way with 578 bioswales or stormwater green streets within 531 acres of the Newtown Creek watershed in Brooklyn, NY. One of a number of commissions in this area, the Newtown Creek project design needs to be completed within one year, and construction completed within three years. Our specific tasks include leading the civil engineering work on tributary analysis, site selection, mobile data collection, GIS data management, detailed engineering design and design services during construction.

Arup developed an efficient workflow and delivery strategy to complete the design and construction of 578 ROW Bioswales within three years. The New York City Department of Environmental Protection (NYCDEP) intends to leverage the use of green infrastructure to reduce combined sewer overflows and to meet and exceed the water quality standards of New York City's waterways. NYCEDC will be managing the process for NYCDEP to achieve the goals set forth in the NYC Green Infrastructure Plan.

Client
New York City Economic Development Corporation



Case study

New York City Transit Flood Resiliency, New York

Hurricane Sandy had a devastating effect on New York City and its surrounding areas when it came ashore in October 2012. It exposed the weakness of much of the infrastructure on the eastern seaboard and drew the attention of many public authorities to matters of resiliency. We are undertaking several flood mitigation projects on behalf of New York City Transit in the upper and lower Manhattan areas as part of their Resiliency and Recovery initiative.

The projects include identifying vulnerabilities and designing mitigation measures at various critical assets on the subway network including stations, fan plants and tunnels. The projects address how to prevent flooding of the subway system under a Category 2 Hurricane and involve the implementation of current industry solutions and the development new and innovative approaches.



Client
New York City Transit

Case study

The Plus Pool - River water floating swimming pool, New York

What if children, athletes, keep-fit swimmers and families could all enjoy safe swimming in New York's East River? The idea that is moving this vision closer to reality is not to build a pool next to the river, but to float a pool on the river itself. The '+ Pool', as the project is called, would be the world's first floating pool to take water directly from a river and filter the water for swimming purposes. Our team studied the water quality of the NYC waterways and the water requirements for a pool. Using that information, we presented the architect with several filtration system options to test. Based on these filtration options, we considered modular structural configurations and integrated mechanical, electrical and plumbing systems to explore how the pool could be built and how it could operate. The proposed system uses an innovative combination of new and existing filtration technologies. Testing is underway to further develop and design a system to transform the East River's water into swimmable water that meets city, state and federal quality standards. In an area lacking beach access, the pool idea has attracted widespread local and international attention and is the centrepiece of an attempt to revitalise the East River waterfront.

Client
Family New York



Case study

Lake Mead water supply tunnel design, Nevada

Arup is pushing boundaries in tunneling technology on this project to ensure Lake Mead can provide water to Las Vegas even if lake levels continue to fall. Lake Mead currently has two intakes which fail to provide water once the dam level drops to 1,000ft above sea level. As drought conditions continue in the nation's south-west, Arup is leading the engineering design of a vital new intake tunnel at Lake Mead. It will safeguard future water quality and supply amid declining lake levels caused by drought.

The design concept for the intake structure in the lake bed was developed during the bid stage to reduce risk, cost and schedule. Construction commenced in summer 2008 with completion scheduled for late 2012. From an access shaft onshore, dug down to over 650ft, a tunnel boring machine (TBM) will cut a 20ft diameter tunnel three miles long to connect to a lake bed intake 330ft below the surface. Due to the depth of the tunneling beneath the lake bed, the TBM will be configured to work with high water pressures, at the limits of current TBM technology.



Client
Vegas Tunneling Contractors

Case study

Managing Water towards Zero Discharge, Mexico

Meeting ambitious targets for reductions in energy and water usage, carbon emissions and waste, Planta Milenio sets an industry standard in value driven sustainability. The 100,000m² Gillette manufacturing facility in Irapuato, Mexico, strikes the right balance between efficiency, sustainability and value.

As the project manager and design leader, Arup expedited each phase of the project by ensuring close coordination between all team members, and served as the client's single point of contact. The facility's water is 100% recycled, water is collected and treated before being reused. Other sustainability measures include: exploiting natural daylighting, using energy efficient systems and equipment, such as a water cooled chillers, dimmable fluorescent light fixtures and high efficiency motors on all major building equipment.



Client
Procter & Gamble

Selected projects – Australasia

Project	Location	Read more
Alice Springs Wastewater re-use for irrigation	Australia	-
Catchment Investment Efficiency Framework, Queensland	Australia	-
Climate Change Adaptation of Interconnected Water Infrastructure	Australia	-
Melbourne Main Outfall Sewer rehabilitation	Australia	
Preston Beach Masterplan & Water management strategy	Australia	
SEQ Smart Water Grid – Development of a Decision Support System	Australia	-
Upgrade of Melbourne Cricket Ground	Australia	
Thanlyin Star City Water Strategy, Yangon	Myanmar	
The Future of Urban Water, Scenarios for Water Utilities in 2040	Australia	



Case study

Alice Springs Wastewater re-use for irrigation, Australia

Arup's recommendation of a specific procurement methodology achieved an excellent technical and commercial outcome within the timeframe required. Water Reuse in the Alice – Dissolved Air Flotation Plant was a design, documentation and delivery management project conducted by a team led by Arup for the Northern Territory's Power and Water Corporation. The total project capital cost was \$6.8 million.

One of the advantages of the suggested approach included early engagement and collaboration with selected process providers to overcome the lack of pilot data in a cost effective manner. This enabled the civil and service details to be designed with certainty and make for more expedient civil and services tendering and contract execution phases with less scope for variations and increased costs. These advantages were confirmed during the delivery of the project.



Client
Power and Water Corporation (NT)

Case study

Catchment Investment Efficiency Framework, Queensland, Australia

Arup's study of two major catchment areas revealed the real value that results from environmental restoration, which is not accurately reflected under short term investment cycles. Natural watershed ecosystems such as forests and wetlands generate important economic services which maintain the quantity and quality of water supplies. They also help to mitigate or avert water-related disasters such as flooding and drought.

Arup led a study to assess how watershed interventions are effective in reducing loads of sediment and other pollutants entering reservoirs and treatment plants. Through the development of an economic framework, the study aimed to compare the long term costs of catchment intervention versus the avoided treatment and reservoir management costs. The study further reiterated that the resulting cleaner water requires less treatment and is therefore potentially more costeffective in the longer term than just built solutions.



Client
Queensland Bulk Water Authority (Seqwater)

Case study

Climate Change Adaptation of Interconnected Water Infrastructure, NSW, Australia

Arup's expertise in water engineering and flood modelling ensured a robust analysis of climate change adaptation options. Arup developed a framework for assessing climate change adaptation options for interconnected water infrastructure. The project was funded by the Commonwealth Department of Climate Change under the Coastal Adaptation Programme and used five case studies to identify and evaluate relevant approaches and economic appraisal methodologies.

Collaborating with stakeholders, Arup assessed existing and future risk to assets, identifying potential adaptation options and barriers, including engineering, managerial, legislative and corporate to develop a flexible adaptation pathway. Economic techniques were used to assess the costs of the climate change impacts and adaptation options. The findings were compiled into a framework supported by series of guidelines for widespread application by water infrastructure owners and operators.

Client
Sydney Coastal Councils Group



Case study

Melbourne Main Outfall Sewer rehabilitation, Australia

The project will determine what contribution the Main Outfall Sewer (MOS) and reserve can make to a regional integrated water management plan for the western suburbs of Melbourne, currently being developed by the Office of Living Victoria (OLV). It is a strategic and innovative piece of work that has the potential to be a key part of this regional plan, showcase the future of urban design and contribute to the realisation of the Melbourne's Water Future strategy.

The project will harvest significant amounts of stormwater which currently go to waste and pollute waterways and Port Philip Bay for reuse by the community. Approximately 3.5% of Melbourne's current drinking water demands. Arup has brought a multi-disciplinary team to deliver the project including water, landscape, economics, community consultation and stakeholder facilitation experts into a single seamless service offering.



Client
Melbourne Water Corporation

Case study

Preston Beach Masterplan & Water management strategy, Australia

Arup prepared a comprehensive water and wastewater strategy as part of an integrated masterplan to extend an existing township in Preston Beach, Australia. Located on the coast, with sensitive habitat, hydrology, geotechnical and environmental issues, the implementation of water sensitive urban design was central to restoring and enhancing the sensitive ecosystem in the area, whilst complementing natural drainage patterns and integrating stormwater management into the landscape.

