Ofwat Innovation Fund

Learning report

Rethinking wastewater systems: new approaches for wastewater networks

waterinnovation.challenges.org

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Ofwat, the Water Services Regulation Authority for England and Wales, launched the Ofwat Innovation Fund in 2020. Ofwat is a non-ministerial government department established in 1989, when the water and sewerage industry in England and Wales was privatised. Ofwat regulates the water sector in England and Wales.

The Ofwat Innovation Fund is delivered in partnership with Challenge Works, Arup and Isle Utilities. Find more information about the Fund at **waterinnovation.challenges.org**

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Learning report

Rethinking wastewater systems: new approaches for wastewater networks

Ofwat Innovation Fund

About this report

Sharing knowledge, information and data is fundamental to ensure successful Innovation Fund projects are scaled up and adopted across the sector. It also reduces the need for multiple companies to trial the same solution.

It is important that knowledge and data are shared at all stages of a project – not just at the end – so that we can all learn from what works and, crucially, what doesn't.

That is why these learning reports are so important. By sharing and learning from each other we can all help the sector meet the challenges it faces and build public trust.

Dr Jo Jolly, Director, Environment and Innovation, Ofwat

Ofwat Innovation Fund

The Ofwat Innovation Fund is a £200 million initiative established by Ofwat, the Water Services Regulation Authority for England and Wales. It aims to enhance the water sector's capacity to innovate and enable it to better meet the evolving needs of customers, society and the environment. The Ofwat Innovation Fund will continue between 2025-2030, with a further £400 million available to foster innovation.

As of May 2024, over £150 million of funding has been distributed to 93 projects.

The Ofwat Innovation Fund has always sought transformational change. At its core is learning – then sharing the information and knowledge gained across the sector. With this comes more opportunities to deploy the solutions developed by the funded projects, realising impact at the greatest scale possible.

What you will learn from this report

This report is aimed at all water sector stakeholders including water companies and their supply chain partners, academia, policymakers, NGOs and third sector/civic society organisations.

Its purpose is to shine a light on partners' experiences, insights and learnings from across the breadth of the portfolio of projects, which were awarded more than £15 million in funding to tackle the subject of wastewater – its treatment, assets and networks.

This report includes valuable insights from these projects and we are keen to see even more active dissemination of this knowledge and learning, in line with Ofwat's ambitions to support the sector's innovation maturity and collaborative nature.

As we approach the latter stages of Asset Management Period (AMP) 7, covering 2020-2025, and some funded projects are near completion or have made good progress towards their aims and objectives, now is the time to reflect, build connections and amplify the learnings and insights from the funded projects. We see this report as a starting point for connections both within and outside the sector.

Circularity in wastewater systems and processes

Much of this learning report showcases innovation in wastewater treatment and its associated assets and networks. The water sector is increasingly embracing principles of circularity and circular economies to recover resources to feed new processes. By reusing byproducts created in the treatment and transport of wastewater we reduce the need to exploit virgin materials, minimising the impacts of the sector on the environment and creating value and growth opportunities. As a result, there is a natural overlap with some of the projects and concepts featured in the first learning report, Circularity in water: resource recovery and circular economies in the water sector, which we invite you to read to complement and supplement the knowledge and insights you glean from this report.

	COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
AI & Sewer Defect Analysis	Innovation in Water Challenge	United Utilities Water for the North West	Complete	£189,315	Dŵr Cymru Welsh Water, Scottish Water, Severn Trent Water, Thames Water, Water Research Centre, Yorkshire Water
Alternative Approaches to Phosphorus Removal on Rural Wastewater Treatment Works	Water Breakthrough Challenge 1	United Utilities Water for the North West	March 2025	£2,836,698	Evergreen, Hydro Industries, Kolina, Power & Water, Southern Water, Thames Water, University of Portsmouth
Artificial Intelligence of Things Enabling Autonomous Waste Catchments	Water Breakthrough Challenge 1	Severn Trent	October 2025	£1,998,000	8power, Blackburn-Starling, British Telecom, Exeter University, Hafren Dyfrdwy Water, Microsoft, National Cyber Security Centre, Northumbrian Water, Rockwell, Southern Water, South West Water, Thames Water
Pipebots for Rising Mains (Phase 1 and Phase 2)	Water Breakthrough Challenge 2+4	Thames Water	Part 1 - complete; Part 2 - June 2026	£1,887,159	Dŵr Cymru Welsh Water, Synthotech, The University of Sheffield, Wessex Water
Transforming the Energy Balance for Wastewater Treatment	Water Breakthrough Challenge 1	Thames Water	August 2027	£6,260,000	Dŵr Cymru Welsh Water, South West Water, United Utilities, University of South Wales
Using Science and Nature to end Sewer Misery	Water Breakthrough Challenge 3	Northumbrian Water living water	April 2026	£939,377	Intelligent Gels, Thames Water, The Centre for Process Innovation, United Utilities, University of Durham
Pipebot Patrol	Water Breakthrough Challenge 4	Northumbrian Water living water	June 2026	£1,615,325	Environmental Monitoring Solutions, Gateshead Council, Jet Aire, Minicam Group, Newcastle City Council, Southern Water, Sunderland City Council, Thames Water, University of Sheffield

Introduction

Wastewater treatment and the infrastructure of wastewater systems play a critical role in a range of contexts, from public health protection, environmental stewardship and water resource management to climate change mitigation and even socio-economic and political stability.

Municipal wastewater treatment involves a multi-stage process to remove contaminants from wastewater before it is safely released or reused. **Primary treatment** screens out large solids and settles heavy particles, while **secondary treatment** uses biological processes to degrade organic matter and further reduce pollutants. **Tertiary treatment** then targets finer particles and achieves lower nutrient limits through advanced filtration and chemical processes. **Quaternary treatment** is the most advanced stage, using specialised methods, such as activated carbon filtration, membrane filtration, or advanced oxidation, to remove trace pollutants, pharmaceuticals and micropollutants, ensuring the highest level of water purity for potential reuse or safe environmental discharge.

Innovation in wastewater treatment and wastewater asset management – the way we distribute, treat and release wastewater back into the environment – is essential to address the acute crises our global society and the water sector faces, due to pressure from climate change, exponential population growth, rapid urbanisation and environmental, economic and public health challenges. It is crucial that we look for novel approaches that keep our customers and our society and environment safe and healthy.

There are a number of areas where effective and sustainable wastewater treatment and asset management can bring significant benefits.

Addressing resource scarcity

Freshwater is becoming increasingly scarce because of population growth and climate change. The safe reuse of treated water reduces the dependence on abstraction from freshwater sources – rivers, lakes and groundwater – which supports sustainable water resource management.

Enhancing operational efficiency

Upgrading wastewater infrastructure and management systems with smart technologies, automation and predictive maintenance can reduce operational costs, energy consumption and the risk of system failures, providing more efficient and resilient service delivery.

Resilience against climate change

Climate change impacts, such as increased flooding and droughts, place additional stress on wastewater systems. Innovations in asset design, treatment capacity and water reuse can make wastewater infrastructure more adaptable to extreme weather and resilient against climate-related disruptions.

Protecting public health and the environment

Wastewater often contains complex contaminants, including pathogens, chemicals and microplastics, that traditional systems may not fully remove. Advanced treatment technologies can tackle these pollutants, safeguarding public health and preserving ecosystems from pollutants and contaminants.

Reducing carbon footprints

Wastewater treatment processes can be energy intensive and emit greenhouse gases, such as methane. Innovative solutions, such as anaerobic digestion for biogas production and energy-efficient treatment methods, can help wastewater facilities become more sustainable and even generate renewable energy.

Supporting a circular economy

By recovering valuable resources from wastewater – nutrients for fertilisers, biogas for energy and other materials for reuse – innovation in wastewater treatment aligns with circular economy principles, turning waste into valuable commodities and reducing environmental impact.

As the projects featured in this report show, wastewater treatment and operations are being transformed across several technological domains and approaches, with impactful results. Below, and to contextualise the wider wastewater innovation landscape, we've highlighted some notable advances and examples of disruptive innovation from across the UK water sector and globally, in water companies, domestic and industrial water settings.

Decentralised water recycling systems

Various companies globally are pioneering decentralised greywater recycling solutions for residential and commercial applications. These systems treat greywater from showers, baths and washing machines, enabling its reuse for toilet flushing and irrigation, thereby reducing overall water consumption. This not only increases water efficiency and reuse but also decreases the load on the wastewater network, helping us to avoid the challenges being faced in combined sewer overflows and their use. What's more, we are also seeing disruptive innovation in decentralised wastewater treatment. Rural, often outlying and less populous areas have tended to use small package plants or septic tanks for wastewater treatment. Now, technology systems are entering the market that require minimal intervention but produce a good quality, compliant effluent. This reduces the need for larger asset investment and maintenance.

Advanced membrane technologies

Innovations in membrane technology, including forward osmosis, pressure-retarded osmosis and membrane distillation, have enhanced wastewater treatment efficiency. These advances offer improved module designs and reduced costs, making them more accessible for widespread adoption.

