



ARUP

GLOBAL WATER ANNUAL REVIEW 2018-19

INSIDE THIS YEAR'S REVIEW:

CITIES ALIVE: WATER FOR PEOPLE

Letting nature do its job to protect our future water supplies and make cities thrive.

CITY WATER RESILIENCE APPROACH

A truly collaborative approach to help cities manage the many water-related challenges they will face in the future.

DROUGHT PERSPECTIVES

Helping manage water supplies through drought planning.

SOCIAL NATURAL CAPITAL

Fulfilling a social contract: how water companies demonstrate that they are delivering for society in the long-term.

THE COP JOURNEY

Our increasing role in the international water community which is tackling climate change.



GLOBAL WATER ANNUAL REVIEW 2018-19

CONTENTS

2018-19 HIGHLIGHTS

Cities Alive: Water for People	3
Drought Perspectives	5
Blockchain	6
City Water Resilience Approach	7
The COP Journey	9
Research Strategy and Review	11
Social Natural Capital	12
Community Engagement	13

REGIONAL ROUNDUP

Americas	15
Australasia	17
East Asia	19
Europe	21
UKIMEA	23

INDUSTRY AWARDS

People Awards	25
Project Awards	25

FOREWORD

I am delighted to share this latest Global Water Annual Review – showcasing our key projects, initiatives and achievements from the past 12 months.

2018/19 has been a truly standout year for Arup's global water business. Across the firm, we are continuing to help the world better manage its precious water resources, and build a sustainable and resilient future. The UN Sustainable Development Goals (SDGs) continue to provide focus across the global water community – and the wider world – to ensure that we strive to achieve these important outcomes.

Together with the Resilience Shift and the Rockefeller Foundation, we have developed a unique, sector-first City Water Resilience Approach (CWRA). This framework sets the agenda at international policy level for cities to deal with shocks and stresses to their water systems, supported with real-life city analysis. There are now eight city characterisation reports available to download from our website; these reports provide details of the research and stakeholder engagement undertaken to date, to understand the local water system, and the factors that affect its resilience.

Our latest Cities Alive: Water for People publication – endorsed by the International Water Association – launched in September 2018 at the World Water Congress in Tokyo. With one in four large cities facing water stress, and water demand projected to increase by 55% by 2050, the report emphasises that cities need to act today to avoid countries reaching 'Day Zero', as almost experienced in Cape Town.

Across a comprehensive calendar of events including Stockholm World Water Week and COP24 in Katowice, we have reinforced the importance of key global water issues including climate change, circular economy and blue-green cities. You can read more about some of these events later in the Review.

We continue to invest in our people and are establishing global and regional Young Water Professional panels to foster collaboration and access to opportunities across the firm.

Arup's Global Challenge also mobilises wider infrastructure development to improve health and environment – working with partners in India, Indonesia and Tanzania, we are ensuring that 'no-one is left behind'.

I hope you enjoy reading the Review.



MARK FLETCHER
Arup Global Water Leader

Cities Alive: Water for People

LETTING NATURE DO ITS JOB TO PROTECT OUR FUTURE
WATER SUPPLIES AND MAKE CITIES THRIVE

By Tom Armour

Water is one of our most precious natural resources – and nature is the greatest ‘machine’ when it comes to efficiency, consistency and longevity. So that is why both were at the heart of our ‘Cities Alive: Water for People’ report when it was launched at the International Water Association (IWA) World Water Congress & Exhibition in Tokyo in September 2018. Media coverage of the underlying message of our report was stark – cities must change their ways and their thinking if we are to avoid the unthinkable, running out of water as populations are set to increase by 55% in cities by 2050. The main message of our report however was one of exciting opportunity.

If we start to think differently about the future now, we can adapt to meet contemporary challenges and use our most natural resource to create more positive and pleasant places to live and work.

USING BLUE AND GREEN INFRASTRUCTURE TO MAKE OUR CITIES PERMEABLE

One in four cities are currently facing water stress. Climate change, population growth and increased urbanisation are issues which quickly need to be addressed. At present, too many cities manage themselves as standalone entities, and only consider the management of water within their boundaries. In reality, however, the management of the entire water catchment, which goes much further afield and into the hinterlands of cities, is key. It is this wider area – the water basin – that influences how much water enters a city, and at what rate, and therefore is integral to the planning of

its management. So much more can also be done within the cities themselves.

All too often Governments, local authorities, land owners and water companies only think in terms of grey infrastructure when it comes to management – major engineering and build projects such

as dams to hold water or tunnels to move it away from the surface. But what if all cities were to focus on making themselves more permeable? What if our cities were able to hold, manage and use water effectively with little, or no waste? For example, flood risk doesn’t always need to be managed by building huge underwater tunnels to

get it away from the surface as quickly as possible.

Finding ways of naturally absorbing and holding water, through green areas, planting and soils, actually leads to better natural cleansing and improves quality compared to being contained and





contaminated in large physical structures. These approaches look to balance ‘grey infrastructure’ better with ‘green’ and ‘blue’ infrastructure to realise significant wider benefits.

We’ve identified five common themes for successfully reconnecting people and cities with the water cycle. They are;

- **Putting People First:** Using a ‘water-wise’ approach to the planning and design of water in cities to contribute to the better health and well-being of residents.
- **Catchment Sensitive Cities:** Recognising that cities sit within wider river catchments and the interactions of water, sediment, nutrients and ecology as they flow through offer benefits if embraced, but threats if ignored.
- **Integrated Design:** Moving away from infrastructure with a singular function to those which are multi-purpose, such as incorporating flood-risk management and water-harvesting whilst providing community and habitat benefits.
- **City Regeneration:** Using water as a focal point for redevelopment, with ‘blue’ and ‘green’ environments helping to maximise flood and drought resilience and bring improvements to the health and well-being of inhabitants.
- **Transcending Barriers:** Ensuring joint working across governments, education, industry and communities to gain mutual, city-wide benefits.

Such modern water management is already being achieved by some of the most forward-thinking cities in the world. These are cities which have already recognised the financial, physical and health benefits it brings, and have worked with agencies, organisations and individuals to collectively make a positive difference.

FROM SPONGE CITIES TO RIVER REGENERATIONS – HOW CITIES CAN BE TRANSFORMED

There are already many great examples of how blue and green infrastructure is working better with grey. It is not something limited to new developments either, as solutions can be retro-fitted to transform long-standing issues in cities. China’s Sponge City program is a shining example. Introduced by the Government in 2014 to tackle flooding and water shortage, 16 cities were selected as pilots. The results are phenomenal, as Tongzhou in Beijing is now accommodating 70% of its rainwater on the surface as residential communities, parks, public buildings, municipal roads and watercourses have been water-optimised. This has been achieved using green belt, rainwater gardens, permeable paving, rainwater harvesting, and detention ponds, providing flood protection, climate change resilience and water purification. A further 40 pilot projects will further boost the region’s rainwater absorption to 84%, creating a true ‘sponge city’.

Similarly, Vancouver is aiming to become the greenest city in the world by 2020 by embracing the ecological principles of rainwater and stormwater management. Alternative permeable pavements and rain gardens have been created, encouraging water to infiltrate across the city, whilst all new large buildings are legally required to manage stormwater as a resource through enhanced landscaping, green roofs or rainwater harvesting tanks. The city has also developed a best management practice toolkit to improve rainwater management and coastal adaptation, from raingardens and pervious paving to constructing wetlands and bringing covered watercourse back to surface.

It all contributes to reducing water demand by encouraging beneficial reuse.

In Seoul, the regeneration of a three mile stretch of the River Cheonggyecheon has

transformed the economic and cultural value of the area.

The river was trapped beneath a three-lane stretch of highway for more than 50 years, creating a centre of congestion and pollution, but now it has been transformed to unlock its potential, boasting three miles of fresh running water, accompanied by open spaces and tree-lined public walkways.

The temperature is lower in that area now than the city centre. It has become a tourist hotspot attracting 64,000 visitors daily and has reinvigorated the city, bringing increased social, economic, and environmental value, whilst boosting resilience to climate change.

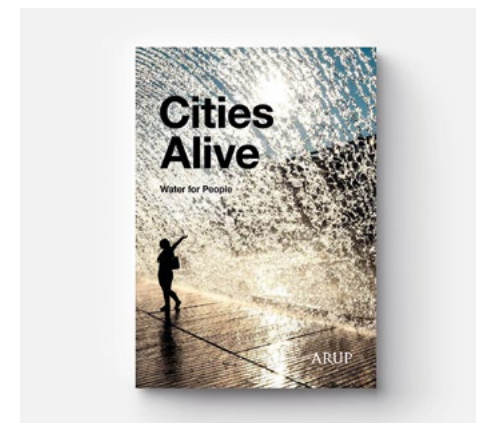
In Copenhagen, a ‘Cloudburst’ masterplan has seen green areas planted to temporarily store water during storm events, whilst stormwater is captured, stored and moved into underground storage tanks which pump the water away as children play in the square. Crucially, the plans and solutions came about after 10,000 people participated in 170 citizen-led initiatives to ensure the needs of the community were met, with these blue approaches approximately half the combined cost of traditional grey interventions.

In Philadelphia, the Green City, Clean Waters plan has seen a whole programme of green infrastructure interventions in streets, pavements, roofs, school grounds and parking lots. All are being greened and by the time the scheme is complete the volume of storm water reduction will be 85% of what used to go into the city drainage system. The wider benefits of this too are enormous - bringing communities and schools together, a green jobs economy and these environmental improvements are attracting a rising number of workers and firms to the city.

The city found the value of green infrastructure benefits ranged from \$1.94-\$4.45 billion, while grey infrastructure ranged from only \$0.06 to \$0.14 billion over a 40-year period¹.

A COLLECTIVE APPROACH ACROSS RESEARCH, POLICY AND PROCEDURE IS NEEDED

Such solutions are often simple, cost effective and much more efficient than those currently used. The complexity comes in getting the key stakeholders to understand the rationale of a longer-term, collective approach. Only by recognising and understanding the complexity of urban water systems, their relationship with the built environment, and interconnection with communities and stakeholders across the water cycle and its catchments, can we truly begin to not only manage water in cities, but live alongside it and bring true long-term health and well-being benefits.



It needs bold innovative cities around the world to lead the way and show best practice, with their communities, businesses and infrastructure organisations working alongside land owners and land managers across research, policy and practice. We have to use our most natural resource more wisely, so let’s make nature do the hard work to help us achieve a more sustainable future.

¹ ‘A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO events in Philadelphia’s Watersheds (Stratus Consulting, Boulder USA, 2009).



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[Click here to read more](#)

Drought Perspectives

HELPING MANAGE WATER SUPPLIES THROUGH DROUGHT PLANNING

By Chris Hughes

In 2018, the World Bank and the United Nations warned that 40% of the world is currently affected by water scarcity. The report, Making Every Drop Count, states that around 2.5 billion people – 36% of the world’s population – live in water-scarce regions where more than 20% of global GDP is produced. “By 2050, more than half of the world’s population—and about half of global grain production—will be at risk due to water stress”, it adds. Around 90% of financing for disaster risk mitigation is directed at emergency response and reconstruction, leaving a shortfall in preparatory measures and resilience. The report adds that: “while US\$106 trillion is available through different funds worldwide, only 1.6 percent is invested in infrastructure and even less in initiatives to increase resilience”.

THE IMPACT OF DROUGHT AND WATER SCARCITY

Droughts can have potentially-devastating social and economic impacts on cities that are unprepared. A recent example being Cape Town, South Africa where a city of almost four million has faced three years of drought during which winter rains failed

to materialise. In January 2018, it was predicted that, by April, Cape Town would reach Day Zero, when it would be forced to turn off the taps. Implementing one of the most radical water conservation campaigns in history gave Cape Town more time to respond to the drought.

