



Scottish Water

Trusted to serve Scotland



Annual Innovation Report 2016

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1. Foreword

Welcome to our Annual Innovation Report

Scottish Water recognises that innovation is a key enabler for delivering a sustainable high quality affordable service for our customers.

We have a track record of delivering performance improvements across all aspects of our business. However we want to do more to meet customer needs both now and in the future.

To support this aim

- We have an active research and innovation programme with over fifty projects developing knowledge and capability to improve efficiency and service.
- We are seeking to accelerate the adoption of new technologies.
- We are working to embed innovation as a core capability across the business.

Recent successes include:

- Use of flow cytometry to understand where the risks associated with treatment and system microbiology arise; enabling these risks to be better managed.
- A smaller footprint solution to meet required consent conditions and resulting in lower whole life costs.
- Proactive management of our drinking water catchments in collaboration with land owners to reduce the risk that damaged peat lands pose to water quality.

Scottish Water continually reviews new ideas that can be adopted to benefit our customers and the environment. We will continue to work in partnership with academia, our supply chain, the Hydro Nation Water Innovation Service and with the Water Industry Commission and Scottish Government to expand our thinking and create new opportunities to deliver higher levels of service for our customers.



Simon Parsons
Director of Strategic
Customer Service Planning

2. Executive Summary

Our customers expect higher levels of service and greater levels of resilience at an affordable cost. Our Delivery Plan for the 2015-21 period clearly states our aim to encourage and enable greater innovation across our business in order to meet these expectations. We will therefore continue to explore different approaches to create opportunity and choice for the benefit of our customers.



Unleashing our potential for greater customer value

Our Delivery Plan included the following areas that provide direction for our Research and Development Programme:

- New technologies that reduce the economic level of leakage;
- Value generation from waste;
- Automation and real time control;
- Sustainable rural communities; and
- Trialling new technologies with our supply chain.

Also, supporting innovation within Scottish Water is the development of a common language that serves to educate and engage our people.

We welcome the Scottish Water Industry Innovation Panel Report findings that there is strong evidence of a positive atmosphere and motivated culture relating to innovation within Scottish Water.

We also welcome the Scottish Government's launch of the Hydro Nation Water Innovation Service to support the development of the Scottish SME supply chain. The development of our innovation testing centres at Bo'ness and Gorthleck facilitate live testing for the supply chain which should help to speed up the route to market.

The remainder of this report sets out our strategic approach to innovation and the common language being adopted in Scottish Water. It explores key developments in the areas noted above and provides an update on the guidance points that form part of the Scottish Water Industry Innovation Panel Report.

3. Strategic Approach

We have developed an approach that centres around three streams of activity; embedding innovation capability in Scottish Water, delivering knowledge and capability through our Research and Development Programme and trialling new technologies.



Embedding Innovation Capability

We aim to encourage innovation across everything we do. To support this we have developed a common language that promotes a culture of innovation in Scottish Water.

Research and Development

We have a practically focussed Research and Development programme. This programme addresses the five focus areas set out in Scottish Water’s Delivery Plan.

Technology acceleration and adoption

We are developing a new process that aims to bring in available technologies to the business quicker by effectively engaging our supply chain and providing a clear route to adoption.

Sections 3(a), (b) and (c) below explores further each of these streams.

3(a) Embedding Innovation Capability

In this section we explore a key component of embedding innovation capability which is the development of a **common language** to engage our people in a way that promotes a **culture** of innovation across the organisation.

The language we use and the narrative we have developed describes **why** innovation is important to Scottish Water, **what** innovation actually is for us and **how** our people can participate.

Why is innovation important to the success of Scottish Water?

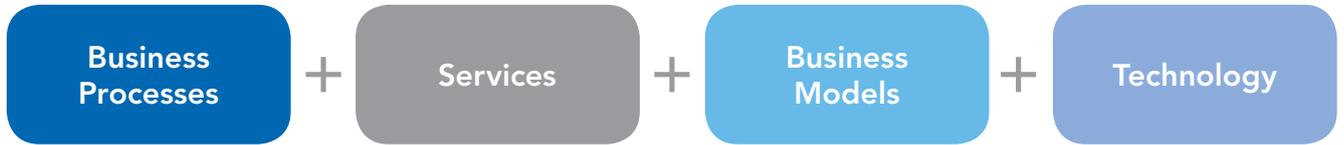
Our customers expect higher levels of service at an affordable cost.