Artificial intelligence and machine learning

The integration of artificial intelligence (AI) and machine learning into wastewater management allows for predictive maintenance, real-time monitoring, and optimisation of treatment processes. These technologies enhance operational efficiency and reduce costs by anticipating system failures, short-term shocks and helping operations teams to manage and allocate resources.

On-site water reuse systems

From an industrial water perspective, companies with large water footprints are developing on-site water reuse systems, which are capable of recycling up to 95% of wastewater. These systems not only conserve water but also reduce reliance on municipal water supplies and treatment systems.

Nature-based solutions

Nature-based solutions, such as constructed wetlands and bio-based remediation technologies, offer sustainable wastewater treatment options. These methods use natural processes to treat wastewater, reducing energy consumption and environmental impact.

Smart, sustainable and safe

Wastewater treatment and infrastructure are at the forefront of addressing some of the most pressing global challenges, from water scarcity and climate change to public health and environmental protection. The advances highlighted in this report demonstrate the transformative potential of innovative technologies and sustainable practices in creating resilient, efficient and responsible wastewater systems. By embracing both technological and nature-based solutions, and placing nature at the heart of our decision-making in wastewater management, the water sector can enhance its operational capability and evolve to meet growing demands and pressures across a variety of fronts. These innovations not only ensure cleaner water and a healthier environment but also pave the way for a future where water management is smarter, more sustainable and integral to societal wellbeing.

1 Building our knowledge

These project-specific learnings and insights aim to inform innovative practices and approaches as well as catalyse new relationships to create impact across the UK water sector – for the benefit of customers, the environment and society.

The Ofwat Innovation Fund delivery team worked alongside partners that had received funding and completed projects, or were part of projects still in flight. Using the responses collected from a learning support survey, as well as other sources of information, the team surfaced insights and learnings that are applicable to others, whether they are delivering projects in similar fields, or looking to apply to future rounds of the Ofwat Innovation Fund.

Knowledge exchange remains a barrier to scaling innovation in the water sector and this has been recognised across a wide range of stakeholders, from water companies and supply chain entities to regulators and policymakers. These reports are part of a suite of measures the Ofwat Innovation Fund is taking, alongside other sector bodies, to catalyse the implementation of the knowledge, outputs and tools generated across all the funded projects. In this way, through collaborative innovation, we are increasing the capacity and capability of the sector to solve the challenges it faces.

AI & Sewer Defect Analysis

COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Innovation in Water Challenge	United Utilities Water for the North West	Complete	£189,315	Dŵr Cymru Welsh Water, Scottish Water, Severn Trent Water, Thames Water, Water Research Centre, Yorkshire Water

The project, led by United Utilities in partnership with six others, focused on collecting thousands of wastewater network CCTV video images and categorising these images to produce a dataset that can improve AI models for defect detection. The initiative involved collecting extensive data on defects such as pipe cracks and invasive tree roots.

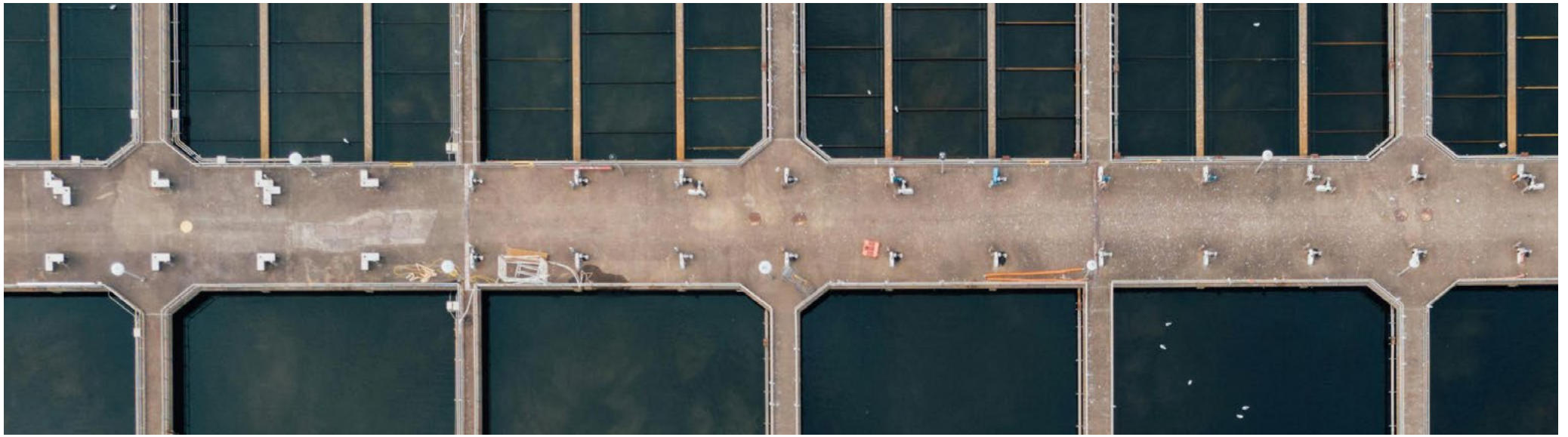
This dataset of 27,000 clean images has been made publicly available so that other water companies and organisations can train their own algorithms. The initiative also included an adoption plan to guide water companies on how to best leverage the data and enable more effective network assessments, reducing operational costs and service disruptions. Ultimately, this project provides a reliable tool for better sewer maintenance management and risk reduction.

"We're really pleased with the level of accuracy in images achieved using this dataset. It was a hugely ambitious project – shown by the sheer volume of data we were able to process – and we hope that water companies and suppliers will take this dataset to improve the accuracy of their models. We also hope it will be valuable to people outside the sector, who may be able to use it for new services and uses we haven't even considered. The achievement should also inspire and accelerate the use of AI within the water sector more generally."

Kieran Brocklebank, Head of Innovation, United Utilities

Key learnings and insights

- **Ofwat project success**: this project is one of the first Ofwat-funded collaborations to reach successful completion, highlighting a pathway for future projects in the sector. As one of the first funded projects, there were a number of hurdles to overcome from a technical, partnership and governance perspective. It showed that collaborative efforts among water companies can successfully pave the way for bigger, more complex initiatives in the sector.
- **Dataset availability**: a cleaned and usable dataset has been published and is now open for public use, demonstrating the feasibility of open data initiatives in this field. This dataset is a valuable resource for AI developers and stakeholders, enabling new insights and potential updates for AI models related to water management.
- **Key takeaway on collaboration**: the project confirms that wide-scale collaboration in the water sector, across organisational boundaries and differing systems, approaches and operational contexts, is both achievable and hugely beneficial, facilitating the creation of usable, open access datasets. By working together, water companies can produce resources that serve industry stakeholders and broader research or development communities, so we may go further, together, for our customers and the environment.



Benefits

- **Removing barriers to AI adoption**: this project aimed to overcome a significant barrier: a lack of clean data to train AI models and improve operational performance and approaches in the water sector. The data would enable water companies to more readily and effectively adopt and scale up AI-based solutions, which are proven to be more efficient than traditional methods in a range of settings, including sewer surveillance and inspection.
- **Encouraging dataset adoption**: the open dataset on sewer fault classification code data is now available for adoption, allowing water companies and AI developers to integrate these insights into operations, potentially leading to more innovative solutions in the water sector. The express intent of the project is not only to improve water sector operations and enable water companies to improve their own approach to sewer fault recognition, but also the approaches of their supply chains, as well as innovators who can leverage this open dataset to support new solutions and/or improvements to existing products and services in this field.

Challenges and gaps

- **Data cleansing and compatibility issues**: significant effort was required for data cleansing, beyond that initially anticipated, which led to delays. More than 180,0000 defect types were considered with over 700,000 images cleaned. There were additional challenges with data compatibility across the collaborators, with incompatible formats adding to complexity of data sharing. To overcome these challenges a bespoke app was developed, led by the Water Research Centre.
- **Underestimated project scope**: as the first collaborative project of its kind, the scope was underestimated, leading to unforeseen demands on resources and time. The scope also did not include measuring the impact on end beneficiaries, resulting in uncertainty about the direct benefits and value for intended users. Delays in establishing collaborative agreements disrupted the project's momentum, further impacting the planned timeline and resource allocation. The project team overcame these challenges by agreeing to work together without an awarded contract to keep to project timescales until an agreement was eventually reached. Future projects will use the sector's collaboration agreement.
- **Missing defect types**: while the dataset has clean data for 72 defect types, a small number of defect types are missing as the team were unable to source and clean these images. This is a low risk gap as they are rare instances. A future project could consider targeting these image types specifically.

Deliverables, tools and resources: see the project's **Spring Showcase** and updates on this project on the **Fund website**.