DROUGHT IN THE NORTHERN HEMISPHERE

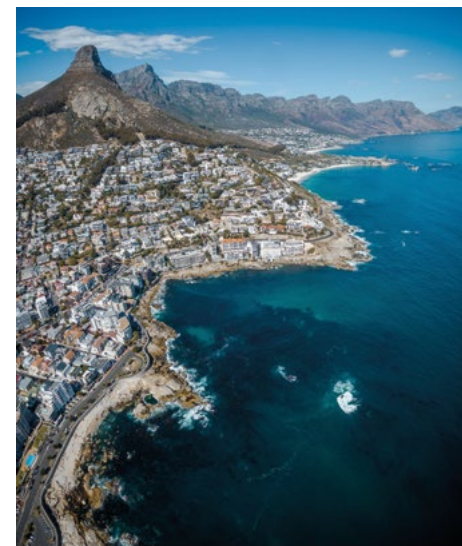
In 2018, the United Kingdom and much of the northern hemisphere experienced significant periods of high demand for water, driven by prolonged dry weather and high temperatures. This resulted in drought in some areas, leading to hosepipe bans and water control measures. The UK Met Office latest climate projections (UKCP18) suggest we can expect more of the same in years to come. In the UK, drought planning processes are focussed on municipal water supply. For example, Welsh Water’s drought plan helps them to secure resilience to extreme and severe weather for their 3 million customers. The role of regional planning and engagement with third parties is also key and governments are keen to understand the demand for water in other sectors, which is a significant stepping stone in multi-sector

water resilience. Some of the UK drought planning and wider water resources planning techniques are among the more innovative in the world and provide robust methods to support water companies in understanding their water stress risks and develop appropriate action.

FACILITATING ENGAGEMENT ACROSS SECTORS

Globally there is a need for robust planning and wider engagement across sectors to achieve multi sector resilience to the challenges of water security. This includes the use of new predictive techniques and digital tools to assess a full and realistic range of possible droughts, including the impacts of climate change, and demonstrate the outcomes, mitigation and trade-offs associated with each. These enable water planners and city leaders to make timely and informed decisions about responses and investments that make their cities and regions smarter and more resilient to drought. This holistic approach supports the International Water Association (IWA) Principles for Water Wise Cities. Building on work with the Resilience Shift and SIWI on the City Water Resilience Approach, and in collaboration with HR Wallingford and their international reputation in Drought Risk assessment, Arup is developing an approach to help cities better prepare for drought by:

- Facilitating multi stakeholder engagement and accountability in drought planning beyond traditional ‘actors’, encouraging new ideas and innovation.
- Ensuring the needs of wider sectors are included in drought resilience planning processes.
- Integrating wider sectoral and societal ‘value outcomes’ in drought risk assessment and planning.
- Developing better ‘predictive awareness’ in stakeholders, ‘putting people first’.



- Supporting the UN SDGs by delivering sustainable integrated water security.

We’ll be further developing this work in collaboration with our partners and aiming to pilot our approach in several locations and projects in 2019.



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[Click here to read more](#)



Blockchain

WATER TRADING – ADDRESSING THE EBBS AND FLOWS OF UNEVEN WATER SUPPLY WITH BLOCKCHAIN

By Jason Carr

Water flows unevenly across Australia. While rain falls in Victoria, New South Wales is entering its harshest drought in decades. Water trading is a process that the government uses to smooth out potentially unequal and unreliable access to water, but the system is imperfect: Not everyone agrees with how water rights are handed out and the sheer complexity of the marketplace makes it difficult to regulate. How can we improve our water trading system so it's more fair, reliable, transparent and efficient to manage?

In a country with rainfall as inconsistent and unevenly dispersed as Australia, water trading can be a lifeline. In its simplest form, water trading involves the voluntary exchange of water access rights between a buyer and a seller. One entity holds the license to collect a certain amount of water from a river, groundwater lake or reservoir. That entity can also sell some of their quota at a market-defined price. Put into practice; however, the processes required to operate such a market begins to introduce complexities. Transactions can be slow and hard to track. Beneath the veil of this complexity, opportunism and even corruption can slip in. The urgency of the problem came to a head last year when accusations of inappropriate transactions prompted a South Australian Royal Commission into the management of the Murray Darling Basin.

OVERCOMING CHALLENGES THROUGH COLLABORATION

To better understand the issue, we have been working with the New South Wales Government. The idea to explore blockchain as a potential solution to the problem first came to Jason one night when he was leaving a Hackathon event. A blockchain is essentially a growing chain of digital records. Each record – or block – contains transaction data, a timestamp and a cryptographic hash of all the previous records on the chain. These records are delocalised, meaning they are copied and

stored in many places at once. This makes them easy to look up and difficult to forge.

The most obvious benefit here is that blockchain offers is transparency. But the technology can also make record keeping more consistent, streamlined and automated—freeing up time and resources along the way. In its simplest form, water trading involves the voluntary exchange of water access rights between a buyer and a seller. But once you consider the number of markets involved the system begins to look a lot more complex. We are now working with the New South Wales Government to explore what such a system might look like by mapping out its intricacies. They're not expecting to revamp Australian water trading overnight but rather they want to begin to untangle certain chains of transactions within the larger water trading ecosystem.

As usual, the devil is in the detail. There's no point applying a technology like blockchain to a problem if it doesn't suit, or if a simpler solution would also work. The team is focusing on mapping out how trades are performed in NSW on a valley by valley basis and are exploring the intricacies of water trading policy, inter-valley trade and interstate trade.

They can then determine if blockchain can adequately address all the shortcomings while still ensuring the necessary policy pieces are fulfilled.

"The first step is to produce a proof of concept", says Jason. "It's timely in terms of technical readiness, political requirement, and general awareness around climate change. I think this technology will move very rapidly once some prototypes are out there. We need to be driven by minimum-viable-product-type solutions. This is uncommon in the water sector. Usually we aim for perfection before we roll anything out." The appetite is there. Over the past three years, we've run a handful of research projects to help utilities explore how technology can be

used to build a better water sector. These projects have varied in approach—from surveying to storyboarding.

When most of us think of blockchain, cryptocurrencies like Bitcoin or Ethereum come to mind. Some of the earliest applications of the technology were to track and trade currency. Even now, fintech remains one of the most widely adopted uses. But blockchain solutions are already gaining traction across Australia as a way of tracking and trading resources as well.

TECHNOLOGY AS AN ENABLER

Powerledger, a blockchain energy trading platform that launched in 2016, helps users buy and sell renewable energy peer-to-peer. The agriculture and the mining sectors have demonstrated how blockchain can be used to track everything from almonds to diamonds. But not all resources are created equal.

"We can always generate more power", says Jason. "With water, we're talking about a seasonally finite resource." Water is much more closely tied to geographical constraints.

"Electrons can actually move around in a way that water physically can't", says Jason.

One advantage to using blockchain to conduct trades is that the technology creates a ledger system that is impossible to forge and easy to trace. We can watch where our water flows. Don't read too much into it - we had to trade water for something! We recognise that there may well be social barriers for their project to overcome.

The data recorded from such a system would be invaluable for people who are charged with designing water infrastructure, or whose livelihood is dependent upon predicting future flows. The system could bring the added benefit of improving everyone's understanding of



how and where the water flows. "I think a well-accepted solution would be one that can give power back to the community", says Jason. As climate change wreaks havoc on our ecosystems, our water cycle is becoming increasingly unpredictable. We need to work together to build resilience in the face of these challenges, but to do so we need a system we can trust. In Australia, water is such a precious resource that living in harmony with it has become part of our natural identity. Stories of drought, hardship and resilience – of parched red dirt and those first thunder-clouds of the season – are part of our national lore.

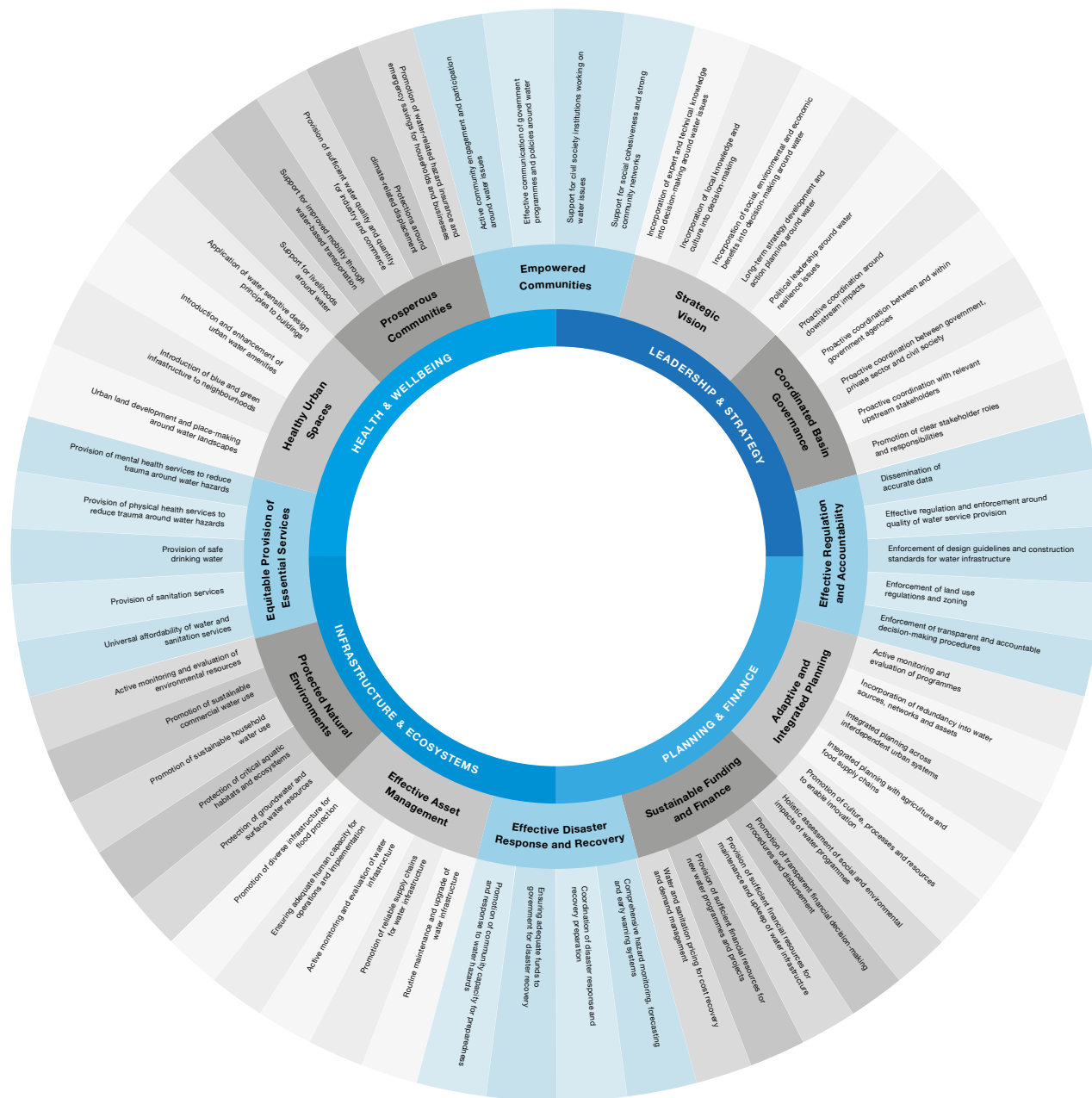
"The water cycle is something that we're incredibly close to", says Jason. "We need to build technology solutions that go hand in hand with that.."