The water strategy was developed to provide a high level of flood protection to the area, and ensure a sustainable supply of water which significantly reduces water demand. The strategy incorporates measures such as wastewater recycling which helps maximise the synergy between managing the supply of water with other benefits to ecology and landscape.



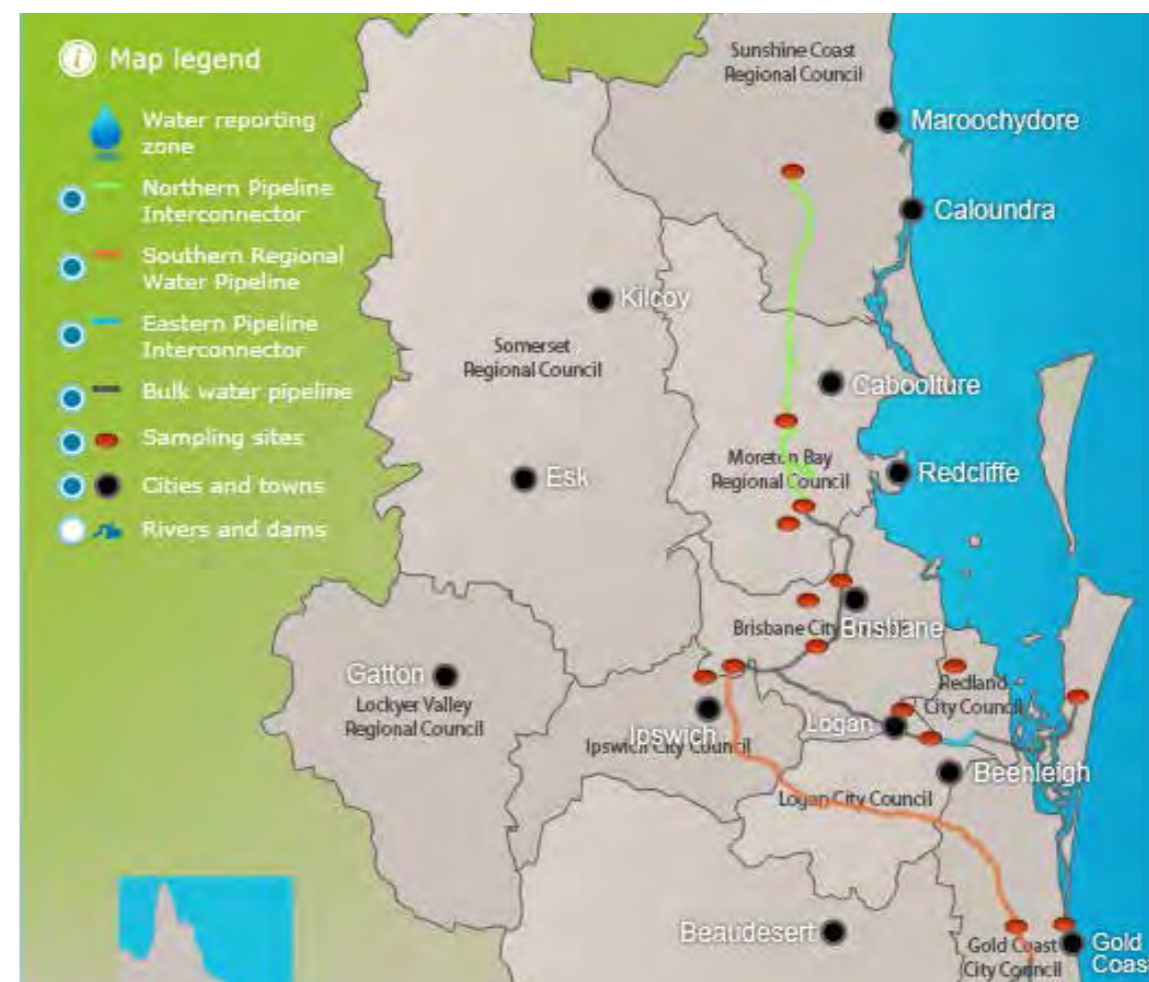
Client
Preston Beach Developments JV Pty Limited

Smart Water Grid decision support, Adelaide, Australia

Arup's commitment to long-term sustainability recognises technology is an integral part of managing scarce water resources where smart grid technology is seen as playing an integral role. In the current climate of variable water supplies, rising costs of supplying and delivering water, it is becoming critical that water authorities find innovative and cost effective ways to secure water and distribute at lower cost while providing the required level of water security.

SEQ Water Grid Manager manages strategic operations in relation to water delivery and engaged Arup to develop a Decision Support System (DSS) for the purpose of optimising the water grid. This form of 'smart grid optimisation' is a great opportunity to change the way water is managed and to provide the level of transparency required in providing safe, cost effective and reliable drinking water.

Client
SEQ Water Grid Manager



Case study

Upgrade of Melbourne Cricket Ground, Australia

The Yarra Park Water Recycled Facility was designed to meet the requirements of the Melbourne Cricket Club and the various regulators, with the water used to provide secure, long-term sustainable supply to the heritage listed Yarra Park, Punt Road Oval and the iconic Melbourne Cricket Ground. The 600m³/day sewer mining plant comprises inlet screening and grit removal, biological nitrogen removal, chemical phosphorus removal and membrane bioreactor, followed by low pressure ultrafiltration, UV disinfection and chlorination.

The plant was designed to provide two distinct modes of operation, summer and winter, which allows lower volumes of recycled water to be produced during winter, as well as varying the nutrient removal levels when irrigating. Our team provided multidisciplinary services on this A\$15m project developing the functional design and performance-based specification for the Class A Recycled Water Plant. In addition to the treatment plant, Arup undertook the design and specification of the recycled water purple pipe system within the MCG to transfer the Class A water around the ground.

Client
Melbourne Cricket Club



Case study

Thanlyin Star City Water Strategy, Yangon, Myanmar

This was the first water project that the water team undertook in Myanmar. The scope of the work included developing a comprehensive potable water strategy for a new residential development called Star City, which is located just outside the capital, Yangon.

The study focused on identification of existing water sources and management practices; groundwater analysis, review of system demand and reliability; proposing possible sustainability initiatives including recycling, and proposing short, mid and long term solutions (including desalination) for a potable water supply for an ultimate population (2020) of 25,000 residents. This is a strategic opportunity to gain experience in a country which has only very recently opened up to international firms to conduct business.

Client
SPA Project Management Ltd



Case study

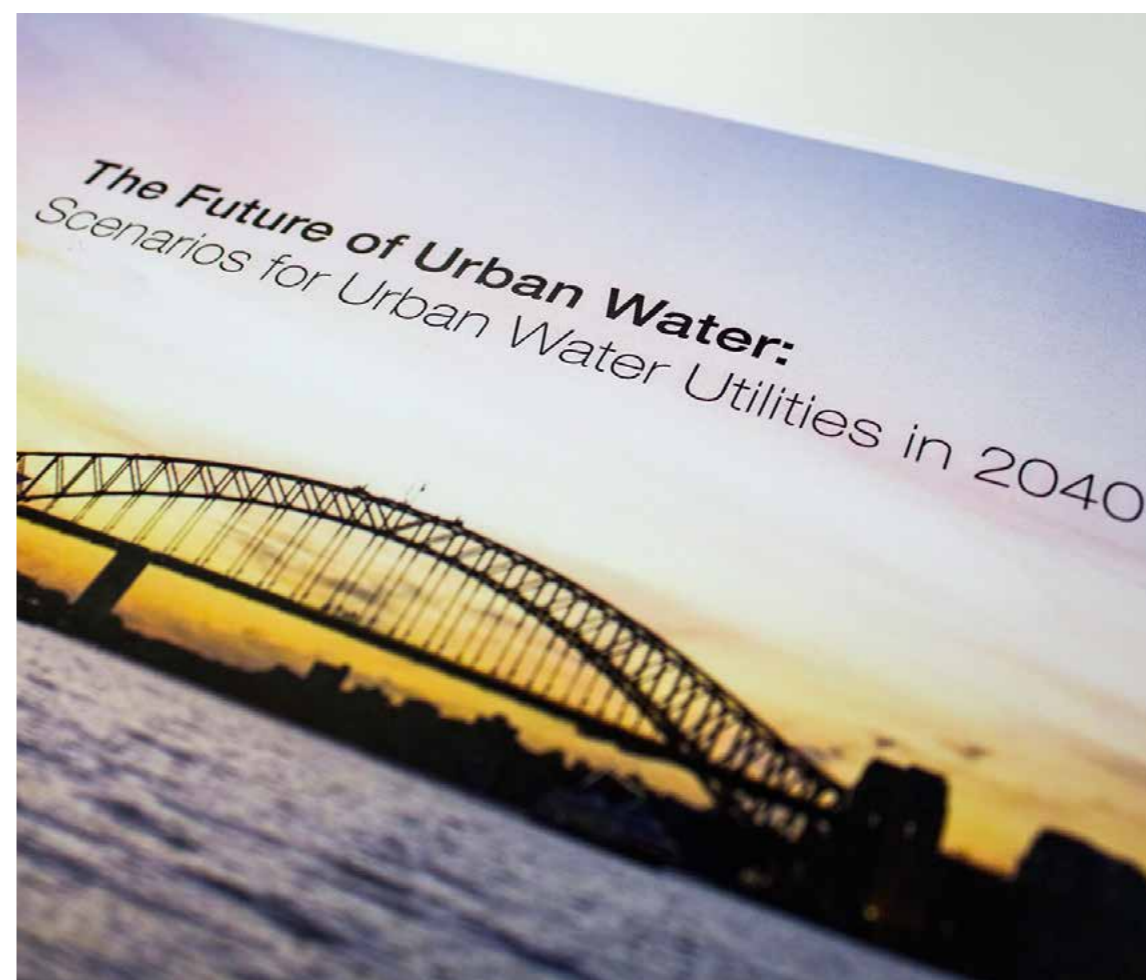
The Future of Urban Water: Scenarios for Water Utilities in 2040

