

TA 12.MG04 M&G Research & Development Business Case

September 2018
Version 1.0

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1. Executive Summary

Name of technical annex	MG04 Research & Development		
Context	Research & Development (R&D) is about building a resilient water future for the South East. Our R&D programme focuses on delivering innovations in wastewater, water, compliance and asset resilience, energy, water efficiency and reuse, catchment monitoring, and resilience.		
Customer and stakeholder views	Our customers and stakeholders say that providing clean, safe, high quality water and removing wastewater effectively while avoiding pollutions and flooding is important to them. R&D will help us achieve our customers' priorities as we pioneer new ways to ensure we deliver long term value for our customers.		
Our aim	Continue our innovations and R&D to ensure we remain resilient and able to provide great service to our customers at the lowest possible cost. Our strategic focus is to deliver R&D to support achieving our five transformational programmes which are Target 100, Sustainable Drainage, Catchment First, Resource Hubs and Network 2030.		
Scope of this technical annex	Base expenditure directed towards delivering our R&D programme. It does not cover all investment required to deliver innovation across the organisation; it only covers R&D opportunities.		
	Botex	Enhancement	Total
Totex (£'m)	15.4	-	15.4
Opex (£'m)	2.2	-	2.2
Capex (£'m)	13.2	-	13.2
Residual, post-AMP7 capex (£'m)	0	-	0
20 year Whole life totex (£'m)	-	-	-
20 year cost benefit (£'m)	-	-	-
Materiality (% of the overall plan)	-	-	0.4%
Relevant business plan table lines	Tables: WS1/ WWS1 Lines: 6,13	-	Tables: WS1/ WWS1 Lines: 6,13
Botex			
Overview of AMP7 proposals	<p>We are investing £15.4m into our Research & Development (R&D) programme which is focused on new and innovative ways of working.</p> <p>To formalise our commitment to and investment in R&D in 2015 we established our R&D programme, with a dedicated team that seeks input and inspiration from our customers, colleagues, external experts, industry participants and the business community. The focus has been on new solutions for the issues and problems which face our customers, such as leakage control, use of market mechanisms and catchment solutions as natural solutions in place of engineered approaches to flooding, leakage and resource management. The R&D programme looks to address transformational business challenges, building new capabilities in digitisation, machine learning, and creating new partnerships.</p>		

During AMP6 we have spent c.£13m on a variety of innovative technologies which have resulted in cost savings, increased resilience, improved compliance, and performance improvements. Our R&D investment in AMP6 and AMP7 are key pillars to our transformative programme in AMP7.

Why are the proposals the best option for customers

Our R&D programme is geared towards supporting our commitment to customers. This includes limiting the impact of any issues to customers for the lowest cost. The programme continuation from AMP6 to AMP7 is our preferred option as this drives the level of engagement and delivery we have developed. We are able to commence new projects quickly which enables efficient reaction to answer any potential issues.

We have considered other alternative investments options; it would be unfeasible to continue our R&D programme with less investment, a higher level of investment would mean a greater level of engagement and activity throughout the business, if this is created within AMP7, funding through collaboration and grants will be sought to enable programme growth. We believe the current cost profile will deliver the best value to our customers.

We have consulted with our customers, including their priorities in our plans by focusing on catchment approaches, market mechanisms, smart metering and resource management. The value of this was demonstrated at our stakeholder workshop in April 2018 where customers provided overwhelming support for our innovation strategy, we have answered this with our approach of using innovation to address their key priorities.

What we would like to highlight

We have a strong capability to commission and execute R&D projects. We have built an ecosystem of external partners to collaborate and accelerate results, including strong links with local suppliers and universities, and participation in cross-industry collaboration projects, which helps to reduce our costs. The programme has won over £1m in external grants. Our work has caught the attention of judges at national innovation awards. We aim to focus our R&D on natural processes, to deliver best value for the customer in the long run. This includes catchment management approaches, flood prevention and how we protect our resources through circular economy approaches.