JASON CARR

Senior Hydrogeologist, Arup
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[Click here to read more](#)



City Water Resilience Approach

A TRULY COLLABORATIVE APPROACH TO HELP CITIES MANAGE THE MANY WATER-RELATED CHALLENGES THEY WILL FACE IN THE FUTURE

By Louise Ellis and Martin Shouler

It has been a significant 18 months for Arup and our partners. Our City Water Resilience Approach (CWRA) has now been used to help eight cities across the world better understand the water-related risks they will face in the years to come. Funded by The Resilience Shift and the Rockefeller Foundation, we have worked alongside The World Bank, The University of Massachusetts-Amherst, and the Alliance for Global Water Adaptation (AGWA) on this ground-breaking piece of work.

We feel we have reached a significant milestone in developing a new global, standardised process to help cities better understand how water impacts on their success, threatens their future, and most importantly the actions they need to take. We were delighted to share our ‘City Characterisation Reports’ for Amman, Cape Town, Hull, Manchester, Mexico City, Miami, Rotterdam and Thessaloniki in March 2019. These cities themselves have led their way in making this significant step forward, recognising how important their relationships with water is, and the importance of gaining a better understanding to make better planning and investment decisions.

The work we have collectively done so far has seen us take huge strides forwards in planning for water resilience in cities. If you consider the need for this action – the threat of too much water and flooding, or too little water and drought – it could be said to be worrying times. However, we feel strongly that we are now in exciting times as we prepare for the next steps with our partnering cities. The opportunity is now there to develop long-term action plans and put changes in place to future proof these cities for the challenges they face ahead.

WHY WE NEED A MUCH BETTER UNDERSTANDING OF WATER WITHIN CITIES

There is an intimate relationship between water and cities. The need for water resources and good communication has historically led to most of the world’s major cities being located close to the sea or on a river, but the natural water cycle often results in water being in the wrong place at the wrong time, leading to too much or too little water. Because of the rapid expansion of cities, water resources are already under increasing stress, placing extra responsibility on authorities to safeguard their populations from climate-related risks. Many cities and towns are in low-lying coastal locations, so flooding is a direct threat to human life, as well as to the economic, social and environmental life. Climate change, urbanisation, environmental pressures, population growth (it is estimated that by 2060 70% of the world’s population will be living in cities), and changes in consumer behaviour

all place additional strain on urban water systems, so there is a clear need to build-in greater resilience for the long term.

The CWRA seeks to give cities the ability to make better planning and investment decisions through a collaborative approach to their resilience to water challenges, setting a new standard and improving the quality of water services for communities.

THE FIVE STEPS TOWARDS CITY WATER RESILIENCE

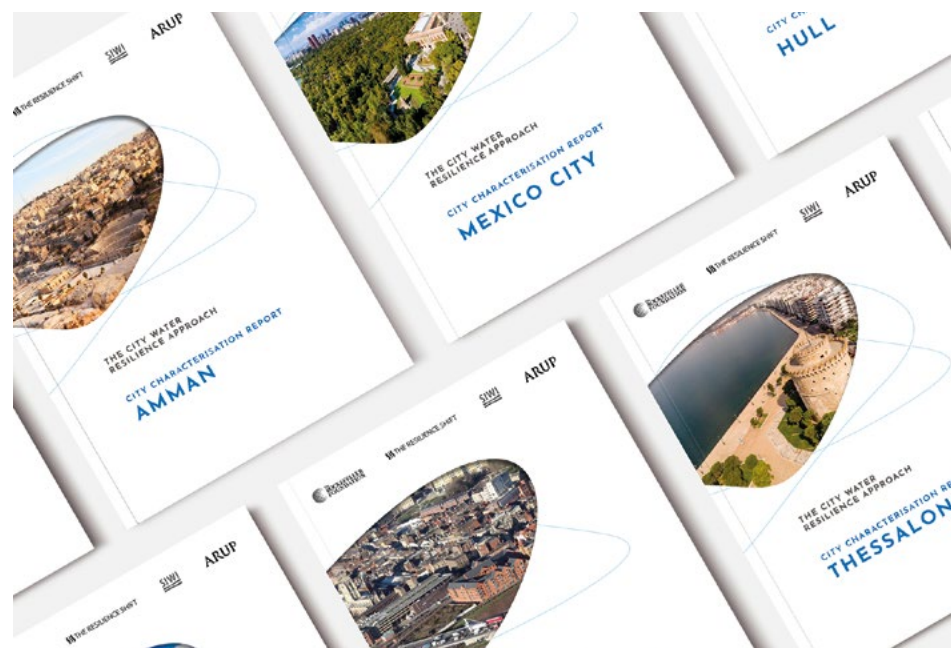
The CWRA is designed to help cities understand the risks they face, and improve the way they plan, manage and maintain their water system. Alongside our partners the Stockholm International Water Institute (SIWI), we have developed the following five-step approach.

1) Understand the system: Every city is different, so engaging all stakeholders and understanding how the underlying water basin is comprised must be the first job. We carry out in-depth research to understand the relevant shocks and stresses a city faces from water. Our focus is to understand who the stakeholders are, who is really in charge of water and making the big decisions, are there interdependencies and what is the relevant infrastructure? In the work we have done with the eight cities over the past 18 months we have had wonderful support in this key aspect. We have had between 20 and 40 different organisations and stakeholders taking part in cities, all keen to share their knowledge of water management, and learn lessons.

2) Assess resilience: A city must fully understand its existing water use and management arrangements and practices to better understand its current strengths and challenges it has to overcome. Could a city withstand enduring drought, sudden flooding, further urban development or other local risks? Only by establishing all of these facts can a baseline be established against which progress can then be measured.

3) Develop an action plan: An action plan must then be developed that strengthens a city’s water resilience, including the anticipated benefits and costs, and prioritising key projects. This is a key part of work for any city looking to revolutionise its water management as it needs to be well communicated to all stakeholders, ensuring they understand the rationale behind the plan, the collective benefits it can bring, and how they can play their part. This is the next big step for the eight cities we are currently working with.

4) Implement the action plan: Turning the plan into actions, delivering improvements, monitoring progress as you go and building on what other cities have learned, while making efficient use of



budgets and resources.

5) Evaluate, learn and adapt: Finally, it is a must that results are assessed. What has the city learned? How are stakeholders’ adapting? What else needs to change? We need capture everyone’s views to improve the process in future. Even in our current work, cities have been advising one another. Cape Town has come through a really tough period of drought, and they have shared their experience of how they have managed this, particularly with regard to communicating with residents, with other cities.

USING OUR EXPERTISE TO DEVELOP MORE WATER RESILIENT CITIES

Public and private organisations including cities, utility companies, local and national government bodies, and other stakeholders can use the CWRA to ensure they become more resilient. We have now developed a comprehensive suite of tools to assess cities and their catchments, and identify the most appropriate interventions to enhance resilience. There will be more news on this later in the year. Over the next 12 months,

we will continue to apply the CWRA in our partner cities. It is a collaborative approach. Building truly water resilient cities is an ambitious and challenging, but achievable project when you have complete collaboration, commitment and understanding of all who play any part in water management.

Looking forward, we would be delighted to introduce the CWRA to new cities which can benefit from what we have learned, and what we are certainly proud to have led the way in developing.



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The COP Journey

**OUR INCREASING ROLE IN THE
INTERNATIONAL WATER COMMUNITY
TACKLING CLIMATE CHANGE**

By Jason Fairbairn

Our teams at Arup are proud to be playing an increasingly influential role in the international community which is discussing key themes and making policy decisions around climate change. We have been particularly focussed on promoting the role and understanding of climate change on

the water cycle, and how we mitigate and adapt to those changes in our water environment. For the past five years, we have worked alongside our partners and collaborators at The Conference of Parties (COP) - the decision-making body of the United Nations Framework Convention on Climate Change (UNFCCC). Our messages each year have been consistent,

whilst also relative to the major theme, which is usually led by the hosting country. That message is simple – Climate is Water.

FROM LONDON OLYMPICS TO THE WORLD STAGE

Our involvement and success with the development and water management at the Olympic Park in London for the

2012 games was a key moment on our journey to being part of this huge annual event, which of course is so important to future proofing our world. We pioneered solutions to achieve key sustainability targets, including reducing potable water consumption around the park by 40% compared to industry standards. Through water efficiency, water re-use and water



substitution measures, a 57% saving was achieved. It was this success which led to a vital relationship being formed between our Global Water Leader Mark Fletcher and John Matthews, coordinator and co-founder of The Alliance for Global Water Adaptation (AGWA). AGWA brings together regional and global development banks, government agencies and ministries, diverse Non-Governmental Organisations (NGOs), and the private sector to focus on sustainable water resources management. AGWA, with Arup and other partners have collaborated closely to create the ‘Climate is Water’ movement over the past five years, and it was the formation of this relationship which opened the doors for Arup to be given the opportunity to help influence policies and themes to tackle the threat of climate change.

FROM PARIS AGREEMENT TO 2020 IMPLEMENTATION

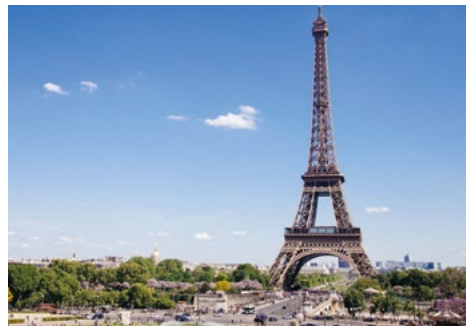
Our first involvement was in Lima, Peru at COP 20 in 2014, a year before the pivotal moment when climate change was largely accepted with the Paris Agreement in December 2015, at COP 21. There, 197 countries agreed the way forward and the true international community on tackling climate change was established. It was at that event that we held our first ‘Water Day’ and worked with AGWA and other partners on producing a video to support the ‘Climate is Water’ initiative, which stressed that water is at the heart of climate change, with drought and flooding threats issues which simply cannot be ignored.

The three key messages were:

- That the impacts of climate change are most often felt through changes in water;
- Failure to address the relationship between water and climate would put our future in jeopardy; and
- Water is a connector, not a sector, and it offers solutions.

This, of course, was a truly significant event, not only for Arup and our partners, but for the world in terms of approach and collaboration with regards to addressing the issues of climate change.

In the following years we have attended COP 22 in Marrakesh, where we have been involved in the organisation and content at the official ‘Water Day’ and a focus was placed on Africa and developing countries. At COP 23 in Germany, but chaired by Fiji, we supported the attendance of delegates representing island nations, as one of the themes for the conference was the perspective of ‘vulnerable’ island nations; an event aimed at informing people of the threat to many countries posed by climate change through the lens of islands vulnerable to sea level rise,



storm surge and other changes to the water environment. It was here that we launched our ‘vulnerability index’ for island nations, aimed at helping to improve the resilience of low lying Pacific Island Nations to sea level rise. Most recently, in December 2018, we were delighted to be involved in making a significant contribution to the COP24 programme, with other Arup businesses - such as Energy, also taking part. Our team joined a panel debate to discuss water’s essential role in addressing climate change and disaster risk, and we hosted an interactive workshop session to introduce the City Water Resilience Approach (which is covered in more detail

elsewhere in this review), and were invited by the Green Climate Fund to participate in a panel discussion around Climate Resilient Integrated Infrastructure.