Find out more: contact **ideas@uuplc.co.uk**

Alternative Approaches to Phosphorus Removal at Rural Wastewater Treatment Works – "Alt-P"

COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Water Breakthrough Challenge 1	United Utilities Water for the North West	March 2025	£2,836,698	Evergreen, Hydro Industries, Kolina, Power & Water, Southern Water, Thames Water, University of Portsmouth

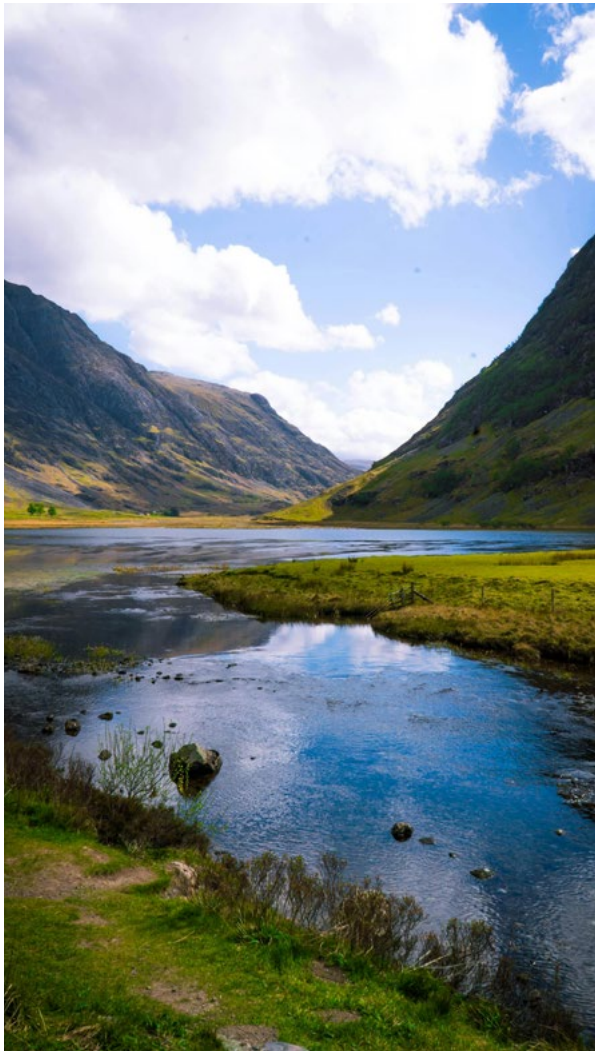
The water industry relies heavily on chemicals for phosphorus (P) removal, which significantly contributes to its carbon footprint and presents risks to operational resilience, especially when supply chain disruptions occur. To address these challenges, this project, led by United Utilities, is exploring more sustainable or chemical-free alternatives for phosphorus removal, specifically targeting rural sites where options are limited.

The project focuses on three innovative approaches: electrocoagulation, natural or plant-based coagulants, and reactive media. All site trials for electrocoagulation and natural coagulants have been completed, and the team has moved into the site testing phase for reactive media. The project also includes a comprehensive lifecycle analysis to equip water companies with the necessary data to evaluate the long-term benefits of each treatment option. Additionally, site visits with other water utilities have resulted in positive feedback, further revealing that some are already implementing electrocoagulation on a full scale, using insights from the project to refine their operational and maintenance practices. United Utilities is also collaborating with the Environment Agency and Natural England to secure approval for large-scale dosing of natural coagulants, marking significant progress towards environmentally friendly phosphorus management.

> *"The Alt-P project has achieved fantastic outcomes, which can directly support the water sector's drive to embed more sustainable treatment processes. Thanks to the levels of research undertaken, we have a greater understanding of the potential for alternative methods of phosphorus removal, the levels of operational input required, how much power is needed, the ideal site characteristics and what residual risks remain with the different technologies. These were all uncertainties at the start of the project. Water companies will have a package of evidence-based findings to inform designs of new chemical-free treatment systems. These innovative approaches will increase resilience, deliver financial and carbon savings and help maintain compliance, which will ultimately mean a cleaner environment."*
>
> **Lisa Mansell, Chief Engineer, Innovation and Carbon, United Utilities**

Key learnings and insights

- **Testing of alternative phosphorus removal methods**: alternative methods such as electrocoagulation, natural coagulants and reactive media were explored as replacements for fossil fuel-based chemical dosing for phosphorous removal. Four types of electrocoagulation technologies were tested, side by side, with documented risks shared across stakeholders for improved planning and adoption, including safety, operational and initial purchase considerations. Natural coagulants were thoroughly tested at bench and full scale with some fully proven and adopted by a water company, demonstrating a shift towards more sustainable phosphorous removal options. Additionally, the project resulted in an advanced scientific understanding of reactive media, providing insights into its strengths and limitations.
- **Combining innovations**: the project was set up as individual trials for electrocoagulation and natural coagulants. In addition, the team explored whether combinations of these would be helpful. It discovered that this combination is a very effective alternative for phosphorous removal and provides extra value and flexibility for water companies to blend treatment solutions.
- **Supplier inclusion and partnership**: traditionally, supplier trials are stand alone and the results shared with that supplier only. This project created an environment where all suppliers can see all results – a breakthrough of collaboration. Including suppliers as project partners proved essential, as their openness to side-by-side trials and transparent collaboration fostered a culture of shared learning and enhanced project success.
- **Sector engagement**: a successful in-person knowledge-sharing event promoted broad engagement, allowing diverse stakeholders to connect and collaborate effectively. This in-person event included a workshop section asking delegates for a list of barriers to adopting these technologies, and the final report will set out the solutions to these barriers.
- **Knowledge sharing**: formal agreements for sharing project findings through initiatives such as Spring enabled continuous dissemination of valuable insights, strengthening the knowledge base in the water sector. This commitment to openness and sharing results supports sector-wide advancements, equipping partners with actionable knowledge to inform future projects and technologies.



Benefits

- **Viable alternatives for phosphorous removal**: the project confirmed that three alternative phosphorous removal methods – electrocoagulation, natural coagulants and reactive media – are viable for AMP8 implementation with their risks identified and shared, allowing companies to decide which method would work best for them and what additional infrastructure is needed to maximise these novel approaches.
- **These alternatives add value**: additionally, these methods present sustainable, environmentally friendly alternatives to fossil-fuel based chemical dosing, reducing dependency on traditional chemical treatments, lowering carbon emissions and promoting resource-efficient practices.
- **Knowledge exchange and innovation**: by including suppliers in open trial processes, the project fostered a collaborative environment where suppliers and water companies could work side by side, enhancing transparency and trust. This approach led to valuable insights from suppliers, who contributed practical expertise and real-time feedback, ultimately improving the technology trials and risk assessments for each method. Furthermore, by making findings publicly available, the project encourages the industry to adopt innovative, proven technologies more quickly, accelerating knowledge dissemination and innovation.
- **Customer benefits and efficiency gains**: the project's success in identifying viable phosphorus removal methods supports the sector's broader goal of delivering improved service quality, reliability and environmental stewardship, ultimately benefiting end customers through cleaner water resources and operational efficiencies.

Deliverables, tools and resources: see the project's **Spring Showcase** and updates on this project on the **Fund website**

Find out more: contact **ideas@uuplc.co.uk**

Challenges and gaps

- A safety issue occurred which required intervention from Health, Safety and Wellbeing teams. However, this was handled well by the lead partner and led to key insight for how to safely and effectively run the electrocoagulation technologies.
- More emphasis on fostering collaborative environments was identified, with additional collaboration time needed to optimise the project's environment and supplier involvement.
- Despite this collaborative environment, the process for drafting, reviewing and finalising project output reports for all these varied technologies has led to delays in completing the project
- It became clear that when water companies start buying natural coagulants (a new purchase from an unfamiliar supply chain), there would be issues, complicated by having to source it internationally. The final report will give tips on how to overcome these challenges.

Artificial Intelligence of Things Enabling Autonomous Waste Catchments

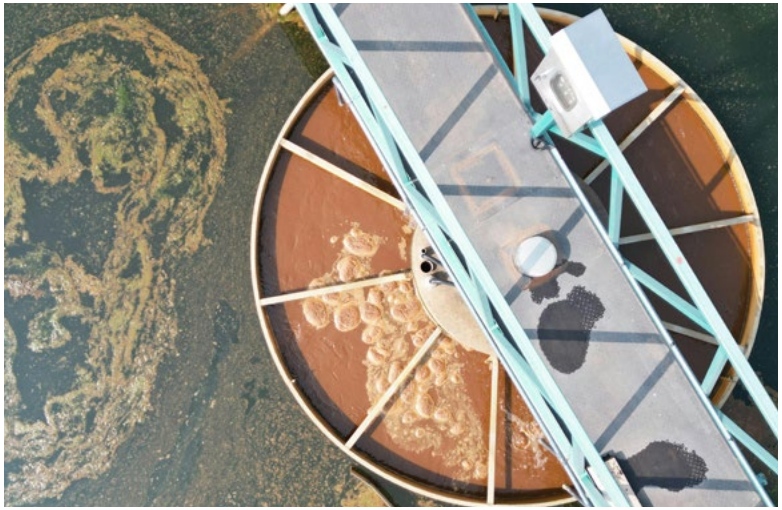
COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Water Breakthrough Challenge 1	SEVERN TRENT	October 2025	£1,998,000	8power, Blackburn-Starling, British Telecom, Exeter University, Hafren Dyfrdwy Water, Microsoft, National Cyber Security Centre, Northumbrian Water, Rockwell, Southern Water, South West Water, Thames Water

The project, led by Severn Trent Water, aims to pilot the use of artificial intelligence (AI) to monitor a waste catchment area in real time. The goal is to minimise the risk of flooding and sewage pollution by using advanced data analysis and predictive capabilities.