Performance Commitments supported by this technical annex

PC	How relevant is this technical annex?	Comment
Water quality compliance	Good levels of relevance for delivering all of these performance commitments in some way.	R&D will be undertaken in AMP7 to look directly at how new technologies and ways of working will improve performance in all of these areas.
Asset health		
Sewer blockages		
Wastewater pollution incidents		
Risk of severe restrictions in a drought		

Bathing water
excellence

% of energy from
renewable sources

Leakage

Interruptions to
supply

Per capita
consumption

Drinking water
quality

Dealing with
customers'
individual needs

2. Scope of technical annex

This technical annex covers our R&D programme. It highlights progress made during AMP6 and the benefits being delivered.

It also defines the shape and size of the AMP7 programme and how it will further enhance the organisation capabilities and overall performance.

An R&D activity of £13.2m Capex and £2.2m OPEX is required to address the customer, environment and business challenges we face in AMP7. We will extend current projects, continue on-site trials and pilots, and support strategic cross cutting themes. Details are provided in this document.

This technical annex does not cover all investment required to deliver innovation across the organisation; it only covers R&D opportunities.

3. AMP6 Strategy

3.1 Investment Strategy

AMP6 budget

Table 1: AMP6 R&D Investment

£m	AMP6 Actual					AMP6 Total
	2015/16	2016/17	2017/18	2018/19	2019/20	
TOTEX	0.052	1.834	4.648	3.734	3.175	13.444
CAPEX	0.052	1.466	4.164	3.324	2.764	11.771
OPEX	0.204	0.368	0.483	0.411	0.411	1.878

Establishing the AMP6 programme

It typically takes a couple of years to establish an R&D programme.

Our R&D team was formed at the start of AMP6. The initial requirement was to establish the function, formulate the R&D strategy, set up the delivery mechanism, and create the internal & external relationships needed to shape the programme over the AMP.

Due to this development period, the first and second years of the AMP had lower project progression and spend, with only 3 projects being started in Year 1, see *Table 1*. This development period has enabled the continued growth of the programme to the position now where there are c50 projects and an average forecast of c£3.5m over the last three years of the AMP.

Figure 1: Development of R&D programme demonstrates the increase over the first three years.

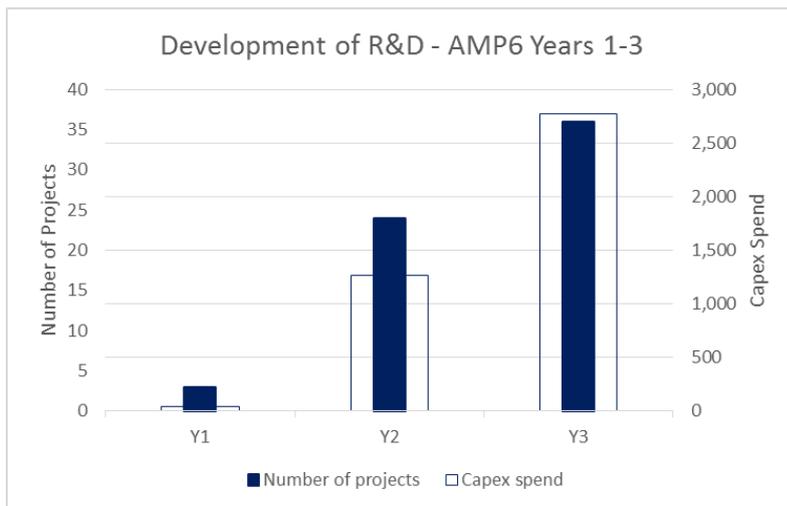


Figure 1: Development of R&D programme

Customers help shape the R&D programme

Our customer engagement and insight programme has engaged with customers and collected detailed qualitative and quantitative data. Our assessment of customer priorities and attitudes regarding their water service is based on a number of key research and engagement programmes conducted by, and on behalf of, us including customer surveys, workshops, interviews and other research methods. Through these customer and stakeholder engagement platforms we have reached over c. 1600 people. We have engaged with a broad range of our customer and stakeholder base including household and non-household customers.