A GLOBAL APPROACH TO SHAPING A BETTER WORLD

Over the years that we have been involved with The Conference of Parties, we have seen a shift with regards to how water is placed within the policy and planning to tackle climate change. Since Paris, where water issues entered into multi-stakeholder engagement processes, water has been increasingly debated in popular and professional circles and brought

into political and economic processes. There has been increasing acceptance and understanding that climate change is not just about controlling CO₂ and global warming, but also changes to our weather systems and water cycle. Some years ago, the focus was prevention, but now it is much more about adaptation and how we live to be compatible with the changing world. Under the Paris Agreement all parties have outlined their climate action plans which are to be implemented from 2020, and which are also expected to be scaled up over time. Whilst it establishes legally binding obligations of conduct, the agreement will not initially be a legally binding obligation for countries to actually achieve their contributions. Essentially, everybody is involved in this transformation to help shape a better world, and every country has a role to play to make our world more resilient to the challenges ahead through climate change.

It is why we at Arup are so committed to the United Nations Framework Convention on Climate Change and The Conference of Parties (COP) and will continue to put so much time and effort into our contribution.

The more we talk about and understand water systems, and their impact on climate change and adaptation, the better placed we will be.



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Research & Development

HOW OUR CONTINUING GLOBAL RESEARCH WORK IS HELPING US TO RETHINK, RESHAPE AND REDEFINE WATER SUPPLY AND MANAGEMENT

By David Hetherington

Research drives much of what we do at Arup. It allows our staff to formulate ideas and design projects that address some of the most complex water challenges in the world. We are passionate about rethinking, reshaping and redefining the world around us, and by focusing on the many water related issues across the world, we can make a positive impact towards meeting the United Nations' Sustainable Development Goals (SDGs). In doing so, we help to improve the health and wellbeing of communities, benefit the environment and contribute towards resilience and mitigation in the context of climate change. We always seek to accelerate innovation, put resilience into practice, and tackle global challenges.

The projects and initiatives that develop from these three drivers have helped millions of people - and will continue to do into the future. With global water demand set to increase by 55% over the next 30 years, the need for change is stronger than ever. We must learn to better manage a resource which, alongside air, food and shelter, is one of our most precious. There is not one universal solution. Solutions must be tailored to best suit each specific

geography, environment and problem. This is why our water research remit at Arup is broad, tackling everything from water treatment and management to machine learning-assisted flood risk assessment and planning.

With the support of a dedicated research team, we have invested significantly across 192 applied water research projects over the past three years, generating ideas and initiatives that are either in progress, or ready to be applied into practice. This, of course, cannot be done in isolation and we have worked alongside many very skilled and knowledgeable clients and collaborators. At Arup, everyone is encouraged to bring ideas to the table and if they see opportunities or feel frustrated are afforded the opportunity to make a positive difference. Some of our best and most successful projects have come from 'sparks' of ideas that have developed and grown into full research and development initiatives. This notion is reflected in the diverse range of projects that Arup colleagues are involved in.

WHAT NOW, WHAT NEXT, AND WHAT FOR THE FUTURE?

We always consider what research can and

should be done now, what new research can be introduced, and what research should come next. It is key that we ensure greater resilience against issues such as an unpredictable and changing climate, an increasing global population and continuing rapid urbanisation. These factors are putting extra strain on infrastructure and ecosystems across the world and without effective action the associated detrimental impact of these problems will continue to grow. With that in mind, we know that it is imperative that our portfolio of research at Arup is well-balanced in order to address both immediate and longer term global water challenges.

We have clear areas of focus. These areas include cities and their demographics, the decentralisation, recycling and reuse of water, creating resilient infrastructures, water resources and ecosystems, water and energy, and smart water and data. All of this is underpinned by a drive to make the best use of existing and future digital technologies that will drive efficiencies and impact.

We continue to invest in the development of digital technologies and services that will provide cutting edge solutions to water issues.

This includes our 'Digital Tide - a 2050 vision of the water industry' project, which we developed alongside industry, academia and clients in order to explore how digital technology can be applied to address current and future challenges in the water industry up to 2050. This foresight, knowledge and data allows industry leaders and practitioners to create strategies that will protect water supplies and increasingly future-proof their communities, and the environment.

Our research into machine learning for river water level prediction and flood protection utilised analysis data from four monitoring stations, which was used alongside historical rainfall data to develop a new model for flood risk assessment. This type



of work has provided useful information that assists in the efficient management of urban rivers and helps to ensure effective city-wide drainage planning.

Better appreciation of potential and likely, sea level rise scenarios has been used to help us rethink our strategies for coastal communities. We are looking at modern ways to tackle longstanding problems, including the development of more resilient infrastructure including the design of buildings and structures near the sea and by undertaking combined fluvial and groundwater modelling and flood risk management. We have also researched how precision agriculture can work as a component of catchment management to hold rainwater for longer, and how the use of soil, sand, mulch, stones and vegetation can infiltrate clean water while simultaneously capturing pollutants and solids.

We will continue to strive for improved future resilience through innovation and research.



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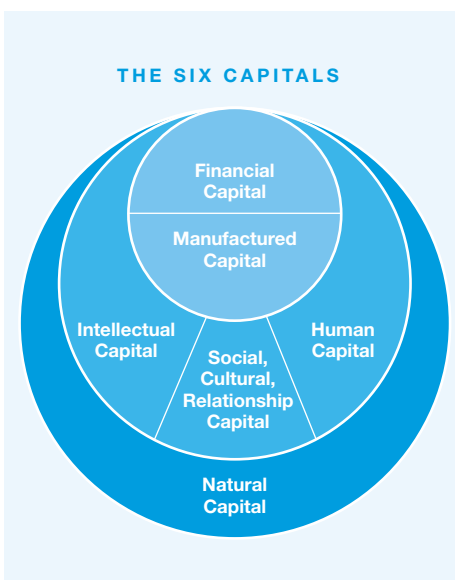


Social Natural Capital

**FULFILLING A SOCIAL CONTRACT:
HOW WATER COMPANIES DEMONSTRATE THAT THEY
ARE DELIVERING FOR SOCIETY IN THE LONG-TERM**

By Adrian Rees

When it comes to the expectations placed upon water companies by its regulators, the tide has certainly turned in recent years. No longer are the key questions solely about operational performance, investment in capital projects and immediate but short-term gain. The big questions facing the water sector today are about what they are actually delivering for society, and what they are doing for long-term sustainability and resilience? How water companies go about their work and the long-term positive impact they make on the communities they serve are now aspects in sharp focus for UK industry economic regulator Ofwat. Increasingly, demonstrating commitment towards delivering on the Environmental, Social and Governance (ESG) criteria and the United Nations' Sustainable Development Goals (SDGs) are factors in discussions with investors.



Are proposed investments not only delivering improved services but also sustainable, more efficient and using environmentally progressive technologies? Are other manufactured capitals (MCs) being considered? Ofwat has been given a main duty in law with regards to furthering long-term resilience as well as contributing to achieving sustainable development,

placing these at the heart of future investment priorities. Is environmental quality being improved by reducing pollution, and is sustainable management and efficient use of natural resources part of an organisation's long-term vision, with less reliance on grey solutions and a move to more blue and green methods? For the England and Wales water sector, will the business plans submitted for the next five years by water companies in September 2018 truly deliver for society? A real challenge for the water companies themselves is whether they can robustly demonstrate the value of that societal good?

LAST FIVE YEARS HAVE BROUGHT A SHIFT IN APPROACH TO WATER MANAGEMENT

The shift in focus has been noticeable since 2015 onwards, as water companies have responded to Ofwat's direction and recognised the need to better demonstrate the natural and social capital value when working on their business plans for Asset Management Plan 7 (AMP7). In supporting several companies in preparing their plans, we at Arup have seen a shift in approach from companies across England and Wales when outlining how they will meet the needs of their customers, and the benefits their work between from 2020 onwards will bring. Companies have for a long time needed to demonstrate a commitment to great customer service, environmental compliance and affordable bills, but there is now a greater need than ever to show resilience and innovation. It is no longer enough only to say what investments are intended, what performance changes result from these and what the bill effects would be for customers. Business plans now must also show how their activities provide wider benefits for the environment and society – as well as delivering financial sustainability over the long term. On the face of it, the benefits from natural and social assets are not as easy to demonstrate in terms of their impact and delivery as for built assets, and that is a clear challenge

which we are seeing.

Take, for instance, the issue of flood threat. Past schemes and solutions have often been based solely on reaching an output where a resultant number of properties have a decreased risk of sewer flooding. Yes, a new larger sewer or flood barrier can physically be seen as delivered, and data can be provided on its performance to inform stakeholders such as customers, the Board, and investors.

However, the impact and success of a more natural solution, such as better use of the natural water catchment around a water source, slowing the flow and managing water levels without the need for an expensive and energy intensive built structure, can bring wider benefits. These can include flood inundation from rivers, as well as enabling regeneration, community cohesion, and health and wellbeing improvements. Equally, while flooding risk caused by blocked sewerage could be tackled by investing in new pipes, as an alternative water companies could take a different approach. Engaging more with customers and communities to share information can mitigate against the causes of blockages, such as flushing of wet wipes or fats disposal, by bringing about changes in customer behaviour. It is all about trading the benefits and costs of potential financial capital investment in built capital options against what can be achieved by putting social and natural capital interventions in place.

PLACING A PROPER VALUE ON NATURAL AND SOCIAL CAPITAL NOW VITAL FOR ALL IN THE INDUSTRY

We recognise the limitations of assigning monetary value to everything. However, demonstrating the success of natural and social capital, and placing a monetary value against it, is a work in progress. And, while the body of evidence is improving, continuing to grow that will be the challenge for water companies. Natural and social capital needs to be properly valued

if we are to collectively approach water management differently. We anticipate far greater levels of community engagement and social catchment-based approaches that work with nature, to provide flexibility built-in to adapt to an uncertain future.

Ofwat's recent assessment has recognised and rewarded the companies which it perceived as having the best plans, while those falling short in Ofwat's eyes are facing closer scrutiny. Leaving aside Ofwat's reading of the runes in what companies said their plans would deliver – those that are able to demonstrate in AMP7 that they are actually delivering their commitments for long term sustainability and societal benefits – and ideally can demonstrate the monetary value that work brings – will lead the way. They will be the companies which attract investors looking for a sustainable future, as green and social bonds are increasingly attractive, with demand for these financing vehicles outstripping supply. The rise in ESG investment is phenomenal, growing from \$3 trillion in 2010 in the US to £11.6 trillion at the start of 2018 (Harvard Business Review, January 2019). It is increasingly important for water companies to offer investors more confidence that they are putting their money into a long-term vision that delivers true societal good.



ADRIAN REES

Associate Director, Arup
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Community Engagement

USING OUR EXPERTISE TO
HELP THE WORLD BETTER
MANAGE ITS WATER SUPPLIES

By Justin Abbott

Our Community Engagement (CE) programme focuses on improving the lives of the most vulnerable, marginalised and disadvantaged members of society – both where we live and work and further afield. Using our time, expertise and skills we partner with organisations who share our aims and who ensure our work has the broadest impact.

Using the United Nations' Sustainable Development Goals (SDGs) as a guide, we are committed to creating better outcomes for the communities who are the most in need. Water is central to all basic needs and is a theme that threads through significant numbers of our CE projects. The following are just a few examples of water-related projects that have created real impact during the past 12 months.

WORKING WITH INDIGENOUS COMMUNITIES TO ENSURE WATER SUPPLIES - AUSTRALIA

Our work with the indigenous Lama Lama community in far North Queensland, Australia, has led to the design and construction of a reliable water system capable of supplying the most remote areas with fresh water. With incredibly high temperatures bringing long dry seasons and the risk of bushfires, and wet seasons causing floods of the Port Stewart River – and the added danger of crocodiles – few areas in the world face a more difficult challenge than this community when it comes to water management.