This pilot leverages AI to analyse vast amounts of data and generate real-time insights. By rapidly identifying anomalies and predicting potential issues, the system enhances the operational efficiency of sewer networks. The aim is to develop a scalable and shared blueprint that, once proven, can be widely adopted across the water sector, demonstrating AI's transformative potential for sustainability and improved service delivery.

"Carried out collaboratively between Severn Trent and its delivery partners, the AIoT project has made great advancements for the sector regarding real-time control design for wastewater catchment management. It integrates three advanced data science models to simulate the Alfreton wastewater network and generate coordinated pumping station control schedules for pre-, during, and post-storm conditions. Simulations predict 20%+ reduction in spills. Furthermore, the project has enabled the development of adaptable hardware design options for real-time control, soon to be shared in our AIoT sector blueprint document."

James Ballard, Innovation Architect, Severn Trent



Key learnings and insights

The design phase for operational technology and middleware has been completed, creating a structured process for managing how AI-generated instructions or outputs are handled, ensuring they are effective, safe and properly executed. The project has now entered the pre-construction phase, focusing on health and safety measures, contractual arrangements and detailed test planning.

- **System simulation for reliability and quality control**: the AI model is designed to replicate real-world sewage system environments and was pre-validated using real-world data before deployment. This process acts as a quality check, ensuring the model performs reliably under realistic conditions and aligns with expected outcomes, reducing risks for live use.
- **Effective workshop programmes and change management**: all-partner workshop programmes were used to focus on building a baseline understanding and agreement on core concepts, ensuring all partners shared a common foundation. This also enhanced general understanding and alignment, especially in navigating new and unfamiliar concepts. A flexible, adaptive approach further increased partner engagement quality and responsiveness to changes.
- **Knowledge sharing and industry engagement**: lessons learned and key insights were shared with other water companies engaged in similar Ofwat-funded projects, promoting best practices and collaborative progress.
- **Open mindedness**: preparing staff to embrace AI (and any other new innovation) culturally and operationally is crucial for successful integration, as it requires a shift in mindset and openness to new ways of working. This has been achieved through the setup and maintenance of stakeholder maps and a detailed communications plan. Regular meetings were held with the various stakeholder groups to report progress and ensure there were opportunities to highlight concerns or ask queries. The project sponsor and technical team continue to play a key role in making sure the project is directed in line with feedback, and appropriate information is shared with the wider business for awareness. Holding focus workshops has also been key to educating stakeholders on what the work needs and what the bigger picture looks like, leading to enhanced involvement across the board.
- **Key recommendations for future similar projects**: ensure consistent technical staffing throughout the project to prevent knowledge loss and maintain output quality. Define the project's core problem clearly at the outset, ensuring all partners understand it fully. This step is especially important in innovation-driven projects where novel concepts can be challenging for partners accustomed to standard operations. The success of such a project also depends on engaging skilled teams, even if it requires higher investment in specialised expertise.

Benefits

- **Defined processes for AI integration**: establishing consistent, robust change control and risk management processes for AI integration projects will help manage complexity and prevent scope creep.
- **Blueprint for success**: a full report will contain the results and conclusions from the project so that other end users can learn from this collaboration to optimise their sewage catchment management. A unified, standardised approach across water companies encourages cross-company collaboration, supports innovation and establishes a consistent industry standard for AI integration.
- **Phased approach to innovation**: breaking projects down into smaller, manageable phases can spread risk, maintain alignment with technological advancements and improve outcome reliability.
- **Experimentation and flexibility**: innovation projects benefit from openness to change, rapid testing environments (such as SPRINT hothouses – a focused working session where a team collaborates intensively to solve a specific problem, design a solution, or make rapid progress on a project within a short, defined timeframe), and adaptability to evolving project needs and technological progress.

Deliverables, tools and resources: see updates on this project on the **Fund website**

Find out more: contact **openinnovation@severntrent.co.uk**

Challenges and gaps

- **Scope adaptation**: technical size and scope had to be adapted to fit the assigned budget, limiting some aspects of the project's potential impact. BT's resources were primarily used for communications and security, but its AI engine and additional resources could have also been used to save time and money. Projects spanning multiple years are also vulnerable to scope expansion, especially with frequent changes in team composition, which can make the project unwieldy.
- **Complexity of managing innovation projects**: innovation projects often require more intensive management than traditional projects due to their dynamic, evolving nature, making traditional management methods less effective. Close attention to risk management and change control is essential to avoid unexpected issues, and a substantial risk contingency fund is necessary to manage optimism bias and unforeseen project tasks.
- **Risk control**: the project learned quickly that any end users will need governance and security frameworks that align with and mitigate the specific risks associated with AI/machine learning, while still enabling project implementation to avoid unnecessary tension, delays and delivery risks.
- **Data quality and quantity limitations**: the project faced challenges due to a lack of high-quality raw data. This impacted the effectiveness of AI model training and overall project outputs.
- **Alignment and expertise challenges**: the project's complexity created challenges in achieving a shared technical understanding, leading to potential misalignments. Furthermore, differing views on innovation costs versus economic pressures complicated decision-making and resource allocation. Clearly defining end-user requirements at the project's outset is essential, along with robust change control management to accommodate any evolving needs as the project progresses.

Pipebots for Rising Mains (Phase 1 and Phase 2)

COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Water Breakthrough Challenge 2+4	Thames Water	Phase 1 - complete; Phase 2 - June 2026	£1,887,159	Dŵr Cymru Welsh Water, Synthotech, the University of Sheffield, Wessex Water

This project aims to test the use of autonomous robots within rising mains (a type of pipe used to transport sewage from a lower elevation to a higher elevation, typically against the force of gravity) to proactively identify, predict and address pipe deterioration, thereby preventing harmful pollution from bursts. Thames Water, collaborating with the University of Sheffield and Synthotech, is exploring adapting robotics technology – commonly used in the petrochemical industry – for water infrastructure. The team is focusing on modifying robots to suit the specific materials and dimensions of rising mains, including selecting sensors to measure pipe deterioration from within. This initiative will transform the water industry's approach to maintaining pressurised sewer infrastructure and enhance monitoring and maintenance in challenging environments. The second phase of this project follows on from successfully completed work in the previous rounds to further develop technology suitable for condition assessment inspections in live sewer rising mains. This project has received two rounds of funding from the Ofwat Innovation Fund.

> *"Reducing pollution from rising main bursts is a priority. This exciting development in robotics and new sensor technology brings us closer to being proactive and preventing pollution, flooding and customer disruption."*
>
> **Nevil Muncaster, Engineering and Asset Director, Thames Water**

Key learnings and insights

Transition from Phase 1 to 2: the project maintained regular meetings to discuss the Phase 2 submission, contract preparations and Phase 1 dissemination activities. The funding gap was not easy.

A kick-off meeting was planned at the start of Phase 2 to re-energise the project, reflect on direction and give a fresh steer. A lot of work is taking place within water companies and it is difficult to detach ourselves from the current problems (such as the current cohorts of ductile iron and small diameter pipes failing) to look into the longer term.

- **Asset stock and challenges identified**: the project outlined key issues related to rising mains, particularly the wide variety of materials used in their construction. Unlike other asset types such as water mains or oil and gas pipes, rising mains are made from diverse materials, including iron, asbestos cement, PVC and GRP (glass reinforced plastic). Initially, the project focused on inspecting 300mm diameter iron rising mains due to their large cohort, potential for pollution impact and suitability for technology transfer. This focus will be revisited in Phase 2 to ensure alignment with project goals.

During Phase 1, the University of Sheffield conducted site visits with Welsh and Wessex Water (to Bretton, Weymouth and Christchurch, where they have 300-110mm cast and ductile iron pipes) to measure acoustics during pumping. Relying on existing sound within the pipes for condition assessment was revealed to be challenging due to variability in pumping regimes and dampening. This led to the design of a robot capable of generating a controlled sound source for consistent condition monitoring. While the current design includes a halo to demonstrate sensor functionality, we intend to remove this feature in later development stages to address operational issues such as navigating sewage and debris.

- **Innovation in condition assessment**: the project has demonstrated the potential for new sensor and robotics technologies, which could lead to better condition assessment for rising mains. A comprehensive review of sensor technologies, including ultrasonic and electromagnetic techniques, was completed during Phase 1, identifying the strengths and limitations of each approach. The University of Sheffield's vibro-acoustic concept emerged as an innovative solution. A tractor-based mobility method was also chosen due to its success in petrochemical applications, where similar challenges, such as silt and grit, are encountered. This methodology will be revisited and refined in Phase 2.
- **Proven concept through testing**: testing conducted at Synthotech's STAR facility showcased the robot's ability to detect joints, navigate pipelines and facilitate insertion and retrieval. Real excavated samples tested at the University of Sheffield's ICAIR facility confirmed the feasibility of the vibro-acoustic method. These results set the stage for further development and expanded testing in Phase 2, including navigating complex pipeline configurations such as corners.
- **Industry interest and collaboration**: technical reports have been shared widely with other water companies. Phase 1 involved active collaboration, with staff from the University of Sheffield and Synthotech visiting sites and working closely with stakeholders. Contributions from Thames and Welsh Water, including pipe samples and pipework for the testing rig, supported progress. Presentations by Thames and Wessex Water at No-Dig roadshows further publicised the project. Industry backing has continued into Phase 2, with funding secured through the Ofwat Innovation Fund and the same dedicated team remaining involved.