We have engaged our customers to better understand their priorities and concerns for the coming years and together with them co-create a view of the future of water and waste water. Some of the key concerns highlighted by customers were climate change, increasing population, pollution and cyber-attacks.

One of the themes that came out as a key plausible solution to these issues was innovation. Innovation to make water services more efficient, decrease water usage, produce more water from new sources and assist with repairs and locating leaks. More specifically our customers expected us to:

- Continue to research and develop systems and products that save, improve or recycle water, or reduce water bills
- Work with developers to create improvement systems and products that can be fitted to new and existing properties
- Work with customers to produce new improvement systems and products that can be fitted in their properties
- Respond to the customers' appetite for rainwater harvesting and domestic water recycling systems and products

Moreover, during panels, stakeholders were asked to brainstorm how we could play a greater role in supporting local communities, creating economic growth and improving the environment over the next 25 years.

Panellists gave specific suggestions on where they saw a crucial need for innovation to change behaviour or increase resilience in the face of an uncertain future. Some areas they highlighted included using more renewable energy, planning investment in strategic wastewater infrastructure in a more-timely manner to support growth, promoting water re-use and maximising energy production as by-product of water treatment process.

Our most recent customer research has identified the following set of priorities which align well with the AMP7 R&D programme, as shown in Figure 2: Customer priorities below.

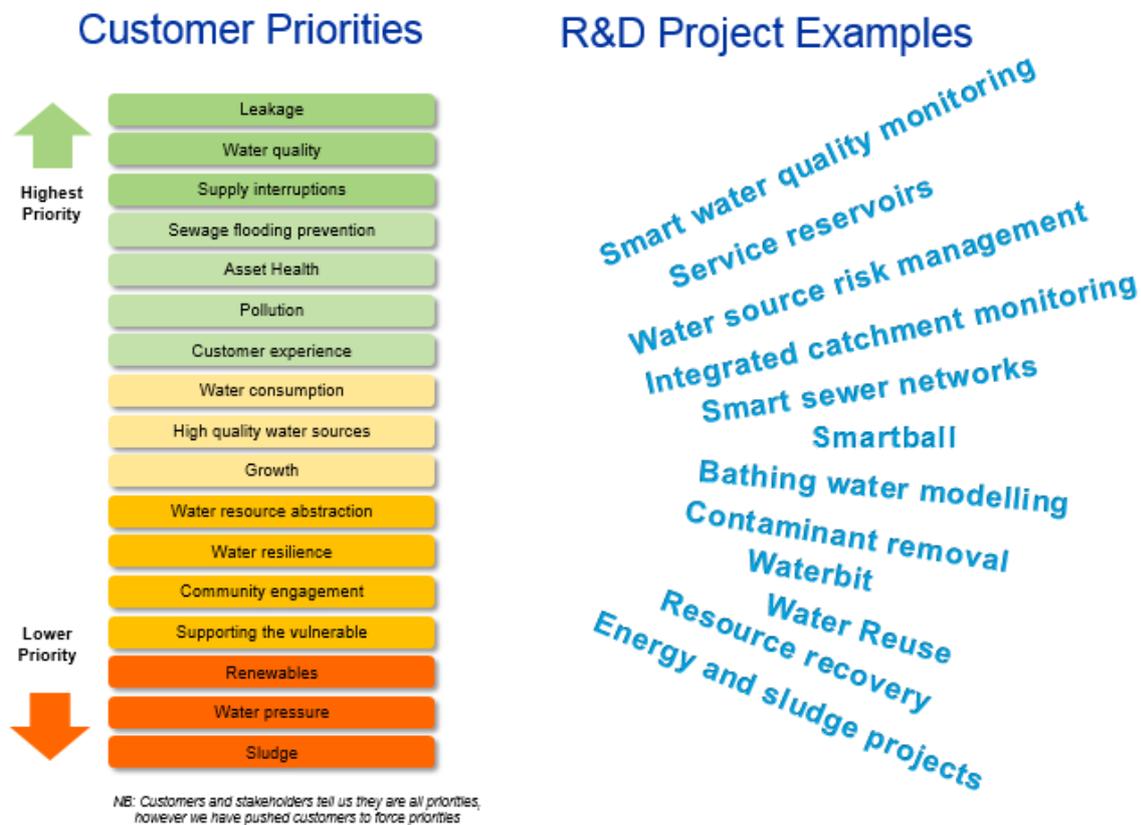


Figure 2: Customer priorities

R&D AMP6 alignment with Customer Performance Commitments (PC's) and Outcome Delivery Incentives (ODI's)