As a community that hasn't been able to access safe or reliable drinking water for



over a decade, the Lama Lama people needed to restart a diesel-powered pump, manually around four to six times a day – both an inefficient and time-consuming process. A new system was needed that could be operational from distance, can work in both droughts and floods, require minimum maintenance and be suitable for a non-technical community.

Using our expertise, we designed a new solar-powered system, designed and built in partnership with the local community. The system works by positioning a submerged bore pump diagonally to the surface, using a pulley system for drawing water from the top of the main river channel. By being submerged, the pump is easily accessible and protected from extreme weather. As

well as running entirely on solar energy, the system uses an electricity-free, chemical-free filter, which uses the pressure of the intake pumps to filter the iron in the water.

Now there is a constant source of water, the local community spend less time accessing clean water, which frees up their time to focus on other areas of life and work every day. The pump is now entirely operated and maintained by the community itself, which ranges from 60 to 100 people throughout the year. The Lama Lama Rangers (an exemplar, indigenous run program, comprised of 20 community members who are responsible for the care and maintenance of the land and sea) also received training by Arup and the community partner to ensure they can manage the system themselves.

This has been a successful project from concept through to design and implementation and is a great example of lateral thinking in situations where there are many local constraints. It's also a system that can work in any indigenous community facing similar constraints within Australia, or the wider world.

ENSURING EVERY HOUSEHOLD IN THE GUATEMALAN HIGHLANDS HAS SAFE WATER SUPPLIES - SAN FRANCISCO, CENTRAL AMERICA

As part of the Global Challenge initiative, our New York office has partnered with charity and NGO, Engineers Without Borders to provide safe water supplies and hygiene practices to every household in San Francisco, a 750-person community



located within the municipality of Chiché - a dry corridor of the Guatemalan Highlands.

Population growth and climate change has led to water demand significantly exceeding supply in this area of the world. During the wet season, the community collects water through rainwater harvesting, but that often leaves insufficient supply during the dry season. Often the collected water is of unsuitable quality for drinking water and frequently not boiled sufficiently by residents to make it safe for consumption.

Our solution was straightforward – to provide a tap with safe water supplies to every home and to implement household sanitation services using latrines. However, as simple the process may be, the project has



been prone to many design challenges. The gravity-fed network needed to supply the community covers more than 20 km, with 300 river crossings, substantial elevation changes and steep terrain. Such conditions have adverse effects such as varying pressures that need to be managed while also minimizing losses. Given the location, the network is being constructed entirely by hand by 100 community volunteers with the support of experienced construction foreman. Once this is completed, a storage tank and distribution network will be installed within the community to supply each household with a tap stand.

Our team has travelled to San Francisco twice to carry out land surveys to fully understand the challenges ahead. They have been assessing the quality of water and understanding the community's water demand and more about their lives in helping plan and design a system that will last 20 years and meet the needs of a larger population in future years.

An ambitious schedule of four months has been set for completing construction during which our team will travel to San Francisco at least twice to aid in construction, monitor progress, and offer technical support. After the implementation of the project is complete, we will travel again to gather data to measure the impact on the health and well-being of the community and our findings and lessons will be shared to help in future projects.

Alongside the expected health benefits, we are also hoping to see social and economic benefits. Residents, specifically women and children will be able to

delegate more time towards school, work, and other responsibilities, rather than water collection. Many women in the community, for example, are highly skilled embroiders and will hopefully be able to spend more time producing and selling their crafts, allowing for greater financial contribution to the family.

This project also has the potential to benefit many other communities within the municipality of Chiché who lack access to safely managed drinking water and sanitation services.

DEVELOPING AN INTEGRATED WATER RESOURCES MANAGEMENT (IWRM) TOOLKIT TO PROMOTE SUSTAINABLE AND INCLUSIVE WATER, SANITATION AND HYGIENE SERVICES IN THE WORLD'S MOST MARGINALISED COMMUNITIES

Also as part of our Community Engagement's Global Challenge initiative we are working with partners to ensure the sustainable management of water resources in the Indian states of Chhattisgarh and Madhya Pradesh. The states are populated by several tribes with poor socio-economic indicators including education, healthcare, income and limited access to basic services including water, sanitation and transport infrastructure.

Both regions face over-exploitation of groundwater due to poor water resource management, and a changing climate will create additional pressures in years to come. Whilst there are many institutions and organisations involved in water resources allocation in India, there is no nationally consistent or widely effective approach to sustainable water resources management.

Through our collaborative 'WASH Basins' project between Arup, FRANK Water and two India-based partners, Samerth and the People's Science Institute, we are developing a toolkit for embedding IWRM principles to support sustainable and inclusive water, sanitation and hygiene (WASH) services. It will aim to empower communities and local government to jointly manage water resources in a way that meets the real needs of the local areas – whilst responding to the national and international context and aligning with the UN Sustainable Development Goal 6.5.

However, over the past 12 months our research, field visits and partner discussions have identified a mixed level of understanding in India of the relevance of IWRM at district and village council levels. There is also a misalignment between national and state level policies and frameworks, with disconnect amongst governmental and non-governmental organisations, and



community organisations, with regards to the application of IWRM and the provision of WASH services. The challenge now is bridging this gap at multiple levels of governance. To approach this challenge, we have developed a six-stage 'water security' process which brings together key steps for sustainable water supply, sanitation and resource management. An important aspect of this process is the use of digital tools for data collection, analysis and sharing information across the different levels of governance. This can help foster a consistent approach to water resource management. Following the introduction of the toolkit, data will be gathered on a number of SDG-aligned indicators including the percentage of population using safely managed drinking water and sanitation services, along with health data.

WORKING ALONGSIDE COMMUNITIES ACROSS THE WORLD SHAPES US

We believe that we are also impacted by the work we do alongside our communities and partners – which in turn influences the way we consider designs in future.

Our people continue to use their professional skills to reduce suffering and improve the lives of those in need – last year, our Community Engagement work delivered hundreds of impactful projects across more than 40 countries.



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[Click here to read more](#)

REGIONAL ROUNDUP

Americas

By Janine Witko & Sheba Hafiz

The Americas region faces many of the same challenges that we see globally – increased urbanization, impacts of climate change and limited water resources. Effective water management, development and implementation of capital improvements to address resiliency and sustainability, and addressing ageing infrastructure needs are critical. We assist our diverse client base in addressing these very issues.

Our innovative work includes sustainable master planning, blue/green infrastructure design, new water tunnel designs and a wide range of water systems modeling. From the San Francisco Bay area to the Boston metropolitan area, we have forecasted water demands, assessed wastewater treatment and reuse technologies and analyzed stormwater management strategies. We see this approach to achieving the UN Sustainable Development Goals increasing throughout the Americas, for both greenfield and brownfield sites.

Our team has helped address geotechnical issues associated with both new and existing water tunnels and dams, while applying innovative approaches to collect critical geophysical data to support our design and minimize risk and costs for our clients. We see an increasing need for new water tunnels to address reliability and redundancy in water supply due to ageing infrastructure, and new CSO tunnels to provide storage and/or conveyance of stormwater, particularly in our growing urban areas.

We have designed hundreds of blue/green infrastructure practices across the US, and similarly planned and designed storm resiliency measures, including flood barriers, for protection during critical storm events. Our unique approach to hydrological analyses has enabled transit organizations to develop cost effective and focused means of protecting assets for catastrophic storms. Dashboards were developed to enable visualization of hydraulic modeling results and the impact of flood mitigation alternatives throughout their systems.

Miami FL is one of the five major cities where we developed the City Water Resilience Framework, and plan to continue the implementation phase into 2019. We see this as a valuable tool to assist other cities in becoming more resilient. We continue to be actively involved in the industry, presenting at national and regional conferences such as the Water Environment Federation Technical Exhibition and Conference (WEFTEC), StormCon, Verdexchange, P3 Water Summit and the TRIECA annual stormwater conference in Toronto.



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Our Stories



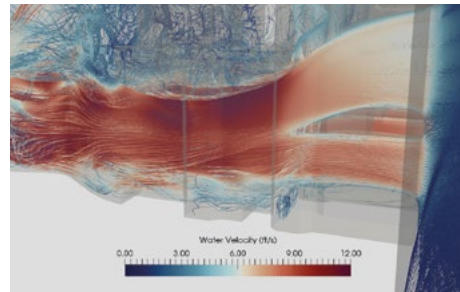
UNION POINT, WATER STRATEGY AND PLAN, MASSACHUSETTS

Union Point is the reimagining of an abandoned Weymouth, Massachusetts air force base. The development features 10 million square feet of residential, industrial, commercial and office buildings as well as over 1,000 acres of open space, landscape, water features and recreation. Arup provided multidisciplinary backing for the masterplan, supporting the water, energy, transportation, and digital strategies for the site.

As part of the water strategy, Union Point incorporates sustainability and digital technology to form a unique integrated water management plan. This strategy is the result of project vision and capacity-stressed municipal infrastructure. Arup studied how water conservation, efficiency, and reuse can be implemented to reduce the water and sewer demands and delay – or eliminate – the expansion of the surrounding public utilities.

Arup developed an integrated water management plan for multiple development scenarios. Baseline water and sewer demands were estimated using Massachusetts Title V design flows. This demand included buildings and site features such as landscape and water features. Studies were then performed to understand how these baseline demands may be reduced by conservation, efficiency and reuse strategies.

The wastewater strategy included a 2 Million Gallons per Day (MGD) treatment plant, which was co-ordinated with several suppliers to assess potential technical quality and financial delivery mechanisms.



KENSICO EASTVIEW CONNECTION DESIGN AUGMENTATION, NEW YORK

The New York City Department of Environmental Protection (NYCDEP) is responsible for supplying eight million New York City residents and one million upstate consumers with drinking water in sufficient quantity to meet all present and future water demands.

To provide water supply redundancy and increased system reliability, Arup was retained to provide integrated design and design services during construction for the Kensico-Eastview Connection Tunnel Design Augmentation Project.

The project includes the following components: a new 27 ft diameter deep rock tunnel and two tunnel shafts, a new Screen Chamber building, and provision for connection to the Catskill Delaware Ultraviolet Disinfection facility (CDUV), the Upper Effluent Chamber (UEC) and a future water filtration plant.

Extensive geotechnical investigations and computational fluid dynamics (CFD) modeling, as well as other specialty design studies, are also being undertaken as part of this project.

The new aqueduct will provide an additional conveyance between these vital components of the water supply, giving NYCDEP the ability to take other facilities out of service for periodic maintenance and inspection.



NYCHA RED HOOK HOUSES RESILIENCY, NEW YORK

New York City Housing Authority Red Hook Houses in Brooklyn, NY were severely affected by Hurricane Sandy in October 2012.

The storm permanently damaged the majority of the electrical and heating systems, while also causing extensive roof and basement flood damage throughout the 28-building campus. As part of the efforts undertaken to restore normal operations for residents and staff, significant emphasis was placed on ensuring future resiliency when redesigning and rebuilding the site.

At a campus-level, an enhanced site-wide hot water distribution network was developed utilizing a central plant complete with back-up electric generators in case of future power outages.

Other MEP and utility equipment upgrades were relocated to new smaller utility buildings constructed above design flood elevations calculated for future storm surges incorporating expected sea level rise.

These back-end improvements were coupled with overall site enhancements for residents that included new landscaping, recreational areas, playgrounds, redesigned parking, and improvements in both overall site and building accessibility.

Throughout the overall site redevelopment accompanying the utility and programmatic redesign, stormwater management was prioritized.