Our stakeholders and regulators also have a clear expectation that we will promote cost effective solutions to resolve customer issues.

Societal and environmental changes are external factors that require Scottish Water to develop new approaches to deliver its service.

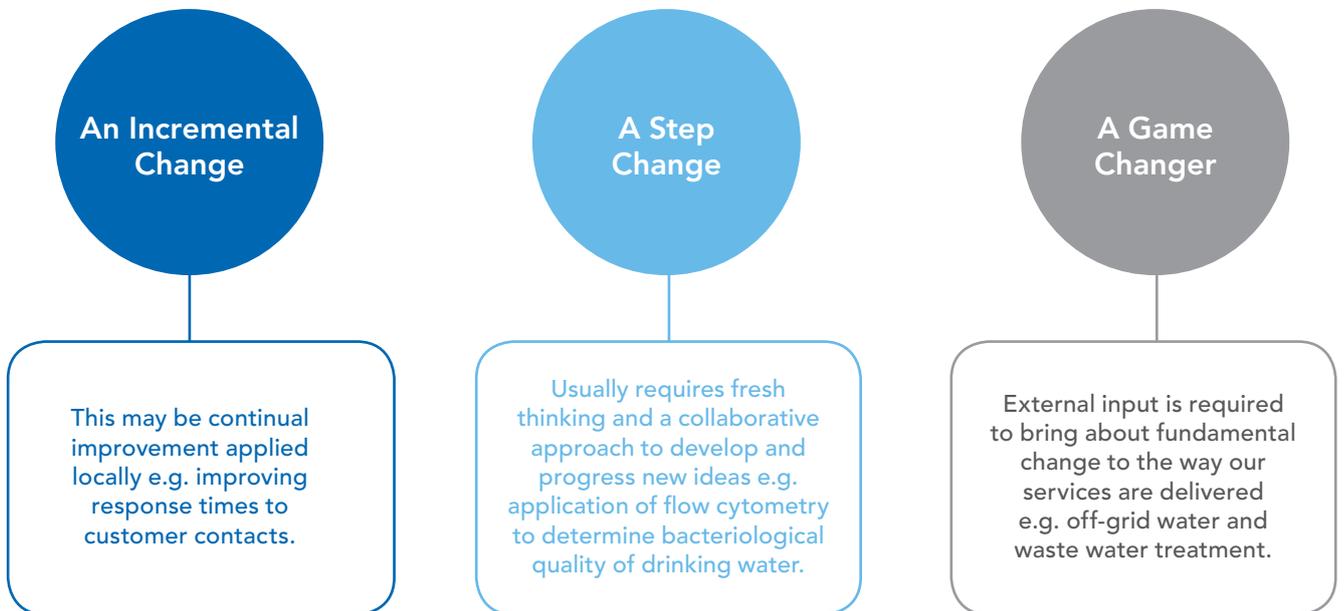
The What?

Innovation is doing something different and better that benefits our customers and the environment. It can be applied to:

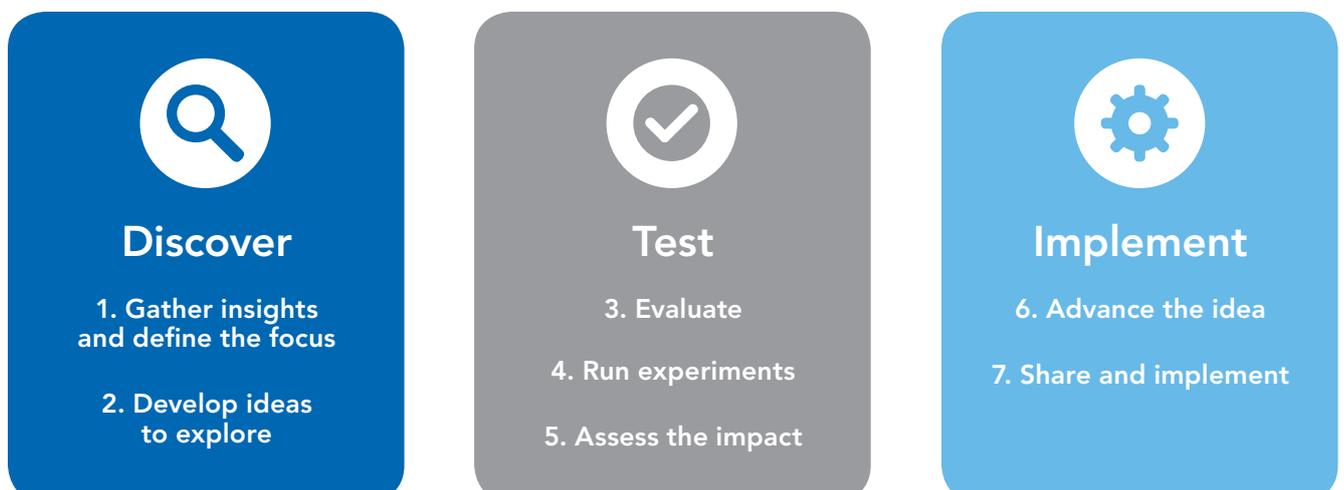


Innovation is a team effort from idea through to delivery.

Innovation can also be:



We have a common process that guides our people through the key steps of **Discover**, **Test** and **Implement**. This is summarised as:



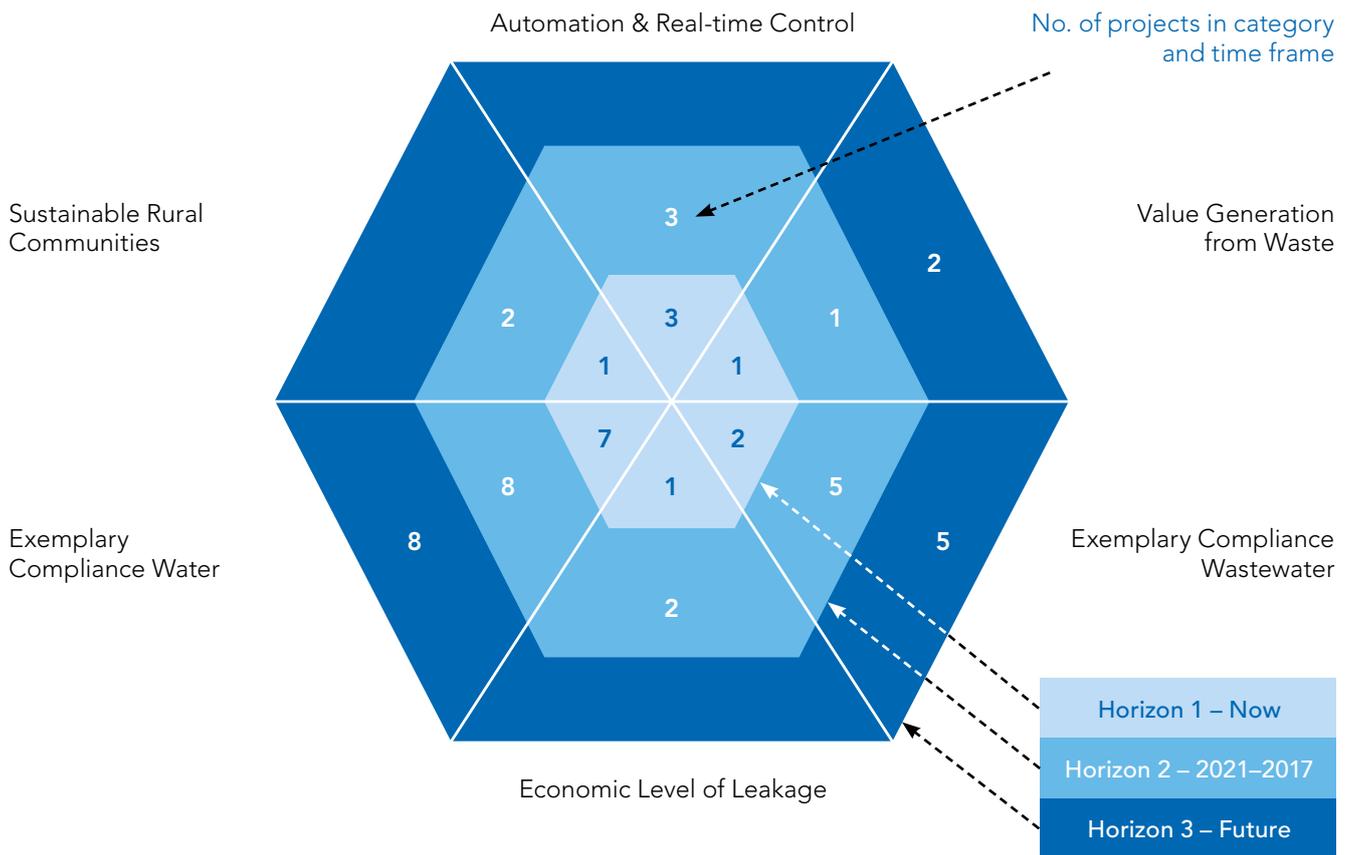
3(b) Research & Development Programme

We have a very active Research and Development programme with over 50 live projects that support the focus areas set out in our Delivery Plan;

- New technologies that reduce the economic level of leakage;
- Value generation from waste;
- Automation and real time control;
- Sustainable rural communities; and
- Trialling new technologies with our supply chain.

The programme also supports our strategic direction of exemplary compliance. We collaborate with the wider water industry on a £4m research programme through UK Water Industry Research (UKWIR) focused on common voice issues e.g. how to address emerging environmental issues.

The diagram below demonstrates the spread of 50+ projects across the strategic themes and highlights the time horizon when benefits may be anticipated.



Our projects are at various stages in the process as follows:

- Discover Stage: **18**
- Test Stage: **22**
- Implementation: **11**

Key Facts

- 50+ Live Research and Development projects (including 5 European projects)
- £6.8m investment planned in the 2015-21 period (£2m committed to date)
- £27m of leveraged investment (through UKWIR, EU funding and UK research councils)
- 9 engineering doctoral students in Scottish Water supporting the Programme
- 3 PhDs funded through Scottish Government Hydro Nation Scholars programme

In addition to the Research and Development programme there are other examples of innovation across the wider business which are summarised in Section 4 of this report and in the appendix.

3(c) Technology Acceleration Process

We are developing a new technology acceleration and adoption process to make it easier for suppliers and employees to get new technology into the business. The aim is to ensure that the business need is identified and prioritised for any technology being considered and to identify the route to implementation to avoid wasted time and effort.

This process is at the test stage and will take time to mature and embed but the early signs are encouraging. As part of the test stage we are developing the appropriate systems to communicate and embed the process across the business and are evaluating a range of business needs, for example, we are;

- evaluating if thermal cameras can be utilised to identify the need for maintenance on pumps
- testing technologies to remove grit from sludge at sludge treatment centres
- evaluating technologies that predict performance of the drinking water distribution network

In addition to this we will continue to work closely with our IT partners to explore future technology and digital opportunities for Scottish Water.

3(d) Partnerships for innovation

We recognise that in order to innovate we need to work in partnership with academia, our supply chain and others.

To this end we welcome the introduction of the **Scottish Government’s Hydro Nation Water Innovation Service (HNWIS)** to support the development of the Scottish SME supply chain. We work closely with HNWIS to identify our needs for new and improved offerings and to assess the potential of products and services being offered by the SME community.

Testing can then be facilitated at our **Innovation Testing Centres** at Gorthleck Water Treatment Works and Bo’Ness Waste Water Treatment Works through Scottish Water Horizons who continue to work closely with Scottish Enterprise to ensure that the facilities and services being offered promote water innovation in Scotland.