The programme is also aligned with ODIs and performance commitments (PC). Performance commitments that R&D is aligned with include:

- Water quality compliance
- Asset health
- Sewer blockages
- Wastewater pollution incidents
- Risk of severe restrictions in a drought
- Bathing water excellence
- % of energy from renewable sources
- Leakage
- Interruptions to supply
- Per capita consumption
- Drinking water quality
- Dealing with customers' individual needs

R&D activity in AMP6

Working alongside our board, executive team and senior management group, R&D has sought input and inspiration from our customers, colleagues across the business and insight from external experts, industry participants and other companies in associated industries.

Selected R&D project ideas are prioritised and developed into business cases. These business cases articulate the strategic fit, drivers, aim, benefits, deliverables, risks, timeline to realise benefits, costs and project plans. We have a structured process in place for approving R&D projects.

Our AMP6 R&D programme focuses on innovations across all areas of our business including wastewater, water, networks, compliance and asset resilience, energy, water efficiency and reuse, digital tools for customers, catchment monitoring, and more. Details are provided below.

We cover a broad range of disciplines from chemistry, microbiology and computer science to cross-disciplinary fields like engineering, construction, and system design.

Collaboration through a number of innovation networks and cross-industry initiatives is central to our work and is resulting in better outcomes for our customers and the environment by taking out risk, accelerating progress and reducing costs. Examples include UK Water Industry Research (UKWIR), Technology Approval Group (TAG Europe, Isle Utilities), Universities partnerships, Innovation Managers Forum (Isle Utilities), and the LITSoN Project on Innovation in UK Water Utilities.

Furthermore, we have leveraged our networks to execute larger scale projects in association with our partners to deliver high quality results to the community at large. Examples are summarised in this chapter.

Recognition of R&D achievements

Our work has caught the attention of judges at national innovation awards (see Figure 3: Awards presentations).

- Waterbit: Finalist in the Institute of Water South East Area Innovation Awards
- Predicting Metaldehyde in Water Systems using Innovative Modelling, Finalist in the Institute of Water South East Area Innovation Awards
- Power & Water and Southern Water joint UKWIR-funded initiative was a finalist at the Water Industry Achievement Awards in the “Most Innovative Use of an Existing Technology” category.



Figure 3: Awards presentations

The programme has won over £1.1m in external grants with further contributions through collaboration of over £1m.

R&D proactively communicating results

- Intranet site dedicated to R&D
- Coverage on BBC South East Today talking about innovations in leakage technologies
- Over a dozen R&D articles published externally
- 10,000s of media impressions
- Presentations at our Innovation Week
- R&D case studies in our stakeholder newsletter
- R&D group on our Workplace FaceBook platform
- Presentation at [SWIG¹](#):
- Conference presentations in 2018:
 - <https://event.utilityweek.co.uk/congress/speaker/gerard-harkin/>
 - <https://event.wwtonline.co.uk/innovation/speaker/gerard-harkin/>
 - <http://www.swig.org.uk/wp-content/uploads/2017/12/Jez-Downs-Mark-Tully-2018.pdf>
 - <http://ewmconference.com/conference-programme/phosphorus/>
- Examples of R&D articles:
 - [Digital water networks²](#)

¹ <http://www.swig.org.uk/wp-content/uploads/2017/12/Sensing-data-driven-technologies-Final-agenda.pdf>

² <https://beta.southernwater.co.uk/the-news-room/the-media-centre/2018/june/sensors-and-network-sensibility>