Key learnings and insights (continued)

- **Practical insights and field testing**: fieldwork revealed several technical challenges that informed the design and operation of the robot. Key issues included the alignment of sensors on the halo, mitigating the impact of vibrations from the moving unit, and ensuring accurate communication and interpretation of data. Benchtop and controlled rig testing are planned for Phase 2, with controlled field testing targeted at the project's conclusion.
- **Value of regular communication**: continuous communication and revisiting key fundamentals have ensured that the end product is valuable and cost-effective. Steering groups have met monthly from the outset, while technical working groups convene fortnightly to address specific challenges, such as arranging site visits and coordinating sample delivery. This structured communication has facilitated timely decision-making and progress, and these practices will continue through Phase 2.
- **Importance of research and feasibility phase**: the research and feasibility stage was instrumental in providing a solid foundation for the subsequent project phases, ensuring that the next steps are well-informed and feasible.

Benefits

- **Scalable industry application**: the success of the project has the potential to impact not just rising mains but may also extend to broader applications within the water industry. Current technologies are not being applied to rising mains due to the cost and the risk involved with shutting a rising main and surveying it. This project aims to survey as much of the length/radius as possible at a survey point in time and while it is still operating.
- **Educational and industry impact**: reports, webinars and further documentation are planned to share findings and benefits with the wider water industry, enhancing industry-wide knowledge on the issues associated with rising mains.
- **Asset management improvement**: by addressing damage detection in rising mains, the technology could help prevent pollution and reduce disruptions, enhancing asset management across the water industry.
- **Bridging research and application**: the Fund has been instrumental in transitioning university research into practical applications, bridging a gap between academic innovation and industry solutions.

Challenges and gaps

- **Testing in harsh environments**: Phase 1 testing was initially intended to take place in the field but was later shifted to controlled pilot-scale trials. Delays in extracting samples from Bretton (Welsh Water) due to high groundwater levels were mitigated by using alternative samples provided by other sources. Thames Water also contributed by supplying archived pipe samples, ensuring the testing could proceed as planned. Rising mains present extremely harsh environments, characterised by sediments, rags, fats, septic sewage and corrosive gases. While these challenges have been acknowledged during development, they have not yet been fully tested under real-world conditions. Phase 2 will address this gap by simulating these conditions on the testing rig as comprehensively as possible before advancing to field trials.
- **Complexity of sensor deployment**: during Phase 1, bench testing was conducted to verify sensor accuracy before progressing to rig testing. To ensure feasibility, sensors were positioned optimally, guided by modelling work completed by the University of Sheffield. By prioritising bench and modelling tests, the project minimised costs and maximised efficiency, avoiding unnecessary expenditures associated with more expensive pilot-scale trials.
- **Resource and timeline constraints**: contract agreements, resource changes and potential funding limitations (such as the possible end of Pipebots' research council funding) have posed risks to the project's timeline and continuity.
- **Need for extended risk management**: future development could benefit from a risk management fund or 'risk pot' to address unforeseen challenges and provide flexibility. A risk pot now exists for Phase 2.
- **Intellectual property and stakeholder engagement**: balancing stakeholder engagement with intellectual property considerations has been time-intensive, requiring careful planning and protection measures.

Deliverables, tools and resources: see updates on this project on the **Fund website**

Find out more: see any updates on this project on the **Thames Water website**

Transforming the Energy Balance of Wastewater Treatment

COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Water Breakthrough Challenge 1	Thames Water	August 2027	£6,260,000	Dŵr Cymru Welsh Water, South West Water, United Utilities, University of South Wales

Thames Water is leading a project in collaboration with eight water companies and academic partners to significantly reduce nitrogen oxide emissions and optimise resource recovery. The initiative focuses on developing anaerobic wastewater treatment processes that aim to decrease greenhouse gas emissions by up to 98%, reduce sludge production by 96%, and cut energy consumption by 80%. This anaerobic treatment will also generate biogas, which can be repurposed for energy production.

This innovative approach not only aims to improve environmental outcomes but also seeks to pass operational savings onto customers through lower billing.

"We have been at the forefront of R&D for anaerobic processes and recognise the importance that these bioprocesses can play in numerous sectors. The funding is enabling the team to drive the novel concept when integrated with nutrient recovery and evaluate its impact in reducing society's wastewater treatment footprint and promoting sustainable resource recovery."

Professor Sandra Esteves, project lead at the University of South Wales

Key learnings and insights

The project's outputs have not yet been realised; a comprehensive experimental programme is about to start to measure performance, to then compare it with the conventional processes and fully quantify the benefits. Thames Water is commissioning a mobile anaerobic pilot plant to test organic removal and effluent degassing, which will be fully operational in early 2025. Dŵr Cymru Welsh Water is conducting similar trials, while the University of South Wales is advancing its research on nutrient removal and recovery methods. These studies focus on identifying optimal adsorbents and key parameters for designing a nutrient recovery plant, with findings to inform the Thames Water pilot. The Fund has significantly advanced innovation in anaerobic wastewater treatment.

- **Technical progress**: development of a unique pilot plant, including a methane recovery system, represents a significant innovation in anaerobic wastewater treatment. Further testing of anaerobic processes has also been carried out to address the high energy consumption of traditional sludge treatment. Early performance results from the Dŵr Cymru Welsh Water plant suggest that the technology is most effective for strong crude sewage streams, enabling more efficient treatment rates.

Benefits

- **Energy efficiency and sustainability**: reduced energy requirements and emissions align with net-zero targets and protect water environments, supporting both ecological and sustainability goals. The anaerobic wastewater treatment process requires 80% less energy compared to traditional activated sludge methods. A 98% reduction in greenhouse gas emissions is achieved, including eliminating nitrous oxide, a potent greenhouse gas released by conventional treatment systems.
- **Enhanced customer and environmental resilience**: protects customers from extreme weather and pollution impacts while enhancing water bodies' ecological status. The anaerobic process is a once-through system – unlike the recirculating flow of activated sludge plants – thereby halving the footprint of existing sewage treatment works. This allows for additional headroom to accommodate wet weather events and minimise storm flow discharges to natural systems.

Challenges and gaps

- **Supplier engagement**: supply chain issues have delayed the pilot plant delivery, affecting project timelines and necessitating project extensions. Sourcing specialised equipment was challenging due to the limited number of suppliers capable of meeting technical demands, as well as a hesitancy to engage in technically complex, lower value projects. This limited options and slowed overall progress. The lesson learned was to engage with the supply chain earlier in the process, ideally during the bid writing stage, to build stronger partnerships and mitigate delays.
- **Need for flexible procurement routes**: there is a gap in the current procurement process as a more flexible approach is needed to accommodate the unique needs of small, innovative projects and enhance responsiveness to evolving project requirements. Water companies are generally better equipped to manage large capital schemes than bespoke pilot initiatives, creating a gap in the value chain. Similarly, supply chains must adapt to facilitate the trialling of emerging technologies within the UK water sector.

Deliverables, tools and resources: see updates on this project on the **Fund website**

Find out more: see updates on this project on the **Thames Water website**

Using Science and Nature to End Sewer Misery

COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Water Breakthrough Challenge 3	Northumbrian Water living water	April 2026	£939,377	Intelligent Gels, Thames Water, the Centre for Process Innovation, United Utilities, University of Durham

Northumbrian Water is leading an initiative to address sewer blockages caused by invasive tree roots, focusing on a root-repellent coating for sewer networks that doesn't hinder tree growth. This approach is designed as a sustainable, long-term solution to reduce pollution events from blockages. Currently, the project team is finalising lab testing methods and determining the optimal coating formulation for future field trials. Both gel and spray-in-place versions of the coating are under development, with tests planned to assess their short-term efficacy in lab conditions and long-term efficacy in field test rigs.

"Tree root intrusion is endemic across all wastewater networks, affecting homes and businesses. The funding will allow us to complete our innovation journey and deliver a new product to the market. With a real-world solution, we are tackling a worldwide problem – this means protection for everyone, everywhere, ending sewer misery."

Matt Wilson, Managing Director, Intelligent Gels

Key learnings and insights

At just nine months into the project, it is still too early to gather significant insights into the proposed solution. However, valuable progress has been made through cross-disciplinary collaboration, which has been instrumental in moving toward the intended outcomes. Intelligent Gels is currently testing the value of novel gel formulations, while the Centre for Process Innovation (CPI) is developing a spray-in-place formulation alongside a test rig to support scale-up experiments. Plans are already underway to continue the work at a larger scale following the conclusion of the current programme in March 2026.