We work with the **Scottish Government Hydro Nation Scholars** programme which delivers a high calibre PhD programme through Scottish universities. Scottish Water is currently the industrial supervisor for 3 scholars on the programme.

We also work closely with **The Centre for Expertise in Waters (CREW)** to promote collaborative research with our regulatory partners to increase knowledge of environmental factors that may improve our service and impact on water policy.

We are exploring opportunities to leverage the resources of our supply chain partners. We have been working with our **IT partners** (Fujitsu and TCS primarily) to develop proof of concept trials in technology and digital. Areas that we are exploring include ‘connected vans’, ‘sewer network monitoring’, ‘digital and analytics for customer insights’ and ‘real-time water quality reporting’.



4. Key Developments

We are encouraged at the progress we have made across our three streams of activity. We have worked hard to encourage our people to do something different and better and will continue to develop our projects and processes to ensure we deliver more for our customers.

4(a) Supporting a Culture of Innovation

To enhance our capability we continue to pursue a variety of approaches including;

- Patent application submitted for innovative valve with employees involved receiving Scottish Water's Vision Award.
- Targeted proof of concept trials with IT delivery partners, for example looking at "Connected Vans".
- Hothouse events, for example, on reducing leakage cycle times.
- A conference on 'zero bacti failures' hosted jointly with Glasgow University and Engineering & Physical Sciences Research Council (EPSRC).
- Roll out of the lean management system and continual improvement training to 150 employees to provide the platform from which we can innovate.
- Our future leaders programme incorporating 'Leading for Innovation' delivered by Oxford Said Business School.
- Engaging our people through internal publications, vision awards and internal surveys. For example, from an employee survey 82% confirmed that they are encouraged to bring new ideas and fresh thinking into their roles.
- Engaging future generations to come up with new ways to tackle future climate challenges through the 2050 Climate Group.
- External recognition, for example, sustainable land management approach featured by UK Water Partnership in Farming and Water video and technology developed by Scottish Water Horizons' partner SHARC where energy is extracted from our waste water networks and transferred as heat for export to the Borders College, Galashiels.
- Pursuing opportunities to generate revenue from our skills and assets through Scottish Water International and Scottish Water Horizons.
- Developed water and waste water innovation testing centres at Gorthleck (near Inverness) and Bo'Ness. These facilities allow for testing of new water and waste water technologies in live or near live environments. These sites are available, on a commercial basis, to suppliers looking to test and demonstrate their technologies.



bacti Conference



Gorthleck Development Centre

4(b) Research and Development Projects

Projects on the Research and Innovation programme are progressing through the stages of Discovery, Test and Implement. Highlighted below is a selection of projects at each of these stages. Further examples can be found in the appendix to this report.

Discover

- Data & analytics for customer insights
- Decentralised water and waste treatment for rural communities
- Waste water treatment works of the future



Test

- Ion exchange and ceramic membranes for water treatment
- Small scale vacuum distillation for water treatment remote communities
- Thermal energy from waste water sludge



Implement

- Process robustness assessment for water treatment works
- Bio thermic digestion of sewage sludge to avoid landfill
- PODDS – proactive water mains conditioning



4(c) Business Wide Innovation

We are encouraged by the application of continuous improvement and fresh thinking across different functions and disciplines that are delivering real improvements for our customers. A selection of innovations applied to business process, service and business model are highlighted in the table below.