- ['Southern Water is taking the P'³](#) – Blog post and video on the R&D 'Innovation Hub' collaboration with the University of Portsmouth for researching phosphorus removal.
- [Southern Water in ground-breaking research on phosphorous removal⁴](#)
- [SmartBall – detecting leaks before they happen⁵](#)
- ['How smart sensors are monitoring water quality in Rownhams, Hampshire'⁶](#) – Blog post on our Smart Network for water quality monitoring trial.
- ['Innovation is everywhere at Southern Water'⁷](#) – Innovation in Southern Water blog post.
- ['Water Innovation Podcast'⁸](#) – Podcast on innovation in Southern Water, including engineering innovation and R&D.
- [Ricardo and Southern Water use automotive software to drive innovation in water supply⁹](#)
- [The SWAT team for slug-killing pesticides¹⁰](#)

³ <https://beta.southernwater.co.uk/the-news-room/the-media-centre/2018/february/southern-water-is-taking-the-p>

⁴ <https://www.waterbriefing.org/home/company-news/item/15199-southern-water-in-ground-breaking-research-on-phosphorous-removal>

⁵ <https://beta.southernwater.co.uk/the-news-room/the-media-centre/2018/march/smartball-detecting-leaks-before-they-happen>

⁶ <https://beta.southernwater.co.uk/the-news-room/the-media-centre/2018/february/how-smart-sensors-are-monitoring-water-quality-in-rownhams-hampshire>

⁷ <https://beta.southernwater.co.uk/the-news-room/the-media-centre/2018/february/the-future-is-here-already>

⁸ <http://waterwatch.podbean.com/>

⁹ <https://ricardo.com/news-and-media/press-releases/ricardo-and-southern-water-use-automotive-software>

¹⁰ <https://beta.southernwater.co.uk/the-news-room/the-media-centre/2018/june/swat-team-for-slug-pesticides>

Summary of AMP 6 project areas

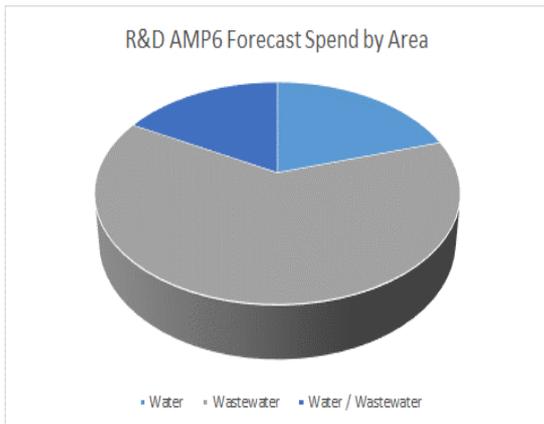


Figure 4: R&D project spend by area

Figure 4: R&D project spend by area shows the split of spend by water wastewater, demonstrating alignment to the size of each business area.

All projects are strategically linked to customer priorities, ***Error! Reference source not found.*** to

Figure 7 highlight some of the projects in different areas of the business. A more comprehensive summary can be seen in *Appendix 0*

Examples of Wastewater and Environment Projects



Resource recovery solutions for large sites (NEREUS)

We are working with an international consortium of 5 companies and three universities to assess a range of resource recovery technologies for transforming wastewater into valuable resources

Maintaining wastewater compliance

Phosphorus removal at our Innovation Hub

In collaboration with the University of Portsmouth, we've set up an innovation Hub, based at one of our wastewater treatment works. The Hub's focus is to run trials for phosphorus removal for our many small wastewater treatment sites. One of the projects is testing various adsorbent medias as we're aiming to find passive solutions.



Bathing water modelling

Developing a cost effective, risk assessment modelling framework that integrates Southern Water asset data, network data, river catchments models and marine models, to predict and identify evidence to support management actions and investment decisions to support bathing water performance.

Improving our bathing waters

Managing microplastics in wastewater systems (PhD)

We are supporting research costs for a Research Council funded project, to assess the pathways and management/mitigation strategies for microplastics (and other emerging contaminants) within wastewater systems leading to marine environments.



Figure 5 Examples of wastewater & environment R&D projects

Examples of Water Projects



Digital water usage tools for customers

We are co-creating a solution to provide customers with digital tools to manage their water usage.