CITY OF RIALTO, WATER SERVICES, CALIFORNIA

In 2012, the City of Rialto entered into a public-private partnership (P3) with Rialto Water Services, a project company formed by Table Rock Capital with the goal of upgrading the city's aging water supply and treatment infrastructure.

This is one of the first water P3 projects to be financed using a combination of private placement bonds and private equity in the United States.

Due to the complex commercial structure and the detailed technical aspects of the project, Arup was commissioned first to perform technical due diligence and retained since as the independent technical reviewer of the design and construction of the water and wastewater system expansion and upgrade. Arup's provides advice on technical, commercial, financial and regulatory aspects of the project.

Arup's unique mix of technical and financial resources has enabled the client to pinpoint a range of issues and formulate solutions to ensure the highest quality project with minimal risk.

The wastewater treatment plant expansion at Rialto is being delivered under a Design-Build-Operate and is currently under construction with the Arup team providing independent advice on technical and financial issues arising during construction.

REGIONAL ROUNDUP

Australasia

By Daniel Lambert

It has been a busy year across Australasia, with Arup having won iconic water projects including the Sydney Water Planning Partner, Central Interceptor design role in Auckland and Queanbeyan Sewerage Treatment Plant in New South Wales. The Sydney Water Planning Partner role is a 10-year contract which involves Sydney Water, Aurecon and Arup developing a fully integrated team to deliver their planning and concept design services as one team. Sydney Water is Australia's largest water utility and this new delivery model is an exciting one for Sydney Water, Arup, Aurecon and the broader water industry.

Central Interceptor will be Auckland's largest wastewater tunnel and is the largest wastewater project ever delivered in New Zealand. The project comprises a 13km long, 4.5m diameter Central Interceptor wastewater tunnel between Western Springs to a new pump station at the Māngere Wastewater Treatment Plant. This project will improve the health of Auckland's waterways by reducing wet-weather overflows and provide for population growth. Not only that, its construction will create employment and opportunities for the city.

Queanbeyan Sewerage Treatment Plant is located in regional New South Wales and is one of Australia's largest regional wastewater treatment plant upgrades.

In addition to these iconic projects, we are continuing to provide innovative solutions to clients throughout the region both cities, regional areas and on the Pacific Islands. Our work in strategic planning (including Urban Water Reform advice to Infrastructure Australia, South East Queensland's long-term scenario planning) is complimented by advisory and design services in more remote areas, including developing Community Based Sanitation Enterprises in Vanuatu and water planning solutions for the communities in Torres Strait Islands. Our water business is passionate about working with clients to deliver solutions that challenge the status quo. We effectively draw on our international expertise and an understanding of our clients' bespoke contexts.



DANIEL LAMBERT
Arup Australasia Water Leader
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Our Stories



AUCKLAND 2050 WATER STRATEGY, NEW ZEALAND

The Auckland Water Strategy will address the full range of water issues in Auckland and develop a conversation around Water in Auckland. It will set the regional directions, to eventually inform Unitary Plan changes and other policy changes.

Arup's team is currently seconded into Auckland Council to develop their Water Strategy for Auckland. The Arup staff sit in a collaborative team, comprised of members from Auckland Council, Auckland Transport and Watercare, to develop this future looking Water Strategy.

The Water Strategy is being developed in a number of steps. Arup's involvement has thus far been:

- Developing, running and facilitating workshops with a range of Subject Matter Experts and key stakeholders to gain insight into the water issues across Auckland
- Setting out global, national and local context and applying Arup's global experience in water strategy and foresight to the local Auckland context
- Research and development of an overall strategy and approach to water in Auckland
- Development of a Draft Discussion Document, setting an aspirational vision, values, big issues, principles and processes to work on

Working closely with Auckland Council and other CCOs, the team's initial secondment of six months was extended to 18 months. This is an exemplar project example of working collaboratively with Auckland Council, as one team, and providing global expertise on a local scale.



BURDEKIN LONG TERM SCENARIO, NORTH QUEENSLAND

The Burdekin region's resource rich area and land suitable for agricultural development, coupled with available and secure water, creates an ideal opportunity for economic development with commercial as well as broader economic returns. Water infrastructure solutions can unlock this potential; however, deciding on the right mix of solutions in an uncertain future is a challenge.

In collaboration with Deloitte Access Economics, Arup undertook an internal pilot of the Sunwater Regional Blueprint which provides a strategic response suitable for a range of possible future conditions.

Using horizon scanning and stakeholder workshop methodologies, Arup developed scenarios to explore possible futures for the Burdekin region. Key factors likely to impact the Burdekin region over the next 20 years were identified; foresight techniques were applied to construct four future scenarios, and frameworks were developed to support early evaluation.

A suite of potential infrastructure and non-infrastructure solutions have been assessed for benefit and feasibility under each of the future scenarios. Investment prioritisation is supported by the assessment, along with a preliminary decision making framework. The blueprint includes trigger points and planning horizons. Subsequent to the completion of this internal pilot project, external stakeholders were consulted in a regional rollout to develop the Sunwater Regional Blueprint, refining the scenarios and solutions.

Whatever the future holds, Sunwater is now in a better position to meet future demand and ensure the future prosperity of the Burdekin region.



DEVELOPING A SUSTAINABLE WATER FUTURE, TORRES STRAIT ISLANDS

Arup has been working with the Torres Strait Islands Regional Council (TSIRC) to develop a Sustainable Water Management Plan to guide the long-term transformation of TSIRC's water business over the next 25 years, facilitating more sustainable, cost-effective and resilient water and wastewater service provision.

Through this project, Arup has worked collaboratively with TSIRC to develop a holistic understanding of the existing water infrastructure and operations, as well as the unique challenges and opportunities of operating 15 separate Water Treatment Plant and networks. Arup assessed island specific strategies as well as a region wide approach.

The Sustainable Water Management Plan will ensure the resilience of water supply and water quality for the 15 communities of the Torres Straits.

The critical success factor for the project has been the collaborative process with TSIRC who have a deep understanding of the infrastructure across the islands. They also have strong relationships with each of the islands and an understanding of community needs.

This plan will guide the long-term transformation of TSIRC's water business over the next 25 years, facilitating more sustainable, cost-effective and resilient water and wastewater service provision, and deliver improved health, economic and social outcomes for the people of the 15 Torres Strait Island communities.



SCENARIO PLANNING FOR SEQWATER, SOUTH EAST QUEENSLAND

The water industry plays a vital role in supporting quality of life in South East Queensland (SEQ).

Reliable, high quality water supplies and strong water security for urban, agricultural and industrial uses allows society to flourish and the economy to prosper. However, planning for an uncertain future remains a challenge which the region is currently striving to address.

Seqwater and the region's water service providers partnered with Arup to deliver a landmark future planning program for water industry in the region. The unique multi-agency collaboration involved close to 50 key stakeholders from across the region to deliver a vision of our collective water future.

A series of workshops gathered input and feedback from stakeholders to form the project's outputs. The major forces shaping the region for the next 50 years were explored, with nine key factors selected as the basis for defining a range of plausible futures. Each of the six developed scenarios represents a different combination of factor projections, and collectively describe the boundaries of possibility.

Detailed narratives accompany each scenario, enabling users to fully envision the scenario. The narratives include timelines, influences from the various drivers, and potential impacts on the region and the water industry in the future.

The outcomes will not only inform Seqwater's Water Security Program, it is made available to the broader SEQ water industry to provide a useful, relevant and consistent basis for a range of planning and decision-making activities.

REGIONAL ROUNDUP

East Asia

By Kenneth Kwok & Adrian Marsden

We continue to support our clients across the Southeast Asia region to deliver integrated water management planning and climate resilient infrastructure, and our portfolio of works outside Hong Kong and China has significantly increased.

In Hong Kong, we have been engaged by the Government to carry out independent safety inspections and advisory services for 66 impounding and service reservoirs over a five-year period. We are also formulating a long-term drainage and sewerage master plan for the existing Hong Kong International Airport and its expansion.

Our works on sponge city and green infrastructure in China have gathered pace. At present, we are designing a regional watershed improvement and wetland restoration scheme in Nanjing, which covers an area of 11km². We are also working on a large-scale drainage improvement scheme for the Shanghai city.

In Manila, following the start of our 5-year framework agreement with Manila Water Company Inc., we are now working on three large sewer network and sewage treatment plants and a new water treatment plant project. We are also continuing to deliver other new process and process improvement projects in the Philippines, examples include Taguig central sewerage system, Kaliwa water treatment plant and Laguna lake water treatment plant. Responding to the Government's 'Build Build Build' programme, our growing water team in Manila is supporting several significant highway and railway infrastructure delivery projects.

The Southeast Asia region is rapidly growing and also experiencing the results of development. Many part of the region still suffer water supply restrictions and inadequate sanitation and we see the need for more integrated thinking across the water cycle and urban development being a key driver for the future. Working with multi-disciplinary teams, we will continue to apply our 'Design with Water' and 'Smart, Green, Resilient' approaches to our urban retrofitting and new development projects.



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Our Stories



EXAMINATION AND REPORT ON THE SAFETY OF RESERVOIRS, HONG KONG

We have been recently appointed by the Water Supplies Department (WSD) of Hong Kong Government to carry out the independent inspection of six impounding reservoirs, 15 large service reservoirs and 46 small service reservoirs across Hong Kong, quantitative landslip risk assessment (QRA) for large and small service reservoirs and to provide advisory services on any matters related to the safety of any impounding reservoirs, service reservoirs, slopes and earth retaining structures.

Under the United Kingdom Reservoirs Act 1975 (the Act), raised reservoirs having a storage capacity exceeding 25,000 cubic metres are required to be inspected from time to time by an independent 'qualified engineer' who should produce inspection reports with recommendations on the measures or any remedial works to be carried out in respect of the safety of the reservoirs.

WSD has adopted this aspect of the Act as a requirement for the proper maintenance of the impounding reservoirs and large service reservoirs with capacity exceeding 25,000 cubic metres. Because of the extremely high population density and the hilly terrain of Hong Kong, some small service reservoirs with capacity not exceeding 25,000 cubic metres are constructed on hillsides close to densely populated areas, which may also have a significant risk to the safety of the public and water leakage from the service reservoirs, if any, may in the long term affect the stability of the slopes in the vicinity of the service reservoirs. To address these problems, the current practice of inspecting large service reservoirs by an independent 'qualified engineer' has been extended to cover the small service reservoirs and quantitative landslip risk assessment (QRA) has been carried out on the slopes and/or earth retaining structures in the vicinity of the service reservoirs.



LAGUNA LAKE WATER TREATMENT PLANT, METRO MANILA

We have commenced work on the Laguna Lake Water Treatment Plant (LLWTP) project. This builds on our recent work with the Putatan Water Treatment Plant 2 scheme.

LLWTP will ultimately provide 150 million litres of treated water per day to the residents of the southern areas of Metro Manila, reducing the demands on the overstretched surface water sources north of Manila.

The plant will take water from Laguna Lake, which is heavily contaminated with a range of organic and inorganic pollutants. Our assessment of the existing data shows that the lake quality is deteriorating year on year resulting in higher levels of solids and algal blooms, which complicates the treatment needs. In addition, the local standards for acceptable levels of TriHaloMethanes (THMs) have recently been tightened. This further challenges our process engineering skills, as THMs are a bi-product of processes to remove organic pollutants.

Dissolved Air Flotation (DAF), Biological Aerated Filter (BAF) with activated carbon media, Ultra Filtration (UF) and Reverse Osmosis (RO) treatment. A new storage reservoir and pumping station is also being provided.

The site area available for the new plant is extremely small, situated directly adjacent to the lake and within a highly residential area, including several narrow roads. Our team has undertaken a site assessment and prepared an Environmental Impact Assessment report with appropriate controls to help manage the impact on local residents in both the short and long term.