Applied to	Initiative	Desired Outcomes
Business Process	Plan Prepare Deliver Process	The redesign and implementation of a new approach to prioritising, planning and delivering asset related improvement to maintain and enhance customer service.
	Automation of Annual Flow Return	Working with IT partners to systemise and automate annual flow return to the environmental regulator, SEPA, leading to a reduction in manual intervention and improved accuracy of reports.
	Flexible Retirement	A flexible retirement programme aligned to recruitment of modern apprentices to smooth the transition to retirement and provide knowledge transfer opportunities to our next generation employees.
Customer Service	Leakage Cycle Times	Addresses a customer priority by exploring ways of achieving next day fix for visible leakage.
	Reservoir Resmix System	Reduces the risk of manganese discolouration events for customers.
Business Model	Integrated Supply Chain Management	Move to longer term frameworks and partnerships with our supply chain leading to better buying decisions and more effective supply chain management.
	Leveraging Partnerships	Working in partnership with heat recovery experts to utilise latent heat within sewers reducing energy costs for Borders College.
	Leveraging expertise via Scottish Water International	We generate revenue by assisting water service providers to develop improvement and transformation programmes based on our experience. Scottish Water International leverages our internal expertise in Canada, Australia and the Middle East.

5. Innovation Panel

We welcomed the opportunity to work in partnership with the Water Industry Commission and Scottish Government to expand our thinking on innovation opportunities.

Following the publication of the Innovation Panel Report which was commissioned by the Water Industry Commission to review the approach to innovation in the water industry in Scotland, we are pleased to note that a number of the guidance points raised in this report are progressing in Scottish Water.

For example:

- As shown in this report, we have developed a common language to engage our people and support a culture of innovation.
- We will provide strategic focus for future innovation activities through Scottish Water's success aspirations.
- We have developed our thinking further in relation to pathways to innovation which we will test with key stakeholders.
- Systemising rollout is a priority activity for us as projects progress from the discovery and test stages on to implementation.
- We have a future leader's programme which is currently looking at the role leaders should play in driving innovation in the business.



Innovation Panel Report

6. Continuing the Journey

2015-21

We will continue to pursue opportunities in this current period to meet and exceed the commitments we have made to our customers. We will systemise our approach to embedding different and better ways of working and will continue to explore the opportunities presented through new technologies and our supply chain.

We have strategic partnerships with a number of universities and will continue to enhance these partnerships to enable research and new knowledge to be applied to issues with no known solutions.

Post 2021

Looking beyond the current regulatory period our research and innovation activity needs to inform and be informed by our future plans and aspirations. We will continue to work with our stakeholders and customers to identify the long term outcomes that we are trying to achieve as well as the external pressures that may impact us.



Appendix: Research and Development & Business Wide Innovation Projects

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Project	Stage	Strategic Theme
Rural community treatment systems – a toolbox of technologies	Discovery	Sustainable Rural Communities
Small scale vacuum distillation for water treatment remote communities	Test	Sustainable Rural Communities
In search of the immortal membrane	Test	Exemplary Compliance Water
Sustainable land management - modelling dissolved organic carbon (DOC) in the future	Test	Sustainable Land Management
PODDS – prevention of discolouration in distribution	Implementation	Exemplary Compliance Water
Bio thermic digestion to avoid landfill	Implementation	Value Recovery from Waste
Flow cytometry for effective water quality management	Implementation	Exemplary Compliance Water
Reducing the footprint size of waste water treatment works	Implementation	Exemplary Compliance Water
Summary details on further business wide improvements and innovation	Test/Implementation	Business wide improvements and innovation

Rural community treatment systems – a toolbox of technologies

Focus Area: Sustainable Rural Communities
Stage: Discovery

Description

For our research into Sustainable Rural Communities we have a toolbox of technologies currently on trial to assess their performance for Water Quality and against social, economic, and environmental sustainable aspirations.

These trials will run for 2 years to build confidence in the robustness of the technology. Throughout the two years technologies will be added and others stopped as they are compared for performance.

Technologies include; Ion-Exchange, Ceramic Membrane, Atlantic Water, Rainsafe, Bridge-Bio Capacitive Recovery System and Wastewater Wizard.

Potential Benefit

No chemical wastes or sludge to deal with. No operational attendance required and very low maintenance to achieve fully compliant water quality for very small communities.

Small scale vacuum distillation for water treatment remote communities

Focus Area: Sustainable Rural Communities
Stage: Test

Description

The oldest method for production of pure water is the thermal method or distillation – water evaporation from the surface and condensation. The basis of the process is the transfer of water in the vapor phase with its subsequent condensation.