The Future of Urban Water: Scenarios for Water Utilities in 2040' depicts four plausible scenarios for the future of urban water utilities in 2040. Using Sydney as a reference city, the report explores how a wide range of social, technological, economic, environmental and political trends could shape our urban water future.

Key questions asked by the study include: How can we meet the water needs of a rapidly growing urban population? Can we provide equitable water services in a world increasingly faced with water scarcity and environmental degradation? How can we achieve this without further compromising the planet's ecosystem?

'The Future of Urban Water: Scenarios for Water Utilities in 2040' is the result of a jointly funded collaboration between Arup and Sydney Water. The programme explored trends and future scenarios for the future of urban water utilities in 2040. It was delivered and managed by Arup, in close collaboration with experts from Sydney Water.

Client
Sydney Water



Selected projects – East Asia

Project	Location	Read more
Guide on climate change resilience of Urban Water, Wuhan	China	-
Hangzhou Wetlands Masterplan	China	
Flood Risk Assessment	Hong Kong	
Harbour Area Wastewater Treatment scheme	Hong Kong	-
Sewage Sludge Incinerator and Energy Centre	Hong Kong	-
Enhancing Climate Resilience of Gorakhpur City	India	
Genting Sewage Treatment Plant	Malaysia	
Water Sensitive Planning and Urban Design, Songdo City	South Korea	-
C40 UrbanLife Workshop Ho Chi Minh City	Vietnam	



Case study

Guide on climate change resilience of Urban Water, Wuhan, China

Arup's integrated strategic and technical expertise gave Wuhan stronger guidance in combating climate change, maximising long-term benefit for the city. Stakeholder engagement is crucial to the analysis of climate change resilience for water infrastructure in Wuhan. To facilitate better understanding of climate conditions, Arup conducted workshops for information input and developed the Rapid Resilience Wuhan Methodology for assessment of urban vulnerabilities.

The report identified major factors which affect current water infrastructure. This determined the public's susceptibility to climate-related factors and adaptations that have the potential to increase resilience to climate change without compromising present day functionality. The guide will have a wider applicability to other cities in China and possibly beyond, and will target a broad professional audience and the general public.



Client
Asian Development Bank

Case study

Hangzhou Wetlands Masterplan, China

Arup's conceptual masterplan brings a broad vision for diverse habitat creation and conservation as well as wetland tourism, managed agriculture and aquaculture, education and research, eco-resorts and aquatic recreation zones. Using microcosmic organisation of wetland ecosystems, Arup created macrocosmic harmony for one of China's largest ecological planning projects – at just over 55km². Specific studies of local wetland systems, endangered species, hydrology and flood control, transportation and economics supported the masterplan's development.

The vision at Jianghai Wetlands is to create greater ecological diversity than other wetlands in the region by establishing large areas of five unique wetland types including salt marsh, freshwater marsh, riparian floodplain forests, swamp and wet meadows. While the primary intent of the plan is to increase populations of threatened and endangered species it will also bring unique outdoor recreation and educational experiences to new city residents and visitors.

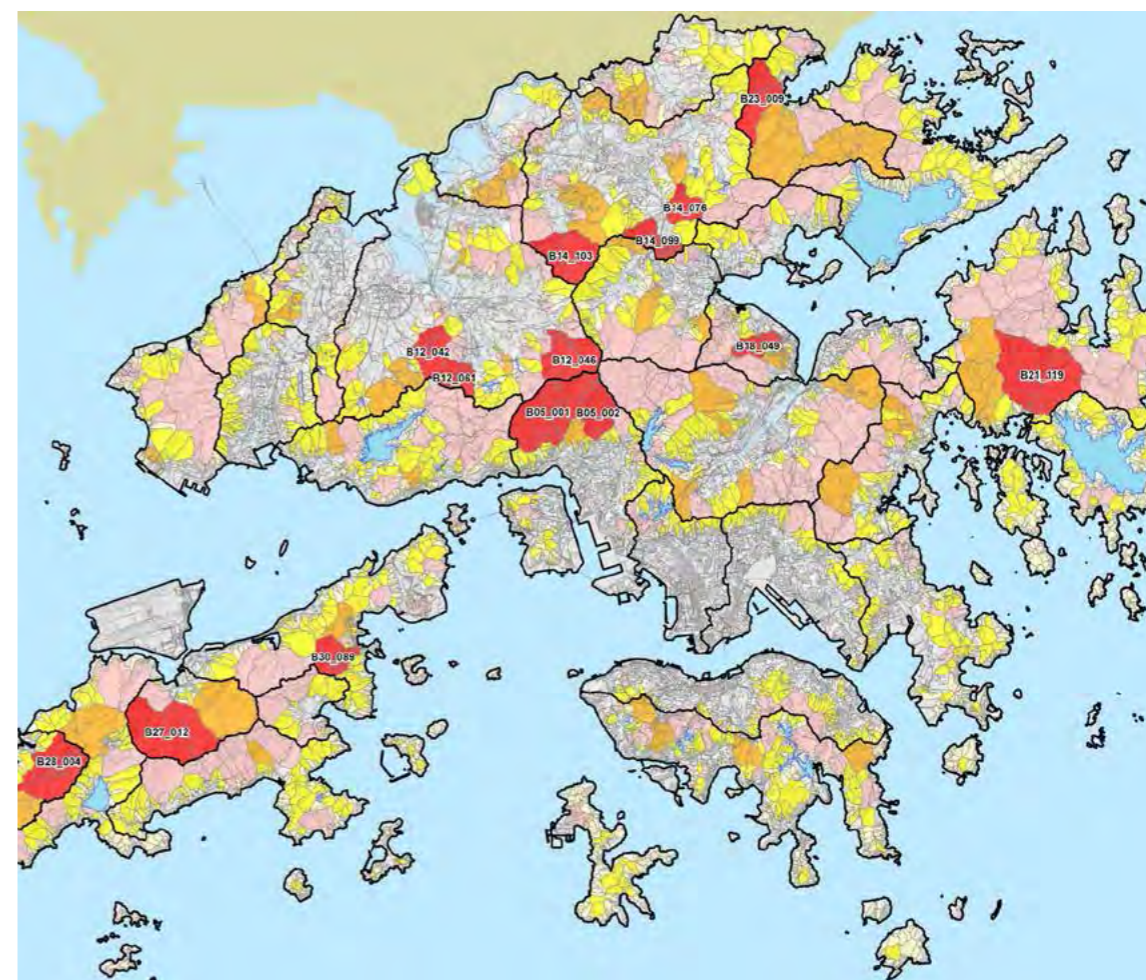
Client
Hangzhou Jianghai wetlands
planning and protection headquarters



Case study

Flood Risk Assessment, Hong Kong

The study will assess the potential flood risk to people living in the vicinity of 14 rural catchment areas (RCAs) across Hong Kong. The project includes various stages such as the prioritisation and verification of river reach flood risk identified, hydrological and hydraulic calculations and modelling, formulation and design of flood warning system as well as the development of a long term improvement scheme to mitigate flood risk for all 14 RCAs.