- **Finding alternatives**: timely in-depth project planning and coordination is essential, particularly the correlation with natural cycles. Tree root growth is critical to testing and demonstrating the formulation and coating effectiveness against tree root growth and this will only happen in spring and summer. However, the project partners have overcome this difficulty through the use of alternative plants (chinese cabbage instead of willow) and mimicking ideal growing conditions by using controlled environment incubators and greenhouses to encourage growth during winter.
- **Innovations for protecting sewers**: the project demonstrates promising innovation in developing chemical formulations and spray methodologies that may provide longer-term sewer pipe protection.
- **Water company engagement**: engagement from industry partners, especially water companies, is challenging yet crucial to the project's momentum and impact. Water companies have been critical in supplying live data regarding tree root hotspot conditions, which have been used to inform the conditions replicated by the field test rig. Partner water companies have been and will be instrumental in advising on the applicability and safety of the application methodology, ensuring that the method can assimilate with current practice and increasing likelihood of uptake throughout the water industry.
- **Plan for planning permission**: changes in permitted development regulations have meant that, for the second phase (deployment of the outdoor test rig), we have had to apply for planning permission. Permitted development now only allows for a timeframe of six months, with any time period longer than this requiring planning permission. The project team started the planning permission process in June 2024 with the aim of extending the second test phase and capturing under planning consent. Due to the complexities in stakeholder engagement, the planning consent activities have taken a total of six months and as such we have missed the plant growing window and will have to run the second phase for 12 months as originally forecasted. Although we have not been able to capitalise on the anticipated early start of Phase 2, we have been able to mitigate the risk of planning permission time periods on our second phase of work.

  A key learning from this is the requirement for planning permission timeframes and costs to be accounted for in the project plan and forecast. Planning departments have strict requirements specific to each planning department and, as such, an allowance for planning consultants would be beneficial for future projects. Northumbrian Water used its framework planning advisors at no cost to the project in order to assist the project but this is not normal practice and we should account for this type of resource in future projects.

Benefits

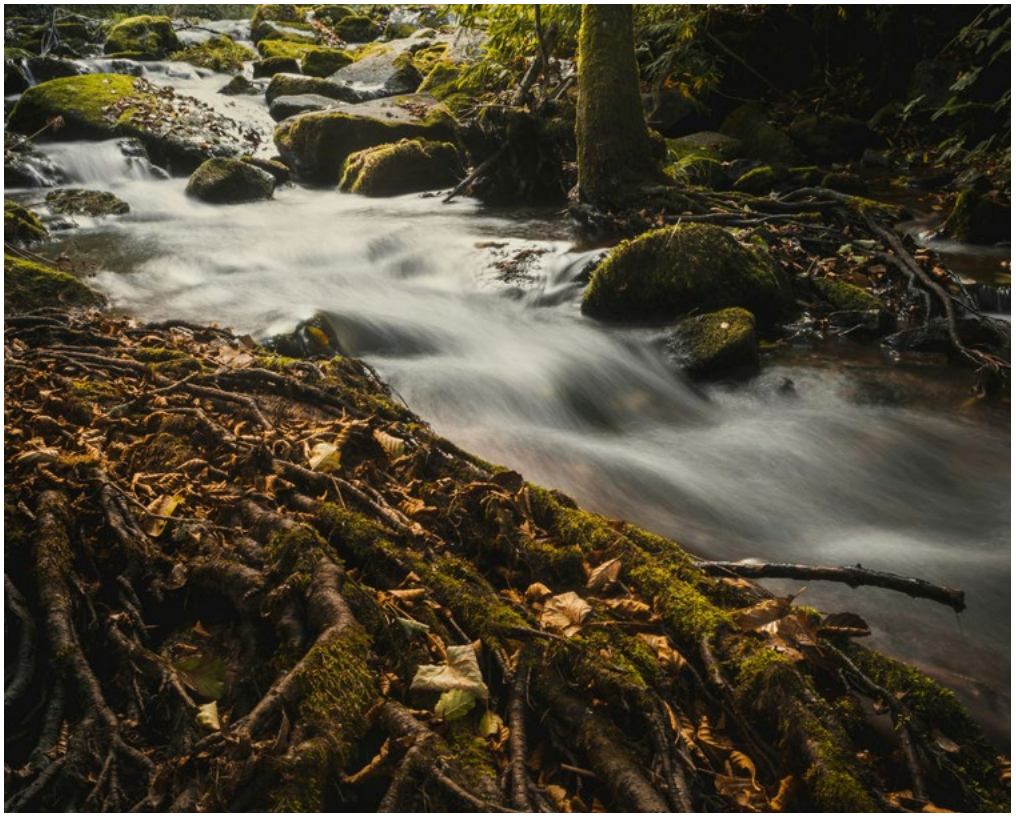
- The development of the coating will potentially benefit sewer network issues in the long term relating to damage caused by tree root intrusion. Coating the sewerage network pipes could also lead to longer life pipe networks, reduced blockages caused by tree roots, and mitigate environmental and operational costs through the replacement of damaged pipes. This also reduces cost issues and potential risks to customers due to water and foul waste leakages.
- Innovations in spray equipment and coating formulations aim to increase the safety, efficiency and longevity of the formulation, while reducing environmental impact through formulation wastage. The original spray coating concept was to use a standard rotative spray head fed from a high pressure (in excess of 3000 PSI) airless spray pump. The benefits are seen as: low air pressure (no unreasonably high hazards), twin feed system with in-line mixing (no pot life issue) and cartridge system to feed the coating allows clean operation (and coating development) resulting in less formulation/coating waste. This is a huge success for the Centre for Process Innovation team as they have managed to mitigate out the operational risk that could have been a blocker to industry-wide adoption.
- Potential industry-wide adoption could establish a proactive solution to pollution and infrastructure resilience across water networks in the UK. Post-project activities will include collaboration with UK water companies to identify tree root hotspots for real-life testing.

Deliverables, tools and resources: see updates on this project on the **Fund website**

Find out more: contact **innovation@nwl.co.uk**

Challenges and gaps

- A delayed start due to the slow signing of the collaboration agreement impacted resource availability, delaying the timeline and potentially misaligning with natural root growth periods. Clear and coordinated delivery deadlines have been challenging to maintain due to initial delays.
- Initial engagement with the broader water industry has been a challenge, resulting in some delays to the collaboration and slowing project onset. Steps have been taken to mitigate this by sharing data and previous trial information, to enable wider engagement between partners and potential collaborators.



Breakthrough 4 projects

The following project was funded in the Water Breakthrough Challenge round four (WB4). Entrants were notified of their award in late spring 2024 and, as a result, have not long been operational at the time of this report being published.

For this reason, the insights they have been able to share are naturally limited to those one would expect with project mobilisation – contractual agreements, project management, partnership and collaboration aspects.

Pipebot Patrol

COMPETITION	LEAD WATER COMPANY	ESTIMATED COMPLETION DATE	FUNDING AWARDED	PARTNERS
Water Breakthrough Challenge 4	Northumbrian Water living water	June 2026	£1,615,325	Environmental Monitoring Solutions, Gateshead Council, Jet Aire, Minicam Group, Newcastle City Council, Southern Water, Sunderland City Council, Thames Water, University of Sheffield

Northumbrian Water is developing an autonomous sewer robot designed to continuously monitor sewer networks for blockages, providing real-time alerts for proactive maintenance. This innovation aims to enhance network reliability by detecting potential issues early and minimising disruptions. The autonomous sewer robot will live in the sewer, constantly inspecting and raising alerts to the precise location of blockages or other asset-related issues, as they are beginning to form, allowing maintenance teams enough time to react before sewer flooding occurs, keeping sewage where it belongs.

Key learnings and insights

The project is in its initial mobilisation phase. Over the first year, efforts are focused on developing a modular robot housing to be placed in manholes, alongside advancing the robot's autonomy and navigation capabilities. The initial patrol system will use a tethered robot powered by a cable, with work underway to organise a power supply for the manholes. Additionally, three hotspot zones are being selected, each with three launch-manhole locations, and a dedicated stakeholder website is being developed to share project progress.

- **Detailed project planning**: a comprehensive project plan developed during the bid stage has proved essential for smooth delivery, minimising unexpected issues and ensuring alignment with the schedule and budget.
- **Early collaboration agreements**: initiating collaboration agreements early is beneficial, ideally during the bid evaluation phase. This proactive approach can accelerate the project start by ensuring agreements are ready for signing upon winning the bid.
- **Payment scheduling**: establishing a clear payment schedule and agreeing on payment milestones before project commencement helps streamline the collaboration process, minimising delays and aligning expectations among partners.