This unit offers an efficient and effective method of treating water that could be powered from a renewable source. This is potentially a very interesting technology for very small remote communities. A trial at Glassford WTW is being completed with a view to deploying on small systems in the 2015-21 period.

Potential Benefit

No chemical wastes or sludge to deal with. No operational attendance required and very low maintenance to achieve fully compliant water quality for very small communities.

In search of the immortal membrane

Focus Area: Exemplary Compliance Water
Stage: Test

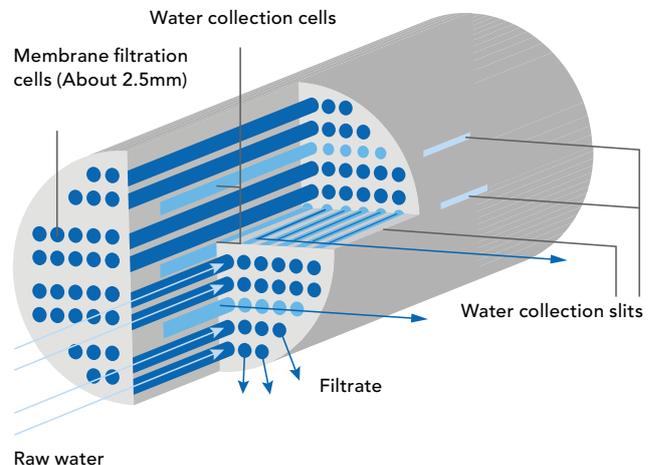
Description

This project aims to establish which filtration technologies ceramic membranes might compete with and better understand their performance characteristics. The technology can provide upstream pre filtration for nanofiltration membranes, direct replacement of cartridge filtration and potentially be utilised as replacement technologies for conventional filtration.

Initial assessment of the technology will consider how it might be used to replace existing membrane and media filter technologies in the future. The proposed trials will also look at upstream ion exchange and coagulation process to ensure the system can provide compliant water quality.

Potential Benefit

Potential benefits are long membrane life, small process footprint, robust treatment process, simple low maintenance processes, flexible and scalable processes.



Evaluating Alternative Membranes

Sustainable Land Management - Modelling Dissolved Organic Carbon (DOC) in the future

Focus Area: Sustainable Land Management
Stage: Test

Description

Long term monitoring across Europe shows a consistent pattern of rising DOC since the 1980's. This is linked to the recovery from acidification and the decrease in sulphur emissions. Current trends suggest that DOC will be higher than the pre-industrial baseline condition.

These increases may have a significant impact on some water treatment works. As part of a recent CREW project, DOC models were developed to predict the increases in DOC at 6 reservoirs. It also modelled how land management practices could help.

All of these reservoirs showed increases in DOC until 2030, some more than others. In reservoirs with a source of nutrients, aquatic DOC is likely to form. This type of DOC is hydrophilic and harder to remove through the treatment process. The models showed that land management can help reduce DOC, but in some cases not enough for the water treatment works to cope with.

Potential Benefit

This approach has highlighted potential pressures that DOC may place on our WTW in the future. By recognising this now plans can be put in place to respond to this.

If this work was extended to all WTW and related to asset capability it would enable the high risk WTW to be identified both for future capital investment and for land based interventions.

This will help us to meet our regulatory requirements for water quality in the future.



Sustainable Land Management

www.scottishwater.co.uk

PODDS - Prevention of Discolouration in Distribution

Focus Area: Exemplary Compliance Water
Stage: Implementation

Description

Water distribution systems are vast physical, chemical and biological reactors with highly variable hydraulics and residence times where the processes occurring at the pipe walls are dominated by the biofilms on pipe surfaces. These variables and processes have a significant influence on the Water Quality in distribution and understanding their interactions will help us to minimise the risk of Water Quality failures and the customer complaints associated with discolouration events.

Models developed allow targeted proactive flushing and conditioning of water networks to ensure that biofilm build up is managed effectively. This minimises the risk of discolouration at customer taps.

A collaborative research programme with Sheffield University and other UK Water utilities is currently being tested in live networks.