Better information
& advice for our
customers

Smart water quality monitoring network with predictive analytics

We are trialling a smart water quality monitoring network using Intellitect and ATI products

Maintaining water
quality
compliance



Dynamic network modelling

We are developing an innovative modelling tool with Ricardo. The tool will test scenarios, such as population growth and water supply, and impact on water infrastructure

Service Reservoirs

Identifying the root cause and risk factors of bacteriological compliance at service reservoirs to produce a tool set for prioritising sampling, maintenance and investment using failure data from multiple water companies.



Figure 6: Examples of water R&D projects

Examples of Conditional Monitoring and Energy Projects



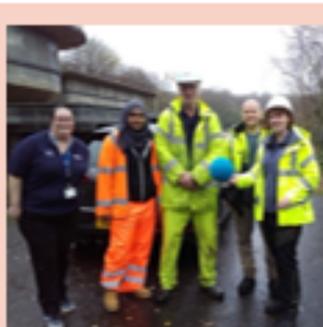
Satellite imaging below ground

The project tested the feasibility of specific applications of earth observation techniques and data analysis to the Southern Water wastewater below ground network

Conditioning Monitoring Sewers

A 6 month trial, SMART Sewer is a system to detect developing blockages before they lead to flooding events, with the ability to differentiate between blockages and other causes of level increase.

Mitigation of potential flooding incidents



Condition Monitoring Rising Mains

A new approach to mains surveying, which provides more functionality and features than other products on the market.

More affordable bills through enabling more targeted asset investment

Increasing % of renewal energy resources & helping with more affordable bills

Biogas Yield Improvement

Funding an EngD from the University of Brighton to study and reduce the scientific uncertainty related to the processes and technologies needed to improve biogas yield.



Figure 7: Examples of conditional monitoring and energy projects

Leveraging our networks to execute larger scale projects in association with our partners

We collaborate on cross-industry initiatives and leverage our networks to rapidly execute projects, at a lower cost and lower risk. Collaboration contributions are shown in **Figure 8: Collaboration Contributions** below, details of which can be found in appendix 0.

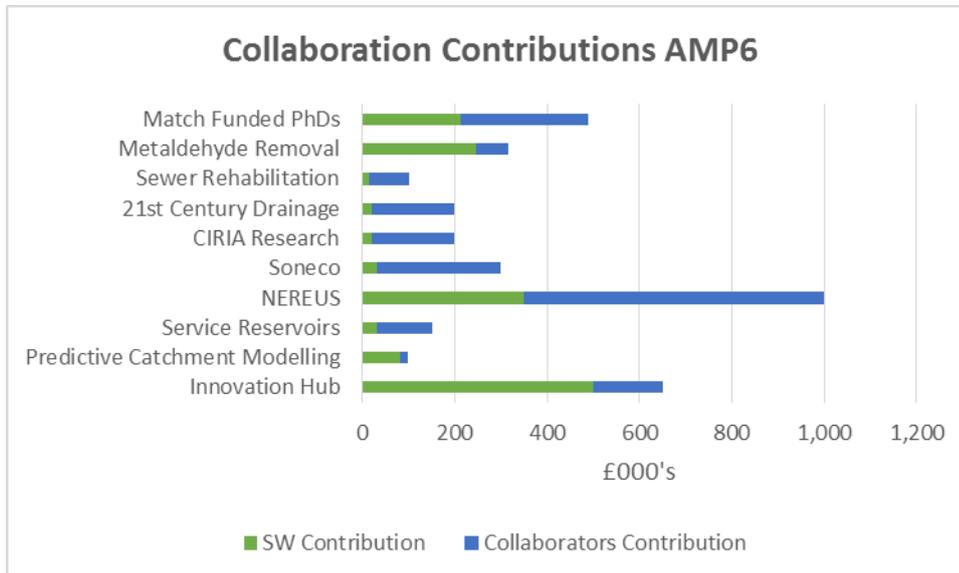


Figure 8: Collaboration Contributions

Encouraging ideas from colleagues

To encourage innovative thinking across our business, we have a special fund called the Idea7Fund. The fund is open to all staff for small, quick-win projects where the technology is at a TRL7 maturity level and above.