Deliverables, tools and resources: see updates on this project on the **Fund website**

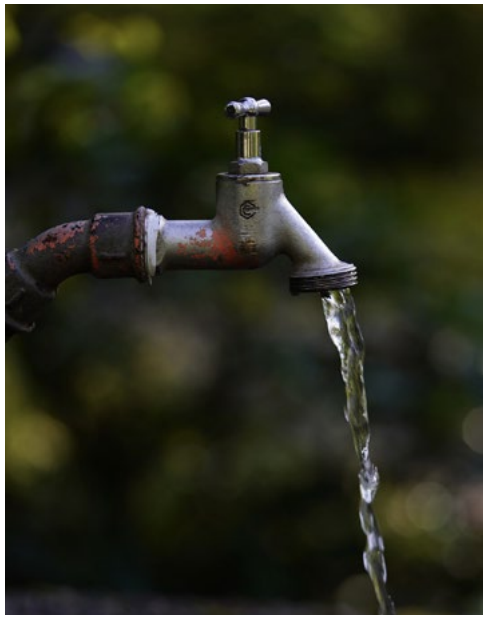
Find out more: contact **innovation@nwl.co.uk**

Benefits

- **Continuous sewer monitoring**: the autonomous robot will enable 24/7 patrolling and inspection of a sewer, aiming to eliminate spills and floods. By targeting known blockage-prone areas with a mobile robot, this project offers a solution to reduce the need for costly, labour-intensive inspections while effectively addressing specific problem areas. This will result in further prevention of customer flooding and river pollution as well as improved oversight.
- **Advanced autonomous technology and docking solutions**: a module docking station for installation in manholes will be introduced, enabling autonomous recharging and support for the robot. The robot will also function with a tether system, ensuring robust communication and a consistent power supply during initial patrols, facilitating effective deployment and data collection.

Challenges and gaps

- **Technical and technological development**: the project is in its early stages, and specific technical challenges are yet to be encountered or documented. As the robot's autonomy and modular docking station are still in development, future updates will likely reveal areas for improvement.



2 Insights from the global community

International case studies

This section shares insights and best practice from the global water community, showcasing projects and broader initiatives that push the envelope of innovative practice within wastewater treatment and associated assets and networks.

By providing this context, UK water sector stakeholders can reflect on where there might be gaps in our knowledge or operations, as well as where there are areas of excellence in the UK that could inform global practice on these topics at the core of sustainable wastewater management. By sharing these learnings, we aim to further increase the ambitions of the water innovation ecosystem and forge new and lasting connections in the UK and across the world.

Location: EU
Date: 2022
Duration: 4 years

Organisation(s) involved: Asociación Centro Tecnológico Ceit, Ghent University, Cobalt Water EU BV, IMEC, Watershap de Dommel, Royal HaskoningDHV, VITO, ESCI

Summary

The EU-funded project DARROW focuses on maximising wastewater resource recovery by leveraging data-driven, AI-based solutions to improve efficiency in water reuse, nutrient recovery and energy production. At its demonstration site in Tilburg, Netherlands, DARROW aims to optimise key processes such as secondary treatment and anaerobic digestion, advancing wastewater treatment plants toward circular economy goals. The project seeks to reduce waste, save energy and expand the feasibility of resource recovery from wastewater.

Key outcomes

Key outcomes of the DARROW project include a targeted 20% reduction in energy consumption, a 15% increase in energy generation, and a 20% cut in greenhouse gas emissions. The project aims to recover 50% more bio-phosphorus and 5% more nitrogen, while reducing sludge production by half and chemical usage by 15%. These improvements focus on enhancing the sustainability of wastewater treatment processes.

www.wastewater.ai

Location: EU and South America
Date: 2015
Duration: 3 years

Organisation(s) involved: FACSA, Atlantis Consulting, Universitat Jaume, Seramik Arastirma Merkezi, IMECA, Iproma, Universidad Antonio Narino, Biowater Technology AS, Camaras

Summary

The REMEB project aims to create and validate a cost-effective ceramic membrane bioreactor (MBR) for wastewater treatment, using recycled agricultural and industrial by-products such as olive oil and marble residues. The low-cost MBR technology will be tested for its environmental impact and effectiveness in water-scarce regions and industrial applications. Manufacturing and implementation are being replicated across Turkey, Italy, Colombia, Cyprus and other countries in Europe. The project aims to significantly lower MBR costs and provide a scalable solution for global water recycling needs.

Key outcomes

Key outcomes of the REMEB project include the development of ceramic membranes using locally sourced, recycled materials such as waste from the ceramic tile industry, olive oil residues and marble powder. These membranes offer enhanced thermal, chemical and mechanical resistance, making them viable for wastewater recycling in municipal and agricultural applications. The project demonstrated cost-effective filtration at a wastewater treatment plant in Spain, with plans to expand into industrial settings, promoting circular economy principles and resource recovery through the reuse of industrial by-products.

cordis.europa.eu/project/id/641998

The BlueGrid project

Location: Denmark
Date: 2017
Duration: 3 years

Organisation(s) involved: Krüger/Veolia Water Technologies, BlueKolding, Energi Danmark

Summary

The BlueGrid project leverages data from the entire Agtrup Wastewater Treatment Plant (WWTP) system, integrating weather forecasts and rain radar data to optimise energy use and wastewater treatment processes. This is achieved through development and implementation of intelligent control, which is based on weather models and radar warnings, of the sewer system, the waste water treatment plant and the energy producing units. The integration of the combined facility for a waste water utility and Smart Grid allows balancing services to be sold via adjustment of the energy consumption and production. This has never been proven at full scale before. By adjusting energy consumption and production based on real-time data, the system enables the sale of balancing services to the electrical grid with a short response time. This innovative approach supports the integration of renewable energy, ensuring sustainable wastewater treatment at minimal cost while enhancing overall system efficiency.

Key outcomes

The project demonstrated energy balance optimisation as part of an active control strategy for wastewater plants. With an estimated market potential spanning 100 wastewater treatment facilities in Denmark and global applicability, the solution represents a breakthrough in the industry. For the first time, a wastewater utility has successfully integrated a combined facility at full scale, proving its capability to provide grid-balancing services through dynamic energy adjustments. This achievement highlights the potential for improved sustainability and cost efficiency in wastewater management.

BlueGrid - Flexible energy utilization in wastewater supply at full system

REwaise
REsilient WAter Innovation for Smart Economy

Location: EU
Date: 2020
Duration: 5 years

Organisation(s) involved: Aqualia, Severn Trent, VA SYD, AQUANET, The European Network of Living Labs, Hidrotec, City of Malmö, POLYMEM, Resourseas, BlueTech Research, AQUAPORIN A/S, Water Environment and Business for Development, Environmental Monitoring Solutions Ltd, Solar Water Plc, Institute for Ecology of Industrial Areas, University of Valencia, Technical University of Ostrava, University of Zagreb Faculty of Electrical Engineering and Computing, Fundación Centro Tecnológico de Investigación Multisectorial, Coventry University, Lund University, Poznan University of Technology, PFK Attest innCome, University of Palermo, Organics

Summary

REWAISE is a collaborative initiative aimed at creating a smart water ecosystem by integrating an intelligent digital framework for decentralised water services and decision-making. By engaging all relevant stakeholders, REWAISE envisions a carbon-free, sustainable hydrological cycle aligned with the principles of a resilient circular economy. The project has three core components: value in water (efficient use and resource recovery), value from water (economic activities and job creation), and value through water (enhanced governance, safety and resilience). These components will be tested and demonstrated in nine living labs across three European climate hubs: Mediterranean, Atlantic and Continental.

Key outcomes

REWAISE will reduce freshwater consumption by over 30% by leveraging alternative water sources and will achieve a zero-carbon water cycle by recovering energy, nutrients and materials from water streams. The project will demonstrate innovative methods for extracting raw materials and minerals, particularly from desalination processes. A series of living labs has been set up to test various concepts and innovations and The Midlands Living Lab is implementing network modelling and control, to reduce distribution leaks and prevent flooding in collection systems. Work is also underway to scale up and design the ammonia recovery unit based on stripping sludge dewatering liquors. Options are also being examined for generating hydrogen from the hydrolysis of concentrated ammonia.

REwaise

MULTISOURCE
enhanced natural treatment solutions

Location: Global
Date: 2021
Duration: 4 years

Organisation(s) involved: INRAE, Aarhus University, Institut Català de Recerca de l'Aigua, NIVA, Helmholtz Centre for Environmental Research, National University of Ho Chi Minh City, INSA, UFSC, Montana State University, Oslo Kommune, Ajuntament de Girona, Citta metropolitana di Milano, Grand Lyon, IRIDRA, Rietland, Alchemia nova, Forum for equitable development, ICLEI, Water Europe

Summary

MULTISOURCE focuses on demonstrating and advancing nature-based solutions for urban water treatment, storage and reuse. By harnessing natural treatment processes, the project addresses challenges such as overflowing sewer systems during extreme rain events and the need for climate adaptation. These solutions are cost effective, sustainable and locally adaptable, offering environmental, social and economic benefits while enhancing urban resilience. MULTISOURCE includes innovative systems such as aerated and free water surface wetlands and collaborates with stakeholders across local, national and international levels to co-create tools and guidance for effective implementation.

Key outcomes

The project will enable the successful removal of waterborne contaminants through enhanced natural treatment systems while reducing chemical and biological risks and improving urban habitats. It will provide decision-support tools and policy recommendations for safely reusing water in urban areas. Additionally, the project's innovations will strengthen urban resilience to extreme events, reduce pressure on sewer systems and foster adoption of nature-based solutions as a viable and sustainable alternative for urban water challenges.

multisource.eu

xylem
Let's Solve Water

Location: Indiana, USA
Date: 2008
Duration: 14 years

Organisation(s) involved: City of South Bend, Xylem

Summary

The City of South Bend faced significant environmental and economic challenges due to an ageing sewer system that could not manage excess discharge during heavy rains, leading to 1-2 billion gallons of combined sewer overflow (CSO) into the St Joseph River annually. To address this, the city partnered with Xylem to implement a real-time decision support system – Xylem Vue and GoAigua's SSO/CSO Prediction and Prevention technology. By integrating more than 165 smart sensors, actuators and automated gates, the sewer network was able to respond to wet weather events in real time, significantly reducing pollution without the need for costly new grey infrastructure.