It is expected that the plant will be able to deliver water by 2022.



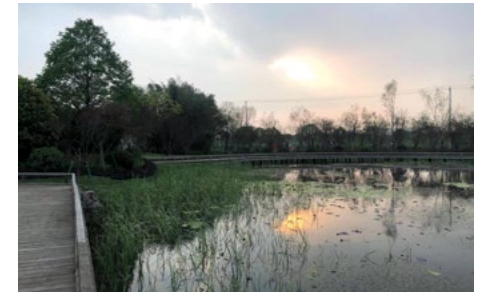
AIRPORT WIDE DRAINAGE SYSTEMS REVIEW, HONG KONG

We are pleased to announce that Airport Authority Hong Kong (AAHK) has appointed us as their professional consultant to carry out an extensive master plan study on airport wide drainage systems covering the entire Airport Island and other planned AAHK developments such as extending the existing Airport platform into Third Runway System. The overall study programme takes 18 months, which commenced in mid-January 2019.

In the study, a holistic review of the existing and planned sewerage and drainage systems will be implemented to appraise its current performance, mitigate existing flooding risks and septicity problems and formulate masterplans to strengthen and improve the resilience of the sewerage and drainage infrastructure.

A series of site surveys on sewerage and drainage systems will be conducted to obtain necessary information for the hydraulic modelling. Based on the modelling results, the formulated masterplans shall derive medium and long-term strategies. Moreover, it shall make use of the latest hydraulic modelling technique with adoption of new design parameters for rainstorm and surge events and taking into account actual hydrological data for model calibration and verification to improve its prediction accuracy and credibility.

The review not only adheres to produce and update master plan for sewerage and drainage systems, but also encompasses a long-term vision in asset data management. We will develop an Asset Information Management System to provide a secure, user-friendly control and management experience over assets of airport utilities infrastructure.



WATERSHED IMPROVEMENT & WETLAND RESTORATION, SHANGQINHUAI

The Shanghai infrastructure team have been working closely with Ecology teams from London and Leeds and the London Landscape Architecture team. This has showcased how a true multidisciplinary approach can produce innovative designs that respond to some of the key challenges the world faces today. Arup provided landscape, ecological restoration, wetland design, hydrology & flood control and water hydraulic infrastructure service.

The Shangqinhuai project involves the restoration of a 11km² area of wetlands in China upstream to Nanjing city, which is a mother river of Nanjing and part of the wider Yangtze River basin.

Currently the area is heavily polluted, principally through unsustainable agricultural practices and intensive fish farming. The aspiration of our client, the Nanjing local government, is to deliver ecological restoration and water remediation to the area, provide public access to nature and green spaces but also importantly for the area to retain its agricultural potential. The site is also part of a wider plan to bring filming industry to the region.

To achieve these aspirations, which to a degree were conflicting, our concept designs focused on using Nature Based Solutions (NBS). These would provide water remediation and a healthy, functioning and resilient ecosystem, supporting diverse wildlife which in turn would provide a range of ecosystem services to local people and the wider region. The team also detailed opportunities for agricultural tourism and ecotourism opportunities and worked with our cultural heritage team to provide details on cultural tourism.

REGIONAL ROUNDUP

Europe

By Justin Abbott & Eoghan Lynch

Ireland has invested significantly in the water business over the last 5 years (since Irish Water was formed in 2013). We are delivering an important WWTP project in Arklow, a number of WWTP upgrades, a number of untreated agglomerations in Cork and a de-salination study for the Aran Islands. Our global colleagues have done extensive advisory work in the water sector and we plan to bring this service offering to Ireland and subsequently other utilities within the region. Our asset management and transaction advice disciplines in particular have excellent experience of bringing very high value to clients throughout the world and we plan to draw upon this experience for the benefit of our clients in Europe.

Ireland has also built a good track record on flood protection with the Office of Public Works (OPW) over the last 5 years and is now delivering a number of important projects in Cork (including Cork City Lower Lee), Limerick (Kings Island) and Dublin (Dodder). The OPW need to deliver a strong pipeline of projects over the next 10 years and we aim to increase the size of the team to respond to this need.

There is a strong demand for flood protection services throughout the Europe Region and we plan to build upon the expertise in Ireland, Poland and to a lesser extent in Spain to service other areas. We have good experience in this sector and our core skills are well supported by our other skills (such as master-planning, sustainability, cities resilience, maritime etc) to give us a strong holistic service offering. We need to do some strategic recruitment of experienced people to support this.

Our Poland team recently won an integrated catchment model project for MPWiK in Krakow. This covers the entire city of Krakow and is one of the largest integrated catchment models in the world.

We are exploring how we and our clients may apply more digital technologies to the water business – in particular, we will be introducing Digital Tide to the industry in Europe.

We plan to do more work on clean water and waste water systems in the Europe Science & Industry sector (e.g. for pharmaceutical and technology clients). We have a very good track record with global S&I clients. We can provide a broad range of services which are complementary to the core water offering, giving our clients a truly holistic service.



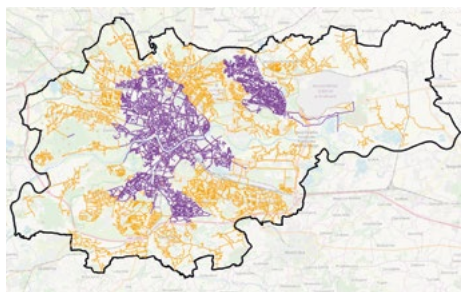
JUSTIN ABBOTT
Arup Global Water Skills Leader
Arup Dublin office, Ireland



EOGHAN LYNCH
Director, Arup
Arup Cork office, Ireland



Our Stories



DEVELOPMENT OF THE MOST COMPLEX EXTENSIVE HYDRAULIC MODEL, POLAND

Our team is working on the integrated catchment model for city of Krakow, southern Poland, that is currently the most complex hydraulic model in the country and one of the largest integrated catchment models in the world. The hydraulic model will include foul water and integrated networks as well as part of surface water drainage connected to, or dependent on, combined drainage systems. It will also include technical infrastructure connected to existing networks.

The network model will be integrated with surface runoff, which will be calculated based on spatial data such as Light Detection and Ranging (LIDAR) surveys, geology maps, digital terrain models and city plans reflecting roads, footpaths and buildings arrangement as well as other terrain obstructions which may influence waterflow or infiltration. Hydraulic model will be calibrated based on the extensive monitoring campaign covering around a dozen mobile monitoring points, almost 180 permanent monitoring units, 25 monitoring units installed for a minimum of three months and 30 rain gauges collecting the data about pipe flows and rainfall intensity.

All network data owned and maintained by the client, Krakow Water Company, will be analysed, verified and confirmed on site if necessary. In addition, Arup is responsible for provision of training sessions, manuals and design guidance catalogues for the client.

This project continues Arup's innovative approach to the project development, based on a close cooperation with the client, knowledge exchange and sharing the scope of works which helps in development of the client's competencies and capabilities for future maintenance and further development of the project outcome. The involvement of the client's experts at all stages of the development and calibration of the hydraulic model will enable the use of employee experience and joint development of a very detailed mathematical model accurately reflecting the work of the network and related technical infrastructure.



LOWER LEE FLOOD RELIEF SCHEME, IRELAND

Over the past year, our multidisciplinary team of engineers, scientists, architects and other specialists have continued to work very closely with the Office of Public Works and Cork City Council to further refine and develop an integrated public realm and flood defence project for Cork City.

The project will protect more than 2,100 properties currently at significant flood risk. It provides an opportunity to significantly enhance key public realm spaces in the city and will increase confidence in Cork City as a destination for significant future investment in the city.

The Scheme consists of a sophisticated flood forecasting system, revised dam operation, partial diversion of peak flows, rural embankments, and low-level quayside defences. With an estimated project value in excess of €140m, it will be the largest flood relief project ever to be undertaken in Ireland. The project includes a significant investment in the restoration of our historic quays as well as providing over one kilometre of new river amenity walkways and cycleways. It will deliver a sustainable flood relief scheme, with a clear climate change adaptation strategy and has been developed holistically considering wider benefits including societal health and wellbeing.

The Scheme incorporates a number of elements which deliver on many of the UN Sustainable Development Goals. An advanced phase of the project at Morrison's Island was lodged for statutory consent in late 2018, with an oral hearing expected shortly. We are currently finalising the statutory documentation for the main Scheme with a view to submit for statutory approval later this year.



ARKLOW WASTEWATER TREATMENT PLANT, IRELAND

The Arklow Wastewater Treatment Plant is the largest water project that Arup Ireland is currently delivering. It is a strategic and high-profile project for our client, Irish Water, with an estimated capital value of c. €80 million. Arklow is one of the largest remaining 'untreated agglomerations' in Ireland. Due to the current lack of treatment in the town, Ireland is in breach of European legislation and could be facing substantial fines if the situation is not rectified.

The project comprises a 36,000-population equivalent (PE) wastewater treatment plant, associated interceptor sewers along the quays, a long sea outfall to discharge treated effluent to the Irish Sea and an upgrade of the existing coastal revetment adjacent to the site. As expected in a project of this scale in an established urban centre the design has posed lots of challenges for our design team.

Add to this, the need to take account of the proposed Arklow Flood Relief Scheme planned for the town, which overlaps with our scheme, and it is clear to see how interesting and challenging a project this is.

At present, we are finalising tender documents for the Design Build Operate contract. We also await the decision on the planning application and are in the process of finalising the foreshore consent and the wastewater discharge authorisation applications to the relevant authorities. The current programme indicates award of contracts in early 2020, with a 3.5-year construction programme.



EXTERNAL RAINWATER DRAINAGE FOR VALEO, POLAND

Breaking away from the traditional calculations methodology, our Krakow Water team applied a mathematical hydraulic model to optimise costs, reduce flooding risk and ensure safe drainage maintenance when working on refurbishment and enlargement of the external rainwater drainage for Valeo production plant in Chrzanów, southern Poland. The global automotive supplier engaged Arup to expand and revitalise their production plant including internal and external infrastructure.

Taking a mathematical model approach, using a software package designed for complex hydraulic modelling enabled us to create a precise picture of the existing drainage system with surrounding infrastructure, and most importantly, accurately assess its maximum performance level. The operations of the existing drainage system were then thoroughly analysed using data about local rainfall including the dynamic distribution of the rain over time, which resulted in a detailed model of a rainfall event and its impact on the drainage system. It allowed us to design a flood-resilient system with minimal impact on the natural water system around the production plant.

Our engineers incorporated the design of the drainage for the new wing of Valeo production plant with the model of the existing system to ensure a smooth integration of the two. Based on that, we created an optimised drainage system made of the most adequate components in terms of diameters, size and efficiency, that corresponds with the surrounding infrastructure, ensuring maximum performance level and reducing the costs of potential recalculations at later stages of the project due to oversizing – a frequent result of standard design approach. Model-based calculations also confirmed that the discharge of surface water into the nearby creek, after accommodating the new drainage system, might be kept at the current level in accordance with the previously obtained water permit.

REGIONAL ROUNDUP

UKIMEA

(UK, India, Middle East & Africa)

By Mark Fletcher

At a critical time for the UK water sector, we are pleased to have supported several of the utility companies in preparing for their PR19 business plans for Ofwat. There is still lots of work to do across the industry, ahead of the start of Asset Management Plan (AMP)7. We continue to invest in innovation and new technologies to help ensure a bright and sustainable future for water. In addition to our role as Network Integrator for the Hydro Nation Water Innovation Service in Scotland which you can read more about overleaf, we are growing both our ‘Venturi’ online water innovation community (www.venturiportal.com) and Wet Networks, which is Arup’s series of industry networking events featuring new, bright ideas and innovation pitches. In the past year, we have set up successful meetings across the UK, and we are on the cusp of taking this established formula international.