Potential Benefit

PODDS is forecast to deliver significant capital savings against the traditional methods of trunk mains cleaning methodologies over the 2015-21 period.



Prevention of Discolouration in Distribution (PODDS)

Bio Thermic Digestion to avoid Landfill

Focus Area: Value Recovery from Waste

Stage: Test

Description

- High temperature anaerobic digestion (between 100 – 200C), enclosed to ensure the reactor reaches adequate temperatures.
- Delivered 85-90% volume reduction during our trials .
- Retention time around 72 hours.
- Generated process heat is used to maintain temperature in the reactor, and it is a net producer of energy.

Potential Benefit

Cost savings as a result of not sending sludge to landfill. Risk reduction should sludge to land become unavailable. Potential application on water treatment sludges.



Avoid sludge to land

Flow cytometry for effective water quality management

Focus Area: Exemplary Compliance Water

Stage: Implementation

Description

Scottish Water is the first Water Authority in the UK to routinely use a new scientific analysis tool: Flow Cytometry. This is a method of counting all bacteria within a sample. Flow Cytometry can track total numbers of bacteria through a drinking water system, giving an overview of the microbiology from source to tap. This will help identify problem areas and

target works optimisation and investment, so that we can provide the best quality drinking water for our customers and continue to improve our compliance levels.

A new team within Process Science is collaborating with Scientific Services on this new project in order to better assess the microbiological performance of our water treatment works and distribution systems.

Potential Benefit

The work that this team will be undertaking will allow us to more fully understand where the risks associated with treatment and system microbiology arise and how they can be better monitored and managed.

Reducing the footprint size of waste water treatment works

Focus Area: Exemplary Compliance Water

Stage: Implementation

Description

The Nereda process offers a sustainable approach to waste water treatment that improves effluent quality over conventional processes in a smaller footprint using less energy. The process utilises aerobic granular activated sludge, the formation of which is controlled by the plant management system.

Glasgow and has now been approved for installation at Inverurie Waste Water Treatment Works. This will be the largest installation of this type of technology in the UK.

Potential Benefit

Nereda offers a smaller footprint solution to meet required consent conditions resulting in lower capital and whole life costs.

- Lower opex solution than conventional options.
- Higher quality effluent than conventional options allowing for future proofing of compliance against future standards (for no additional cost).
- More sustainable solution (less construction materials, low energy and zero chemical).

Business Wide Improvement/Innovation

Protecting public health

Increasing the range of pesticides that can be efficiently monitored at no additional cost to customers.

Managing odour

A new integrated system to validate, trend and manage odour events at Shieldhall WWTW.

Tackling theft of water

Ability to determine that water is being used by a monitored property without a site visit.

Managing raw water

Actiflo turbo to respond to the rapid changes in raw water and improve raw water quality.

Detecting leakage

Willowstick - a new technology to trace leakage paths through earth embankments to minimise the risk of failure.

3D scanning

3D survey that provides safe and accurate non-contact scanning of plant and equipment.

Physical Activity Monitoring

Providing meaningful data on activities leading to analysis of how injuries can be prevented through changing working practices.

Productisation

Developing 15 catalogues of standardised products for offsite manufacture to reduce construction and commissioning time by 50%.

Sustainable Land Management

Using satellite imagery to assess catchment risk.

Integrated Supply Chain Management

Creating a fresh approach to improve the way we do business with our supply chain.

Innovation Testing Centres

Testing new technology innovations on operational scale assets.

Rant & Rave for Business Customers

Extended utilisation of 'Rant and Rave' to measure business customer experience from Licence Providers and Scottish Water.

Dynamic Financial Business Modelling

Enabling multiple financial scenarios and stress testing to be undertaken on a number of business factors simultaneously and quickly.

Flexible Retirement

Utilising the opportunities for employees to flexibly retire, to maximise business benefit and meet individual aspirations.

For more information on Scottish Water and our services visit www.scottishwater.co.uk or contact our Customer Helpline on **0800 0778778***.

* We record all calls for quality and training purposes.

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