Client
Hong Kong Drainage Services Department

Case study

Harbour Area Wastewater Treatment scheme, Hong Kong

Arup's integrated design team is further improving the water quality of Victoria Harbour for the benefit of the community and surrounding environment. We are responsible for the design and construction management of the upgrading of eight Preliminary Treatment Works along Hong Kong Island and the sewage treatment works on Stonecutters Island.

Arup achieved considerable savings for the client by value engineering the design peaking factor to optimise the sewage tunnel sizes while maintaining the return period for overflow occurrences to an acceptably low level. This resulted in substantial capital and operational savings with no detrimental effect on the water quality of Victoria Harbour. HATS Stage 1 currently handles 75% of wastewater from both sides of the Victoria Harbour – and the works under HATS Stage 2A will handle the remaining 25%.



Client
Drainage Services Department, Hong Kong Government

Case study

Sewage Sludge Incinerator and Energy Centre, Hong Kong

Arup's design team of experts developed a self-sufficient and sustainable solution to dispose of up to 2,000 tonnes/day of sewage sludge. Procured under a design-build-operate (DBO) contract this will be the largest sewage sludge incinerator in the world.

The plant will be self-sustaining: heat generated in the incinerators will be recovered for power generation and surplus power will be exported to the regional electricity grid. Potable and processed water will be supplied by processing sea water through a desalination plant. Rainwater will be collected for non-potable use, and waste water will be treated and re-used on site with a very low impact on the environment.

Arup, together with the JV overcame the challenge of constructing on a previous pulverised fuel ash lagoon, and achieved the client's desire for an iconic architectural design whilst meeting stringent building and fire services requirements for the process buildings.

Client
Veolia-Leighton-John Holland JV



Case study

Enhancing Climate Resilience of Gorakhpur City, India

Gorakhpur faces annual flooding and waterlogging due to an inadequate drainage system, a lack of on-going maintenance, and an observed rise in seasonal rainfall intensity. Flood risk is further increased by urbanisation processes, which increasingly lead to the filling and development of the many existing lakes located in peri-urban areas around the city which store flood water in rainy season. Through funding provided by the Rockefeller Foundation as part of the Asian Cities climate Change Resilience (ACCCRN) program, Arup is working with Gorakhpur Environmental Action Group (GEAG) to develop planning and design guidelines to improve the Ward level drainage system, and developing a concept design for drainage improvement works specifically for Mahewa ward.

In addition, we carried out a hydrological study for Gorakhpur City, focussing on preserving peri-urban areas as a flood buffer against seasonal flooding and waterlogging. We presented the findings from InfoWorks ICM model which shows city has high risk of flooding even with a moderate rainstorm and recommended to prepare a comprehensive drainage master plan for the city.

Client
Gorakhpur Environmental Action Group



Case study

C40 UrbanLife Workshop, Ho Chi Minh City, Vietnam

As strategic advisor to the C40 Cities Climate Leadership Group (C40) and its partner the Clinton Climate Initiative, Arup is providing strategic advice on urban resilience through a series of action-orientated 'UrbanLife' workshops. As part of the series, a workshop took place in Ho Chi Minh City focussed on flood management and climate resilience.

Due to its coastal location and low-lying terrain, the city is ranked as being one of the most vulnerable to climate change by the World Wildlife Fund. Arup's multidisciplinary experts addressed the city's current difficulties in responding to flood risk and water resource management and proposed ways to build resilience, which will contribute to its water masterplan. Arup produced a report and animation containing research analysis and recommendations for the next steps that could be replicated in other cities around the world.



Client
C40 and the Clinton Climate Initiative (CCI)

Case study

Genting Sewage Treatment Plant, Malaysia

The Genting Highlands Resort is a major resort of the Genting Malaysia Berhad organisation (GMB) located approximately 50 kilometres east of Kuala Lumpur. A major expansion to the facilities, which will include 3,000 new hotel rooms, a gaming area and a theme park, has been planned. This expansion is expected to attract some 100,000 extra daily visitors.

Arup has been appointed by GMB to carry out the feasibility study, design and construction supervision of a new sewage treatment plant with effluent re-use facilities at Genting Highlands. Due to site constraints, the plant is proposed to be built in a multi-storey structure at the top of a cliff with a treatment capacity of 150,000 population equivalent, mainly to cater for the new development. The work is a joint project between Arup Jururunding, Malaysia and the Hong Kong office and our services include process, mechanical, electrical, control, instrumentation and automation systems and hydraulic, structural, geotechnical and building services engineering.



Client
Genting Malaysia Berhad Sdn

Case study

Water Sensitive Planning and Urban Design, Songdo City, South Korea

The 101-acre Central Park provides a multifunctional oasis for the Songdo International Business District, a new city built on 1,500 acres of land reclaimed from the Yellow Sea.

Arup's scope for the park included a major seawater canal; a remediation strategy to provide a plantable landscape on a platform of sea-dredged soils; sustainable irrigation via rainwater harvesting; pavement analysis; drainage, utility, and lighting design; a three-level underground parking garage; and two footbridges spanning the canal. We have also been heavily involved in a number of additional aspects of the New Songdo City development.

The multiple intended functions of the canal – transport artery; waterfront development space; natural cooling mechanism; biodiversity facilitator – involved often-conflicting drivers such as transport, sustainability, and water quality and ecology. This required a highly creative, complex design process - a collaborative effort coordinating the work of more than 10 Arup offices worldwide.

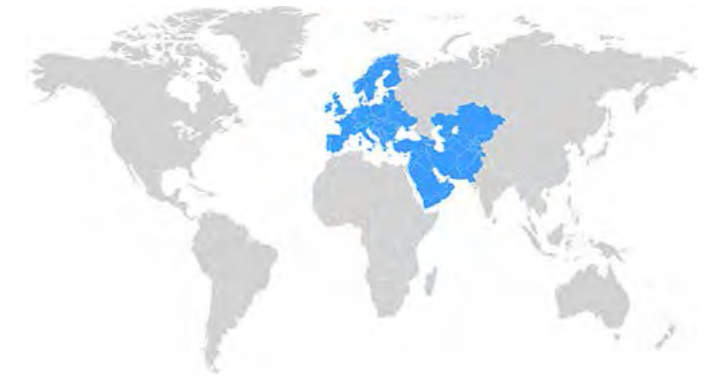
Client
Gale International Limited



Europe &
Middle East

Selected projects – Europe & Middle East

Project	Location	Read more
Integration of Ecosystem Services within WFD and FD, UK	Brussels	
Czarna Staszowska and Nida River Flood Programme, Krakow	Poland	
Recreational Masterplan of Dobczyce Reservoir	Poland	-
Upper Raba Spawning Grounds River Restoration	Poland	-
Vistula Dam Hydropower Scheme	Poland	-
Bursa Wastewater Project II	Turkey	



Case study

Integration of Ecosystem Services within WFD and FD, UK

Arup developed guidance on how to integrate Ecosystem Services within the next WFD planning cycles and as part of the implementation of the FD. EU Member States have been urged to improve implementation of the Water Framework Directive (WFD) and Flood Directive (FD) to relieve pressure on river basins. This will be achieved by utilising best available techniques and mitigation measures to reduce the EU's vulnerability to floods and droughts, support biodiversity and soil fertility as well as improve the status of waters.

Arup is developing practical guidelines that can help river basin managers identify, quantify, value and optimise Ecosystem Services as well as consider payments. The practical guidelines are based on the river basin managers' experiences of implementing the WFD and FD to date.



Client
European Union DG Environment

Case study

Czarna Staszowska and Nida River Flood Programme, Krakow, Poland

In the view of implementation of the Flood Directive Arup is preparing a flood protection scheme for the catchments of the Nida River and the Czarna Staszowska River, both tributaries to the Vistula River. Significant flood losses have been noted within the catchments in recent years.

The aim of the project is to propose the best option to minimise them. The scope of work is covering: site surveys, hydraulic modelling, GIS analysis, concept design, flood extent assessment, damage assessment, flood protection program proposal, and Strategic Environmental Assessment.