We are enjoying significant growth with our Advisory offering, having supported key clients including Anglian Water and Northern Ireland Water with their business strategies, as well as specific project delivery plans. We continue to work with the Welsh Water Capital Delivery Alliance and are in the process of transitioning with it from AMP6 to AMP7. In particular, we have supported Welsh Water with two significant digital initiatives:

- **Catchment Root Cause Analysis**
by developing an automated database running quality assurance and complex analysis, we have provided a solution which processes enormous amounts of raw data – including rainfall, tide and flow survey – which is then interpreted and presented visually to provide insights into catchment behaviour that were not previously possible.
- **Predictive Pollution Reduction**
with hundreds of thousands of sewer assets across its network, we are using data-driven methods to help establish which assets present the greatest risk of pollution. We are helping to build statistical models which profile each asset and help prioritise intervention, eliminating some of the challenges associated with human bias.

Finally, we were delighted to end the financial year with the news that we have been successful in securing two hubs of the Environment Agency’s new Collaborative Delivery Framework, in the North-East and Midlands. We look forward to working with our network of partners, delivering the Environment Agency’s programme of projects to create a better environment for people and wildlife.



MARK FLETCHER
Arup UKIMEA Water Leader
Arup Leeds office



Our Stories



HYDRO NATION WATER INNOVATION SERVICE, SCOTLAND

The Hydro Nation Water Innovation Service (HNWIS) is the front-end of a package of support focused on accelerating the development of water technologies in Scotland and aims to build an ambitious well-connected water sector to help develop Scotland as a recognised centre of excellence. The project is integral to delivering the Scottish Government's Hydro Nation Strategy.

In our role as Hydro Nation Water Innovation Service Network (HNWIS) Integrator, Arup is the face for industry engagement for three years to help develop the emerging cluster and stimulate a pipeline of referrals to Scottish Enterprise and Highlands and Islands Enterprise support, prospecting and wider opportunities by creating effective linkages between disparate parts of the water sector in Scotland to drive innovation, sustainability and investment, with the ultimate aim of achieving economic growth.

The role capitalises on growth opportunities and creates effective linkages amongst the constituent parts of the entrepreneurial ecosystem in Scotland and help the cluster engage in a coordinated and cohesive basis with wider UK / European activity. The aim is to ensure that Scotland's company and academic base is positioned to gain the optimum share of market growth.

This is a joint project between Scottish Government, Scottish Enterprise, Highlands and Islands Enterprise, Scottish Environmental Protection Agency, Scottish Water Horizons and Scottish Funding Council, who form the project steering group. Arup's role is being delivered from our Glasgow office, utilising the Arup global water network.



WATER SUPPLY RESILIENCE, NORTHERN IRELAND

Over the past 12 months, we have seen a truly multidisciplinary and multi-office infrastructure planning and advisory service deliver some innovative projects to help improve the resilience of water supplies in Northern Ireland.

Our Belfast team supported by technical experts from our Campus, Leeds, Bristol and Cardiff offices have all been active in supporting high profile projects such as water treatment Process Audits of over half of the clean Water Treatment Works in NI; updates to the Northern Ireland Water (NIW) Drinking Water Safety Plans (DWSP); the assessment of benefits of Ultra Violet Disinfection to mitigate water quality risks across a number of catchments; review of options to design an upgrade to a key Water Treatment Plant at Killyhevlin in the town of Enniskillen and, helping NIW improve some of their Water Resources Management Planning (WRMP) processes.

This work is in light of the high demands for water and hosepipe bans which occurred in the Province in 2018 and will be a significant challenge and area for us to support as we continue to help deliver resilient water supplies into the future.

More strategically, we are supporting NIW with the preparation of their 6-year investment plan (called PC21), drawing on our Business Planning experience from our Water Advisory team and this included us hosting the NIW Chief Executive and senior managers at a breakfast meeting in our Belfast office in January 2019 to discuss further collaboration.



SOUTHSEA COASTAL DEFENCE PROJECT, PORTSMOUTH

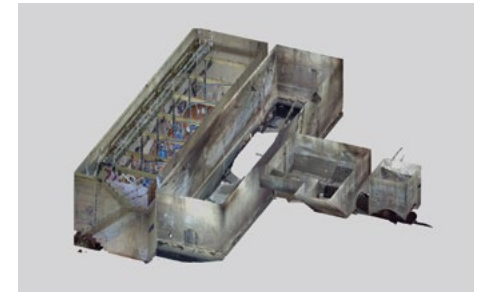
Arup is part of an integrated delivery team that has been drawn together to design and build a 4.5km coastal defence for Southsea, Portsmouth.

Throughout history, major storms have caused severe flooding in Portsmouth. In recent years, waves have regularly washed over the top of existing defences, causing damage which cost £1m in repair works.

The existing sea defences are up to 100 years old, do not provide sufficient protection against flooding, and need to be replaced or improved. It is estimated that recovering from a major flood event in Southsea could cost up to £950 million.

The scheme comprises seven individual design proposals to offer protection from a major flood event to 8,000 homes at risk from flood inundation. It will also enhance the existing public realm for the seafront introduce new character zones along the coast, as well as protect heritage sites, areas of public open space and environmentally designated sites.

Alongside organisations including the Environment Agency and Portsmouth City Council, Arup is a key member of the integrated delivery team which is specifically employed to provide civil, structural, geotechnical, landscape architecture, planning, environmental and project management services, leading to a true multi-disciplinary offering.



DIGITAL IMPROVEMENTS TO HEALTH & SAFETY, WELSH WATER

Today's technological advancements offer an excellent opportunity to couple increased efficiencies with significant improvements to health, safety and wellbeing. By embracing the digital wave, Welsh Water's Capital Delivery Alliance is reaping the benefits.

Information gathering, automation and data centralisation are key areas where the Alliance has exercised its digital acumen – saving time, resources and revolutionising work processes.

Using 360 panoramic cameras, we have been able to mount a camera on an extension pole to operate it remotely, which directly reduces risk and the requirements associated with confined space entry. Laser technology – Spike – allows dimensional measurements to be captured by taking photos. And point cloud surveys enable fully dimensioned 3D models to be developed without exposure to dangerous environments.

Automated data retrieval, processing and analysis has reduced the need to carry out repetitive tasks, thereby improving job satisfaction and making better use of designers' skills.

Finally, data centralisation is allowing the alliance to store its information on a central system – enabling it to be accessed by all relevant parties, quickly and easily, via structured keywords. This leads to improved health and safety by removing the need to be on site carrying out repeat surveys, as well as improved collaboration between teams.

CELEBRATING OUR SUCCESS

Industry Awards

People



DANIEL LAMBERT

Arup Australasia Water Leader
Arup Sydney office, Australia

Daniel has received the prestigious EngExec award – an invite-only credential reserved for members who have played a significant role in driving leadership and management as engineering professionals in Australia.



PRIYANI MADAN

Water Consultant, Arup
Arup Auckland office, New Zealand

Priyani was Highly Commended both as National Young Water Professional at Ozwater, Australia’s international water conference, and Rising Star at the National Association of Women in Construction (NAWIC) Awards.



RACHEL MURNAGHAN

Graduate Engineer, Arup
Arup Belfast office, Ireland

Rachel won the Northern Ireland regional heat of the Institute of Civil Engineers’ Emerging Engineers Award. She impressed the judges with her presentation on Arup’s Living with Water programme.



STEPHEN OLLIER

Associate, Arup
Arup Cardiff office, UK

Steve won the Outstanding Individual Contribution Award at the 2018 Capital Delivery Alliance Excellence Awards, where he was noted as a standout performer across the Alliance.

Projects



CONNSWATER COMMUNITY GREENWAY PHASE 2

This project won the Community Engagement Initiative of the Year category of the British Construction Industry Awards 2018.



THE HARBOUR AREA TREATMENT SCHEME

The Harbour Area Treatment Scheme (HATS Stage 2a), a major sewerage infrastructure project in Hong Kong, won the following awards - the ICE Edmund Hambly Award and the Tien Yow Jeme Civil Engineering Prize.



MCA AWARDS 2019

Arup was highly commended in the Social and Environmental Value category. Our work with Yorkshire Water was acknowledged for its use of data, introducing new models and challenging conventional practices. The project demonstrates the community and environmental benefits of an urban partnership – driving greater value for

money for the 2.3 million households and 130,000 businesses serviced by Yorkshire Water.

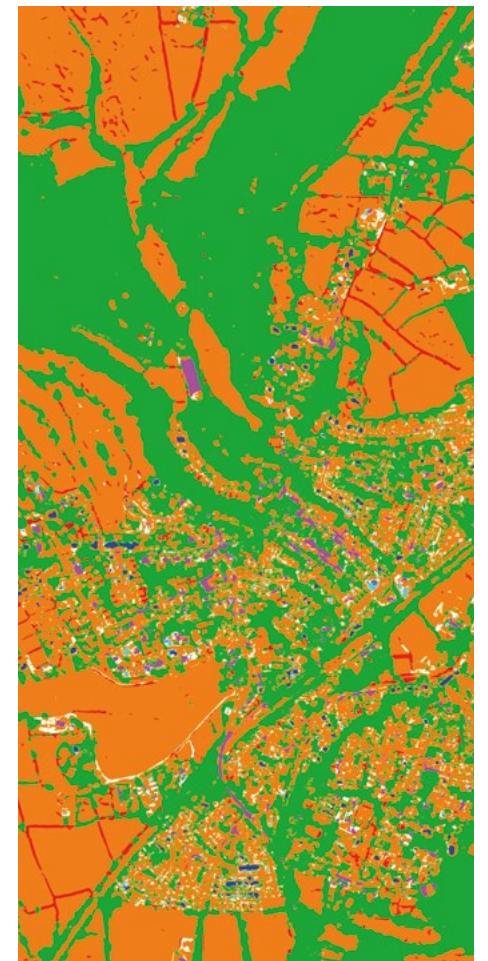
We were also awarded the Consulting Excellence Firm of the Year award, which recognised our commitment to clients and the delivery of sustainable solutions that add value, have a lasting impact and align to the UN Sustainable Development Goals.

DIGITAL TRANSFORMATION AWARDS 2019

‘Unlocking the Potential of Natural Flood Management with Machine Learning’ - won first prize at the Digital Transformation Awards (DTA) Grand Final.

The project employs cutting-edge deep learning techniques to produce high-resolution land use maps to increase resilience to climatic and seasonal extremes. It develops risk maps to identify levels of resilience to high flows, droughts and climate change across river catchments. It can also be used to monitor and make recommendations on landscape-scale biodiversity or habitat corridors, and other ecosystem services.

The judges called it an outstanding project, adding: “A high-quality solution, using an innovative methodology with global application.” The winning team and each of the category winners will now receive funding to spend on either furthering their knowledge or their idea.



2018 WWT WATER INDUSTRY ACHIEVEMENT AWARDS

Arup was successful in two categories at the 2018 WWT Awards:

Engineering Project of the Year: Greener Grangetown, a sustainable drainage system (SuDS) project that has also been designed to transform the quality of the public realm and improve cycling and pedestrian infrastructure across a city centre neighbourhood.

Drainage and Flood Prevention Initiative of the Year: Rainscape (Llanelli) with Dwr Cymru Welsh Water - developing new, innovative solutions to manage the amount of surface water entering sewerage systems.

ARUP

This publication has been produced in-house with contributions from the Arup water team globally. Special thanks go to the marketing teams in each region who helped gather information.

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