Key outcomes

South Bend's smart sewer programme has achieved remarkable results, eliminating dry weather overflows and reducing CSO volumes by 80% – an annual decrease of roughly one billion gallons. E. coli concentrations in the St Joseph River have also dropped by over 50%, significantly improving water quality. This innovative approach, endorsed by the Department of Justice and the EPA, allowed South Bend to meet environmental goals 10-15 years ahead of schedule, demonstrating the potential of real-time technology to transform urban water management.

Xylem case study

3 Collaboration in practice

A notable success of the Ofwat Innovation Fund in the period 2020-2025 has been the step change in collaboration across the UK water sector. The increase in partnership activities and maturity of the sector in its approach to knowledge sharing and pursuit of mutual benefits will be a lasting positive legacy of the fund.

Beyond the project- and topic-specific learnings and insights highlighted in this report, partners across the Ofwat-funded portfolio have also gathered valuable experience in other aspects of project delivery, management and governance.

In this section we delve deeper into these learnings, across topics such as partnerships, legal agreements and other collaborative learning themes.

We also shine a light on the challenges and barriers to effective scaling and implementation of project tools, outputs and results.

We hope that by acknowledging these learnings we enable future applicants and stakeholders to overcome these challenges, improving the outcomes and impact of the Ofwat Innovation Fund and its portfolio of funded projects.

1. Collaboration Agreement (CA)

Drafting and signing the CA took significantly longer than expected for nearly all project teams. It is valuable to start the CA process with partners as early as possible to allow time to focus on the project scope, delivery planning and recruitment. Without an agreement in place, many partners were working on goodwill and were exposed to an unfavourable degree of risk, especially for smaller organisations. More experienced partners now start drafting a high-level CA as part of the application process, preparing and agreeing the CA, up to proceeding to signature, between the announcement and the project start.

2. Right people, right time

Transdisciplinary teams with a diversity of skills and expertise, and clear roles and responsibilities, work best. Any gaps should be identified early as recruiting the right talent, especially if on short-term contracts, can take time. Partners all agreed that the lead partner organisation should ensure appropriate project management capacity is in place from the start. Recruiting communications and marketing roles early enables robust communications and dissemination plans, which are essential for the widest impact and uptake of project outcomes. Adopting an agile methodology allowed projects to adapt swiftly to changing requirements, especially with an iterative approach with frequent feedback loops and user-centric design.

3. Co-creation

The need for co-design and co-creation with end users was stressed by projects. Taking time to plan these engagements and thinking through how a project engages across different end users pays dividends. Using human-centred design techniques to ensure the customer/end user voice is at the heart of design processes is highly effective, yielding longer-lasting, more profound impact. Some partners suggested a funded co-creation phase to enable a deeper understanding of the problem space – its people, their needs and pain points. This would ensure the relevance and targeted nature of future project interventions. Partners stressed the need for a transparent and collaborative culture of co-creation within the project, too. Without this, learnings were less easily shared, and risks less well managed.

4. Inter-project collaboration

Some partners reflected that, within the portfolio of projects in a theme or a grouping of inter-related themes, there is currently a missed opportunity to come together and share learnings, insights and resources. This would enable greater and more systematic alignment between project partners, throughout the lifetime of the projects. One suggestion was the creation of a network of project leads within these thematic areas. This network would drive the agenda on behalf of the sector and create a discernible community of innovation practitioners and excellence to engage within the sector, the supply chain and regulators alike.

5. Early engagement

Considering and defining what success looks like before project delivery starts enables far better evaluation of objectives and key results, ensuring a continuous reflective culture from the outset. Partners shared insights on the merits of engaging the breadth of end users and adopters early in the project to ensure the project offer is relevant and can secure adoption. Consultative, consensus-driven planning with the regulators, other external partners, water companies, customers and even internal colleagues is critical to an innovation project's smooth delivery. It enabled partners to secure engagement, creating relationships that would benefit the project, plugging resource and skill gaps and helping shape the delivery programme.

6. External partners

Some of the projects shared insights around how water companies' hard and soft infrastructure, as well as processes and systems, were significant barriers to project delivery and how they were unable to capitalise fully on the expertise, technology or capabilities of external partners as a result of this. Providing data to external partners could be a challenge due to the sensitivity of the data or attempts to link incompatible systems.

7. Regulation and policy

Many partners cited current regulations and the policy landscape as a significant barrier to achieving the full potential of their innovation projects, highlighting fragmented regulations working against a systemic approach. There is an opportunity for these innovation projects to act as a sandpit/testbed to trial new regulatory models, with dispensation that may impact their regulatory compliance in the short-term as these new models are embedded in water company operations. Given that one of the fundamental principles of innovation is that if a project is delivered in a collaborative, consultative way then regulation can and will change, if necessary, partners should not be deterred. Partners also remarked on the importance of a project's alignment to strategies beyond the water sector that can enable change at a wider deeper level, as they cross government agendas and other investment opportunities.

8. Data

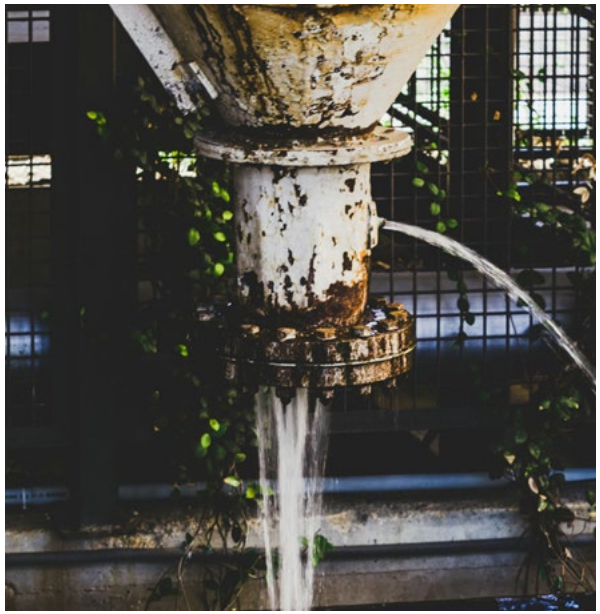
Partners reported concerns over access to data from project partners, in particular water company-held datasets. Lack of access to data resulted in a reduced impact to the project through having to rely solely on publicly available data that was of lesser quality and lacked the granularity required in certain cases. It often required interpretation and wider input to validate assumptions, introducing inefficiencies and margin for errors. The sector now benefits from the growing support of the Stream open data initiative, championing the use of open data and the positive impacts it can bring to innovation in the water sector.

The time for action is now

Ofwat's hope is that this report and the insights and learnings in it will be useful in implementing and scaling the knowledge and resources shared by these Innovation Fund projects.

As we stated at the beginning of this report, this is a starting point for connections, further collaboration and development, as well as a catalyst for change that can bring about positive impact for the water sector, its customers, society and the environment. If you would like to discuss any of the topics described in the report we invite you to reach out directly to the projects and their partners, or to the Ofwat Innovation Fund delivery team at waterinnovation@challengeworks.org

The time for action is now! We urge you to embed and scale these learnings, seizing the opportunity to further develop our wastewater treatment, operations and asset management – all fundamental, frontline services that protect public health and improve environmental sustainability. By harnessing innovation and collaboration we can overcome the current and future challenges facing wastewater management in the UK, and beyond.



Further reading

- Michigan Department of Environment, Great Lakes, and Energy Water Resources Division. (2021). Evaluation of PFAS in Influent, Effluent, and Residuals of Wastewater Treatment Plants (WWTPs) in Michigan. Available at: https://www.michigan.gov/-/media/Project/Websites/egle/Documents/Programs/WRD/IPP/pfas-initiatives-statewide-full-report.pdf

  This report has been prepared by AECOM for the Michigan Department of Environment and presents a detailed study assessing the presence and behaviour of PFAS in Michigan wastewater treatment plants.

- AESGP, EFPIA and Medicines for Europe. (ND). Balancing Challenges on Environment with Access to Medicines in Europe. Available at: https://www.efpia.eu/media/677263/white-paper.pdf

  This report discusses the increasing pharmaceutical residues in wastewater and what techniques are being used to overcome this challenge.

- IWA. (2023). Greenhouse Gas Emissions and Water Resource Recovery Facilities. Available at: https://iwa-network.org/publications/greenhouse-gas-emissions-and-wwrfs/

  This white paper has been produced by the IWA Climate Smart Utilities GHG sub-group with the aim of providing a concise overview of greenhouse gas emissions for utilities and practitioners, highlighting the relevance of lifecycle carbon accounting and wider life cycle assessment.

Ofwat Innovation Fund

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