Client
RZGW Krakow

Case study

Recreational Masterplan of Dobczyce Reservoir, Poland

Arup undertook preparation of masterplan for the largest clean water reservoir near Krakow – Dobczyce Reservoir. For almost 20 years the reservoir has been closed to any public activities and protected by significant protection zone. Arup investigated options for opening up the reservoir for public recreational use without causing any damage to the water environment and water quality.

Our team of water, road, environmental, GIS engineers and economists and landscape architects analysed existing information about the reservoir gathered from 20 years, including water quality test results, modeling results of pollution flow, bathymetry data, environmental data and existing socio-economic context. We investigated the potential for ecotourism, and integration of leisure activities that could be implemented in sustainable and low cost with no harm to natural environment and no threat to water supply for Krakow Municipality.

Our team worked closely with the Client, local communities and stakeholders in order to deliver a short and long-term sustainable strategy and phasing plan for the reservoir.

Client
MPWiK in Krakow



Case study

Upper Raba Spawning Grounds River Restoration, Poland

The natural character of the Raba River, between Lubien and Stroza has been modified by development of the banks, floodplains and dams at its tributaries. These modifications caused deterioration of the in-stream storage capacity of the river, damages to the environment of fish, manifested by high water temperatures in the summer and impeded access of protected fish to spawning grounds in tributaries of the Raba River.

Arup proposed innovative ways to reverse the degradation which included removal of obstacles, reconstruction of biological structures, securing borders of the channel of free migration by planting dense tree buffers and upbuilding crowns of natural riffles to re-establish the dynamic equilibrium of the river. Lowering the existing dams will restore the continuity of the channels and of habitats for organisms living in it and allows the fish to pass through the reconstructed cascades.



Client
"Ab Ovo" Association

Case study

Vistula Dam Hydropower Scheme, Poland

The existing Wloclawek dam reservoir, if released may contaminate a large part of the lower Vistula, the main Polish river. Polish parliament passed a decision to support the existing Wloclawek dam which is at risk of failure due to river bed erosion. The solution that Arup was asked to study and design is raising of downstream water level by construction of a new dam. Located in the protected area of Natura 2000, this is an extremely environmentally sensitive project.

The client, Energa S.A.- who is the hydropower operator of the existing plant on Wloclawek Dam, is an important energy holding in Poland, with ambition to be a leader in renewable energy production and innovation. Arup scope included study of potential locations, site investigations and concept development for selected sites. Multi-criteria analysis was carried out to support final decision and an Environmental Impact Assessment was prepared along with an economic and financial Feasibility Study. A detailed environmental compensation plan was developed based on Water Framework Directive and Habitat and Birds Directive requirements. One of its key elements was design of a unique, several kilometers long by-pass gravel-bed river channel for fish migration

Client
ENERGA SA



Case study

Bursa Wastewater Project II, Turkey

Located in western Turkey, to the south of Marmara Sea, Bursa is the fourth most populated metropolitan centre in the country. The city was the first Ottoman capital and holds important industries and cultural heritage. Since 2005, the service area for Bursa Water and Sewerage Administration General Directorate (BUSKİ) was expanded by more than tenfold, with the population nearly doubling. BUSKİ, who received a loan for Bursa Wastewater Project II from the EIB, allocated part of this loan for the contract for the technical assistance and consulting services for the second stage of the Bursa wastewater project.

Arup, together with Temelsu, (forming the 'AR-TEM' joint venture) is providing technical assistance and consultancy services to BUSKİ. The scope of services include assistance with tendering and contracting of the works, preparation of tender designs for the sewerage and storm drainage networks (over 500 km) as well as supervision and consulting services during implementation of the main collectors of the sewerage and storm drainage systems.



Client
BUSKİ

UK (1)

Selected projects – UK (1)

Project	Location	Read more
Environmental and water resilient design for HS2 Rail	Birmingham	–
City Park Public Realm and Water Infrastructure	Bradford	
Surface Water Management Plan	Bristol	
Greener Grangetown Green Infrastructure Retrofit	Cardiff	
City Centre Flood Alleviation Scheme	Leeds	–
Leeds/Liverpool Canal Waterfront Regeneration	Liverpool	–
2012 Olympic Park Water Infrastructure design	London	
Beam Parklands Habitat Creation	London	
BID Green Infrastructure Toolkit	London	
Dartford Creek Ecological and Engineering design	London	–
Designing with Data: Smart Cities Report	London	
Siemens Urban Sustainability Centre	London	
Thames Estuary 2100	London	
Thames Tideway Tunnel	London	



Case study

Environmental and water resilient design for HS2 Rail, Birmingham

Arup led a large multidisciplinary team, working to a highly constrained programme, to deliver the largest Environmental Statement ever produced in the UK across the 230km project.

In the West Midlands Arup led the development of a water resilient design. Including extensive flood modelling of the Rivers Rea, Tame and Blythe, integrated modelling of urbanised sections and groundwater modelling of tunnelled sections. The outputs included flood risk assessments, innovative mitigation measures and a resilient design.

Our route-wide assessment work included sound, noise and vibration, greenhouse gases/carbon footprint and socioeconomics, as well as route-wide photomontages and visualisations, mapping/GIS coordination for the whole project. We also produced a Climate Change Resilience report, Equality Impact Assessment, Health Impact Assessment, Code of Construction Practice, Consultation Summary report, Water Framework Directive assessment and provided technical leadership across all other environmental topics.

Client
HS2 Ltd



Case study

City Park Public Realm and Water Infrastructure, Bradford

Arup in collaboration with Gillespies Landscape Architects and the Fountains Workshop developed the detailed design of the 3600m² 'Mirror Pool', which lies at the heart of Bradford's City Park. Surface water captured within the Mirror Pool is drained back to the main storage tank which replaces water lost from the system by natural losses (evaporation) and filter backwashing from the treatment plant. Rainwater supplements the water supply from a mix of potable water and ground water. Water is recycled by a small treatment plant to maintain a minimum water quality standard.

The construction of the new development enabled the surface water to be collected and drained to a new network which discharges to a culverted watercourse on the site boundary. Prior to the construction of the park, water drained directly to the combined sewerage network that was operating at capacity. The new surface water drainage system creates additional capacity within the combined sewerage network. The peak discharge rate of surface water off-site was limited by hydro-brakes, which utilise the available storage capacity within the new drainage network. Further reductions were achieved by improving the amount of green space around the periphery of the site.

Client
City of Bradford Metropolitan District Council



Case study

Surface Water Management Plan, Bristol

The Department for Environment, Food and Rural Affairs identified Bristol as one of 10 high risk areas susceptible to surface water flooding in the UK. Arup was commissioned by Bristol City Council to develop a strategic surface water management plan which would identify areas for prioritisation of investigation and to help deliver a comprehensively informed strategic plan of response.

Arup developed a high-definition, integrated, two dimensional, 4 metre grid terrain model to understand the surface water drainage. As well as being the largest model for this size of catchment and at this level of detail, it is also the first of its kind in the UK. This informed the basis of the strategic plan, identifying 'hotspots' for investment to manage the surface water flooding in Bristol. Arup worked with the Council to develop interventions using water sensitive urban design principles, providing benefits beyond flood risk management. These included sympathetically designed retrofit sustainable drainage systems and associated amenities into commercial and urban streets for delivering tangible benefits to socially deprived areas within the city.



Client
Bristol City Council

Case study

Greener Grangetown Green Infrastructure Retrofit, Cardiff

Grangetown is a socially and culturally diverse residential neighbourhood in Cardiff. Surface water in the area is collected in a combined network and is pumped approximately eight miles to be treated at Cog Moors wastewater treatment works, incurring energy and carbon costs. Arup is currently providing advice to the three partners; Cardiff City Council, Dŵr Cymru Welsh Water and Natural Resources Wales, who are collaborating on a feasibility study that recommends options to implement water sensitive urban design (WSUD) which will re-use surface water. Proposed interventions include planters, swales, bio-retention ponds, permeable paving and kerb drainage, making use of the existing streetscape and open spaces. Using these features to develop community gardens, allotments, picnic areas and recreational spaces is also being considered. The wider benefits of the implementation of WSUD to this neighbourhood include education, health, well-being, sense of place, as well as developing more sustainable transportation routes - in particular the cycle and walking routes linking the city to a regenerated and vibrant Cardiff Bay. Stakeholder engagement and appropriate assessment frameworks are being carefully documented to confirm the most suitable proposals for this site and for other parts of Cardiff.

Client
Cardiff City Council



Case study

City Centre Flood Alleviation Scheme, Leeds

Leeds City Council is promoting a staged approach to developing a more flood resilient city. The council's highest priority is the city centre, which is a key focal point for the economic regeneration of Leeds City Region as a whole. There are approximately 3,000 residential properties and 500 businesses at high risk in this area, which is all developed or previously developed land within twenty minutes walking distance of the railway station. The Council's challenge was to reduce the risk posed to this area by the River Aire to acceptable levels whilst enhancing the river corridor, which is a focal point for high quality public realm. Flood defences had potential to act as a physical barrier and were a specific concern to riverside residents and businesses on visual amenity grounds.

The solution developed by Arup involves the replacement of two existing fixed river weirs with movable structures that can be lowered whenever there is a flood. As a result, the height and extent of the flood defences required has been significantly reduced. The Arup design also incorporated a new footbridge, improved public realm, a new riverside walk/cycle way, pocket parks, fish passes and hydropower generation capacity.

Client
Leeds City Council



Case study

Leeds/Liverpool Canal Waterfront Regeneration, Liverpool

With Arup as principal designer, close collaboration with public and private bodies delivered a project which boosts the Liverpool economy by approximately £1.9m annually. The Liverpool Canal Link achieves British Waterways aim to reinvigorate Liverpool's South Docks as a tourism and leisure destination. Previously, the canal terminated two miles short of the city centre, was degraded and viewed as unappealing by local people.

The canal was constructed at a time of intense regeneration activity, and coordination with adjacent projects was vital to its success. Arup generated 3D engineering models which were used at all stages to seek client approval, create drawings, determine construction sequences and communicate safety. The completed project has been praised for its high quality finish, and excellent coordination between the design team. Use of the canal has far exceeded British Waterways' expectations.



Client
British Waterways

Case study

2012 Olympic Park Water Infrastructure design, London

Arup provided multi-disciplinary engineering services for the infrastructure design of the southern section of the 2012 Olympic Park, as well as for three of the major venues. Arup's approach was underpinned by the principles of water sensitive urban design, water being one of the client's key themes in their sustainable development strategy to make the Games the 'greenest' in history. One of the main water strategy objectives was to reduce potable water consumption by 40% compared to industry standards. Through a combination of water efficiency, water re-use and water substitution measures, this target was exceeded and a 57% saving in water was achieved. 20% was through water efficient fittings in venues, and measures such as rainwater harvesting for toilet flushing. A park-wide non-potable water supply network used treated sewage for irrigation and toilet flushing, accounting for a further 37% reduction in potable water consumption, exceeding the Olympic Delivery Authority's sustainability target. Separate foul and surface water drainage systems reduce combined sewer spills and improve river water quality whilst minimising flood risk. The river outfalls were specially designed to maintain a continuous riverside ecology whilst controlling discharges sufficiently to avoid interference with navigation.

Client
Olympic Delivery Authority



Case study

Beam Parklands Habitat Creation, London

Arup worked with the Environment Agency (EA) and the Land Trust to produce the landscape design and manage the environmental assessment process for the enhancement of the Beam parklands site in Dagenham, London. The scheme included the creation of over 12 hectares of Biodiversity Action Plan habitat in the floodplains of the River Beam and Wantz Stream, including reeds, wet woodland, ponds, lowland acid grassland, and traditional orchards. As well as increasing flood storage and improving protection to hundreds of homes and businesses, the project enabled active engagement with the local community, giving people access to green space and associated health benefits, and delivering a sense of ownership yielding much greater overall social and environmental outcomes. The relationship between Arup, the EA, the Land Trust and other project partners, was instrumental in securing external funding from the European Regional Development Fund to deliver the scheme and maintain it in perpetuity, enhancing the value of the EA's planned funding for flood risk management. Success was achieved by developing a shared vision which provided and promoted the route to collaborative working and actively sought opportunities to understand, realise and deliver partners' different aspirations and objectives.

Client
Environment Agency, The Land Trust



Case study

BID Green Infrastructure Toolkit, London

Arup developed a Green Infrastructure (GI) Audit guide for the Victoria Business Improvement District (BID). Working with Natural England, in collaboration with the Greater London Authority and Cross River Partnership, the guide provides authoritative guidance to assist organisations (particularly BIDs) in considering whether to undertake GI audits. It helps them to make informed decisions and follows an evidence-based and methodic approach. Arup identified how a GI Audit should be completed utilising lessons learned from recent projects and how the findings of a GI Audit can be used to catalyse improvements in the local environment.

Our research found that Gi Audits have provided a wide range of benefits including bringing in additional income, developing relationships with new partners, targeting investment in projects that have greatest benefit, providing organisations and businesses with improved knowledge of their area and contributing to a wide range of other objectives.



Client
Victoria Business Improvement District

Case study

Dartford Creek Ecological and Engineering design, London

Innovative flood defence embankment works, combining both hard and soft engineering solutions, along critical areas of frontage in one of the few remaining natural tidal Thames creeks. Dartford Creek's in-channel mudflats, reed beds and adjoining salt marshes form recognised Biodiversity Action Plan habitats. Due to natural channel migration, the creek's embankments had become unstable, posing a flood threat to residential and commercial properties.

Arup's hard and soft flood defence embankment works included a system of brushwood revetments, using ash and chestnut faggots and stakes sourced from sustainably managed woodland in Holland, to counter the effects of scour by encouraging silt accretion and starting a process of new salt marsh creation. To minimise impact, the project team innovated a water-based method for installing the brushwood using a long reach excavator working from a Self-Elevating Platform in the centre of the creek. This also reduced health and safety risks.



Client
Environment Agency

Case study

Designing with Data: Smart Cities Report, London

This joint report by Arup and the Royal Institute of British Architects (RIBA) offers an examination of the role consumer-generated data will play in the planning and design of our cities, an angle in the smart cities debate that has been largely neglected until now.

We produce reams of data every day, generating thousands of insights into how we live our lives. Using this data more effectively can offer a deep insight into people's needs, which has the potential to transform the way architects and urban planners design our built environments. This could result in greater and much less costly opportunities for experimentation and testing of designs before construction begins and the chance for greater consultation with potential users. This would speed up the process, saving time and money and resulting in better and more affordable design.

The report uses four points to examine how data use could transform our built environment and the barriers which must be overcome for its wider application. The report also makes recommendations to the UK Government on how it could enhance its smart city initiative by paving the way to designing with data.

Client
Published jointly with the RIBA



Case study

Siemens Urban Sustainability Centre, London

The Crystal is an exemplar ‘building of the future’ for Siemens. The development in London’s Victoria Dock consists of a public exhibition and education centre, as well as offices, an auditorium, and conference centre. A highly integrated design process, where Arup engaged with Siemens across their extensive range of technologies, has allowed the development to target the highest international sustainability benchmarks – LEED ‘Platinum’ and BREEAM ‘Outstanding’.

The Arup team developed a fully integrated energy strategy for the building, realising Siemens’ brief for an all-electric building through a combination of low carbon on-site generation, battery storage, and ground source heat pumps. The public health design adopts a water sensitive design approach, focusing on water efficiency and advanced treatment, resulting in a 90% reduction in mains water use and a closed water loop in the winter season. By integrating water and wastewater industry expertise into the team, Arup was able to advise on selection of Siemens technologies for blackwater recycling, configure the public health systems to allow for rainwater treatment to potable quality, and advise on licensing and approvals for the innovative water systems.

Client
Siemens Real Estate LtdClient name



Case study

Thames Estuary 2100, London

Arup worked with the Environment Agency to develop a tidal flood risk management plan for the Thames Estuary through to the end of the century. The plan recommends what flood risk management measures will be required, focusing on how to integrate defences into the surrounding landscape and townscape, enhancing the river frontage and achieving other environmental objectives for a range of different situations. These were illustrated by using a series of 3D visualisations portraying the changing estuary character and a subsequent series of vision sketches for specific areas along the river undergoing substantial change.

The draft report was designed as a guidance document to inform and inspire those involved in flood risk design, to think and act creatively in integrating environmental enhancement into flood risk management schemes. The focus included the creation of a continuous public walkway along the River Thames, connecting to a series of public realm opportunities, and ecological enhancement.



Client
Environment Agency

Case study

Thames Tideway Tunnel, London

The Thames Tunnel project is a major new sewer that will tackle the problem of overflows from the capital's Victorian sewers for at least the next 100 years. It is required to ensure the UK complies with European environment standards and will also bring wider social and economic benefits. The project has identified a series of sites spanning London where existing sewers will be intercepted with new sewer infrastructure.

Arup is part of an integrated team working alongside architects, engineers, planners and environmental specialists. As landscape architects on the project we have worked closely with the lead architects in creating a legacy of high quality and distinctive public spaces that are fitting for a project of this scale and ambition. Integrated SuDS and sustainable surface water management through the use of permeable surfacing and green roofs. Large scale consultation has been carried out, which has allowed the design team to create design solutions that are responsive to each locality providing valuable new public spaces to both local people and visitors.

Client
Thames Water



UK (2)

Selected projects – UK (2)

Project	Location	Read more
UK Water Sensitive Urban Design Scoping Study	London	
Ulley Reservoir Rehabilitation	Rotherham	–
New Water Storage Reservoir, Cheddar	Somerset	
Stebonheath School Landscape Retrofit	Llanelli	–
SuDS retrofit projects	Llanelli & Gowerton	
East Coast European Bathing Water Directive	Yorkshire	
Humber Estuary Flood Risk Management Strategy	Yorkshire	–
Humber Estuary Ecosystems services assessment	Yorkshire	
RT NET intellignet data monitoring	Yorkshire	
Yorkshire Water Demand Management Best Practice Review	Yorkshire	
CIRIA Flood Risk & Critical Infrastructure Study	(Nationwide)	–
CITIES ALIVE	(Global)	
Water Use in Scarce Environments Study for WRG2030	(Global)	



Case study

UK Water Sensitive Urban Design Scoping Study, London

Arup has been working closely with the Construction Industry Research and Information Association (CIRIA) to produce a report which creates a vision for water sensitive urban design (WSUD) in the UK.

‘Creating Water Sensitive Places’, published in spring 2013, summarises the results of a scoping study which explores the potential to deliver WSUD in a UK context. The report demonstrates the benefits of the process in creating more adaptable places that enhance amenity and well-being, responding to the water challenges facing communities and supporting economic development. As lead research contractor on the project, Arup has assisted CIRIA in proposing recommendations for its uptake in the UK, drawing upon research of international experience in WSUD and feedback from workshops with key agencies that could deliver and benefit from WSUD in the UK.

Client
CIRIA



Case study

Ulley Reservoir Rehabilitation, Rotherham

Following heavy rainfall in June 2007, a spillway at Ulley Reservoir failed, causing scour to the embankment. Arup managed emergency works to stabilise the dam including blocking the upstream end of the existing spillway, lowering the water level in the reservoir and placing 2,500 tonnes of coarse limestone into the scour hole. Further investigations determined the extent of rehabilitation works needed.

Arup designed the rehabilitation works and procured a hydraulic model of the spillway to verify the design assumptions. Maintenance of reservoir safety during construction was controlled through overpumping, temporary sheetpile defence and careful sequencing of excavation works. Arup managed the whole project maintaining high standards of safety throughout. Rehabilitation works were completed on time and under budget through successful collaboration with stakeholders during the design and construction phases.



Client
Rotherham Metropolitan Borough Council

Case study

New Water Storage Reservoir, Cheddar, Somerset

Arup prepared the planning application for a new 9,000Ml raw water storage reservoir. The location, south of the existing Cheddar Reservoir, was determined previously by Arup as part of a Site Selection and Water Resources Study. The new reservoir will be fed from Mendip spring sources close to the famous Cheddar Gorge show caves, and gravitate from there to the existing reservoir, located nearby. Our high level master plan sets out the recommended strategy and covers all aspects of the scheme including consultation, environmental surveys and studies, planning, land purchase, design, construction and operational issues. Once operational, the reservoir and surrounding nature areas will transform low grade, intensive agricultural land with limited community value into an environmental asset that sits comfortably within the Somerset landscape. It is anticipated that the adjoining SSSI will expand as overwintering bird populations thrive in the newly created wetland habitats, otter and water vole populations improve and bat populations continue to grow off integrated foraging habitat. For the community health, wellbeing and educational benefits will be seen through the network of footpaths, cycle paths, bridleways, natural trails and associated educational facilities. The planning application was submitted in December 2013 and has now been approved.

Client
Bristol Water Plc



Case study

Stebonheath School landscape retrofit, Llanelli

The Dwr Cymru Welsh Water Capital Delivery Team have been working with teachers and pupils from Stebonheath Primary School, Llanelli to integrate an innovative retrofit sustainable drainage system, typically only used in new build schools, into the existing school grounds.

The aim is to reduce storm flows entering the sewer network and reduce the risk of flooding and pollution downstream.

The multiple wider benefits achieved include increasing the biodiversity of the site, providing an educational tool to teach pupils about the water cycle, the environment, carbon reduction and create a more pleasant atmosphere for teachers and pupils to educate and learn.



Client
Dŵr Cymru Welsh Water

Case study

SuDS retrofit projects, Llanelli & Gowerton

As with many ageing combined sewer networks, the Llanelli catchment in Wales receives large volumes of surface water as a result of factors including urban growth and climate change. This is resulting in significant combined sewer overflow spills from the sewers into the protected shellfish waters of the Burry Inlet. Arup has worked closely with Dŵr Cymru Welsh Water to deliver large-scale water sensitive urban design remove surface water from the sewer network. This was made possible by building one of the largest hydraulic models of a sewer system in the UK to assess sewage spill frequency, duration and volume at all assets in these catchments. This model also identified the areas where surface water entered the combined sewer network so that solutions could be targeted. Arup then developed an innovative schematic plan of the sewerage system together with a flow/area map for a comprehensive understanding of the catchment. The result was 181 innovative solutions ranked according to their contribution to surface water reduction, flooding, environmental enhancement, societal benefit, ease of construction and carbon cost using Arup's CO2ST tool. The top 10 schemes reduced surface water entering the sewers by 25% and been completed during the Asset Management Plan (AMP) period 5.

Client
Dŵr Cymru Welsh Water



Case study

East Coast European Bathing Water Directive, Yorkshire

Yorkshire Water are investing £110 million between 2010-2015 to help many of the region's seaside resorts achieve an 'Excellent' bathing water quality standard.

During feasibility stage, Arup built the initial marine impact model and carried out studies which showed the feasibility of adopting an innovative approach to achieving improved bathing water quality and allowed Yorkshire Water to gain regulatory funding for their programme. The marine impact modelling approach has continued to be used for the development of major schemes along the Yorkshire coast with a view that all the resort beaches along the Yorkshire coast achieve blue flag status.

Arup have continued to support Yorkshire Water with technical services through outline design, planning and site supervision of projects involving £70 million of investment, including tunnels pumping stations, sea outfalls and new high quality public realm and public art along the existing seafronts. The project involved integration of critical infrastructure with new high quality public realm on the seafront.

Client
Yorkshire Water Services Ltd



Case study

Humber Estuary Flood Risk Management Strategy, Yorkshire

The communities around the Humber estuary are protected from coastal flooding by more than 200km of earth embankments and flood walls. The Humber strategy sets the overarching framework for sustainable flood risk management around the whole Humber Estuary for the next 20 years, mindful of rising sea levels and increased storminess.

Arup is working with the Environment Agency to update the strategy in light of new government funding regimes, better modelling tools and data, and the regional growth agenda. Our work as technical advisor includes condition assessment of the defences, probabilistic hydraulic modelling (with HR Wallingford our specialist sub-consultant), developing and costing sustainable strategic solutions, and preparing the business case for future investment.

We are working closely with the Humber local authorities, Natural England, landowners and other key stakeholders to ensure the strategy delivers wider benefits to the region.

Client
Environment Agency



Case study

Humber Estuary, ecosystems services assessment

Arup carried out an Ecosystem Services (ES) assessment of coastal managed realignment schemes on the Humber Estuary, valuing the benefits for the Environment Agency (EA). The project entailed a comprehensive review of the existing valuation guidance, scientific and economic evidence (both EA, national and international). The study identified important gaps in the evidence, along with the considerations and risks of proceeding to a full valuation. Current guidance was assessed against best practice, with reference to academic studies, the National Ecosystem Assessment and the Economics of Ecosystems and Biodiversity (TEEB).

The study critically evaluated the approaches and outlined a recommended methodology for a full ES valuation of all existing and proposed managed realignment schemes on the Humber Estuary. The study will be an important component of the wider EA strategy of embedding an Ecosystem Services approach into their operations.



Client
Environment Agency

Case study

CIRIA Flood Risk & Critical Infrastructure Study, (Nationwide)

Arup worked with CIRIA and numerous industry stakeholders to provide a detailed report on how to improve the flood resilience of critical infrastructure systems across the UK. The specific objectives of Arup's research were to: propose a rationale for key terms such as 'critical infrastructure', 'resilience' and 'resistance'; collect and collate information on the flood resilience and resistance measures that are currently being adopted by infrastructure owners and operators; collate information from post flooding incidents in the UK and overseas relating to performance of resilience and resistance measure; identify approaches to improve the adaptation of critical infrastructure to future flood risk and climate change; promote collaboration and consensus between different disciplines and sectors across the industries which provide the UK's Infrastructure; disseminate findings amongst relevant organisations and identify any future research and guidance requirements to improve resilience and resistance. The resulting publication, CIRIA C688, has influenced Government thinking in this area, providing an important evidence base for the various departments' sector resilience plans.

Client
CIRIA



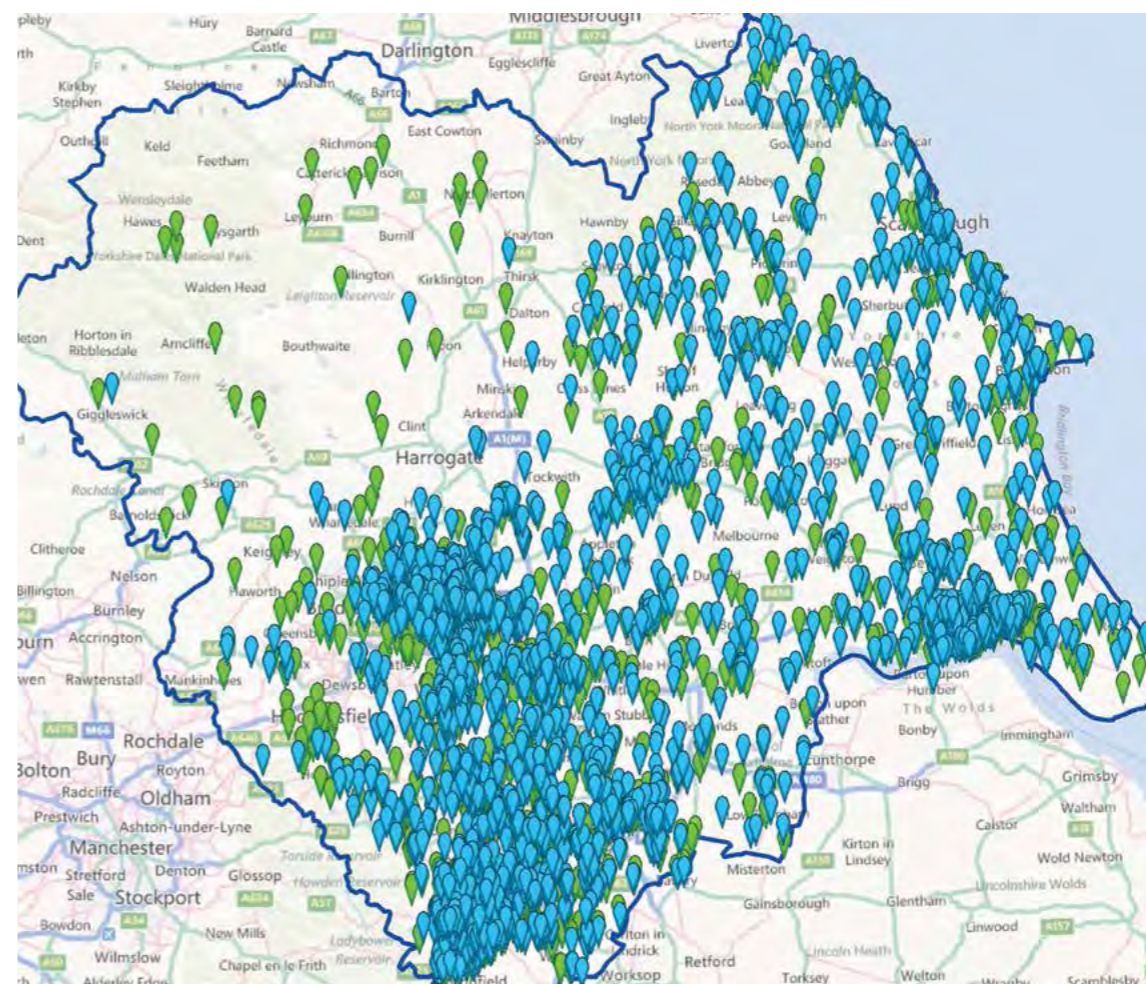
RT NET intelligent data monitoring, Yorkshire

RTNet Phase 3 is a project to install around 4600 flow and pressure data loggers on Yorkshire Water's distribution network. The data loggers have a facility to call in to Yorkshire Water's control room automatically sending useful flow and pressure data for the water distribution network many times a day.

Arup's role included project management, GIS enabled electronic data capture, data management and processing, and software development.

The data loggers were installed in flow meter chambers, pressure hydrants and at Domestic Customer Meters (DCMs) sites across the East of Yorkshire including the major conurbations of Leeds, Sheffield, York, Hull and the surrounding areas. The project involved Arup conducting a pre-survey of around 4600 sites to assess suitability for logger installation and then the design and installation of data loggers at prescribed locations. Arup were responsible for the design and installation of IT Infrastructure to suit the data logger supplier.

Client
Yorkshire Water Services Ltd



Case study

Yorkshire Water Demand Management Best Practice Review

The energy requirements and associated cost of treating and pumping water, together with the threat posed by extreme weather events and gradual climate change, have resulted in water conservation and resilience rising up the socio-economic and environmental agenda.

In order to respond effectively, Yorkshire Water Services has outlined a strategy called “Taking Responsibility for the Water Environment for Good,” which sets out clearly the company’s view on water issues including demand management and water loss.

Arup carried out a maturity assessment to identify the strengths and weaknesses of Yorkshire Water’s historic and current water demand and loss management actions, benchmarking these against international best practice from Australia, Singapore, the US and Europe. Arup researched best-practice case studies, against which the company’s position was compared. The comparison focussed on contributory factors such as population growth, water reuse, household retrofitting and collaborative working. The approach and outcome of each case study was then transposed onto Yorkshire Water’s aspirations.

Client
Yorkshire Water Services Ltd



Case study

CITIES ALIVE – Rethinking Green Infrastructure: Can nature help restore harmony in our cities?

Our cities are facing an uncertain future. Underground roads and automated transport, permeable pavements and water roofs, vertical farming and even glowing trees – from large-scale interventions to smaller scale enrichments, cities in the future will need to look vastly different to cities now.

Cities Alive – rethinking green infrastructure – shows how the creation of a linked ‘city ecosystem’ that encompasses parks and open spaces; urban trees, streets, squares; woodland and waterways can help create healthier, safer and more prosperous cities and realise significant social, economic and environmental benefits. To accomplish this vision, green infrastructure has to now take a more influential role in the planning and design of cities and urban environments. Cities Alive is a product of collaboration between the Landscape Architecture and Foresight + Research + Innovation teams at Arup and has involved a wide range of specialists within the firm.

Client
Arup Research Initiative



Case study

Water Use in Scarce Environments Study for WRG2030, (Global)

The 2030 Water Resources Group appointed Arup to gather global case studies of interventions that address water scarcity. Arup researched and analysed case studies across the Agricultural, Municipal and Industrial sectors, covering over 60 types of interventions. Arup worked with external partners from across the globe, collaborating with the private sector, government ministries and local authorities to gather feedback and identify projects.

The case study catalogue includes an analytical framework to enable assessment and comparison of various interventions on water scarcity, including economic assessment based on a system of comparable unit costs of water. Key to the study was clear and concise communication of complex issues to non-water specialists within the private sector, amongst policy makers and to governments. An online searchable database of the case studies can be found at www.waterscarcitysolutions.org



Client
2030 Water Resources Group, Washington DC