- What's it for?
 - To stimulate innovation across the organisation
 - To encourage speed and rapid exploration of innovative ideas
- Why was it established?
 - As a reaction to administrative burden of the existing approvals process for small projects (i.e. smaller projects of less than £50k require the same approvals as £500k+ projects)
- What kind of projects?
 - Low risk projects
 - Value of <£50k (including overheads)
 - For projects requiring small inputs to prove cost savings or efficacy to the business
 - TRL of 7 and above

Got a great idea?

We have a special fund called the **Idea7Fund**



The fund is open to all staff for small, quick-win projects.

Contact: Rebecca.Kennedy@southernwater.co.uk



Guidelines and details of how to submit ideas are available on our intranet site.

We have currently funded 7 projects, all of which are expected to provide significant improvements to our future operations. Our existing projects include:

- **Electro-Chemical Disinfection**
 - We are trialling a unit to manufacture chemicals on site for the treatment of odour issues (sewer septicity), to reduce operational costs for chemical purchasing and improve health and safety by removing the need for chemical storage.
- **Calcium Carbonate Trial**
 - A number of trials of various sources of calcium carbonate (e.g. chalk, limestone) for use as a buffer (a substance which reduces change in pH) when ferric dosing for the removal of Phosphorus. Calcium carbonate is an alternative for sodium hydroxide and will provide cost savings (up to £3m in AMP6 if successful) in addition to health and safety improvements.
- **Budds Farm Methanol Dosing**
 - We are trialling the use of methanol sourced as a waste from other industries for use in waste water treatment. If successful, we will harness circular economy approaches whilst decreasing operational costs due to the reduced need for methanol purchase.
- **Strathkelvin Activated Sludge Plant (ASP) Controller**
 - A trial to better understand the impacts and suitability of a new ASP controller to improve sludge thickness. Note: Increased sludge thickness improves energy production in CHP units.
- **Real Time Control Sludge Thickening**
 - A trial of real time control for sludge thickening to assess the impacts on the rest of the process and the feasibility of a scaled roll-out to the rest of the business.
- **Lontra Compressor (Sulzer)**
 - Assessment of energy saving potential for a new and more efficient blower, which is expected to have 10% improvement on energy efficiency. This project will de-risk future purchasing and reduce energy usage.
- **Hach Turbidity Monitor Trial**
 - A trial of a new turbidity monitor in water treatment. There is some uncertainty for the operational improvements provided by the new monitor, requiring a trial.

3.2 Customer Benefits & Resilience

Clearly, R&D is aligned with our resilience agenda, whether it's through projects to address water shortages (e.g. water reuse), investigating battery and alternative energy solutions to address power outage issues, providing solutions to help customers reduce water usage, developing smart networks, our work on integrated catchment management, circular economy, and building innovation ecosystems with partners.

Regarding impact on serviceability, in AMP7 we will start to reap the benefits of the AMP6 R&D programme as we rollout smart water networks and smart sewer network solutions, reduce leakage, reduce bathing water pollution incidents, ramp up the deployment of digital water usage tools for customers, have de-risked solutions for phosphorous removal on small sites, have installed software solutions to optimise our large plants.

It is worth highlighting that the R&D programme is mapped onto seven benefit drivers.

Supporting compliance and building regulatory confidence

1. Efficiency and cost savings



2. Investment avoidance & tech de-risk
3. Supporting strategic themes
4. Building new capabilities
5. Collaborating with others to reduce costs and risks while speeding up delivery
6. Enhancing our reputation with our regulators, customers and other regulators and build confidence in our policies, strategies and operational practices

Given R&D's long-term focus and the length of time taken to conduct an R&D trial, coupled to the fact that the programme was only launched in AMP6 (where years 1 and 2 were about establishing internal capability, processes and relationships with external delivery partners), we expect to see financial benefits within AMP7 (£10s millions), although a range of non-financial benefits have already been achieved in AMP6, as highlighted in Figure 9: R&D Programme focus areas below.

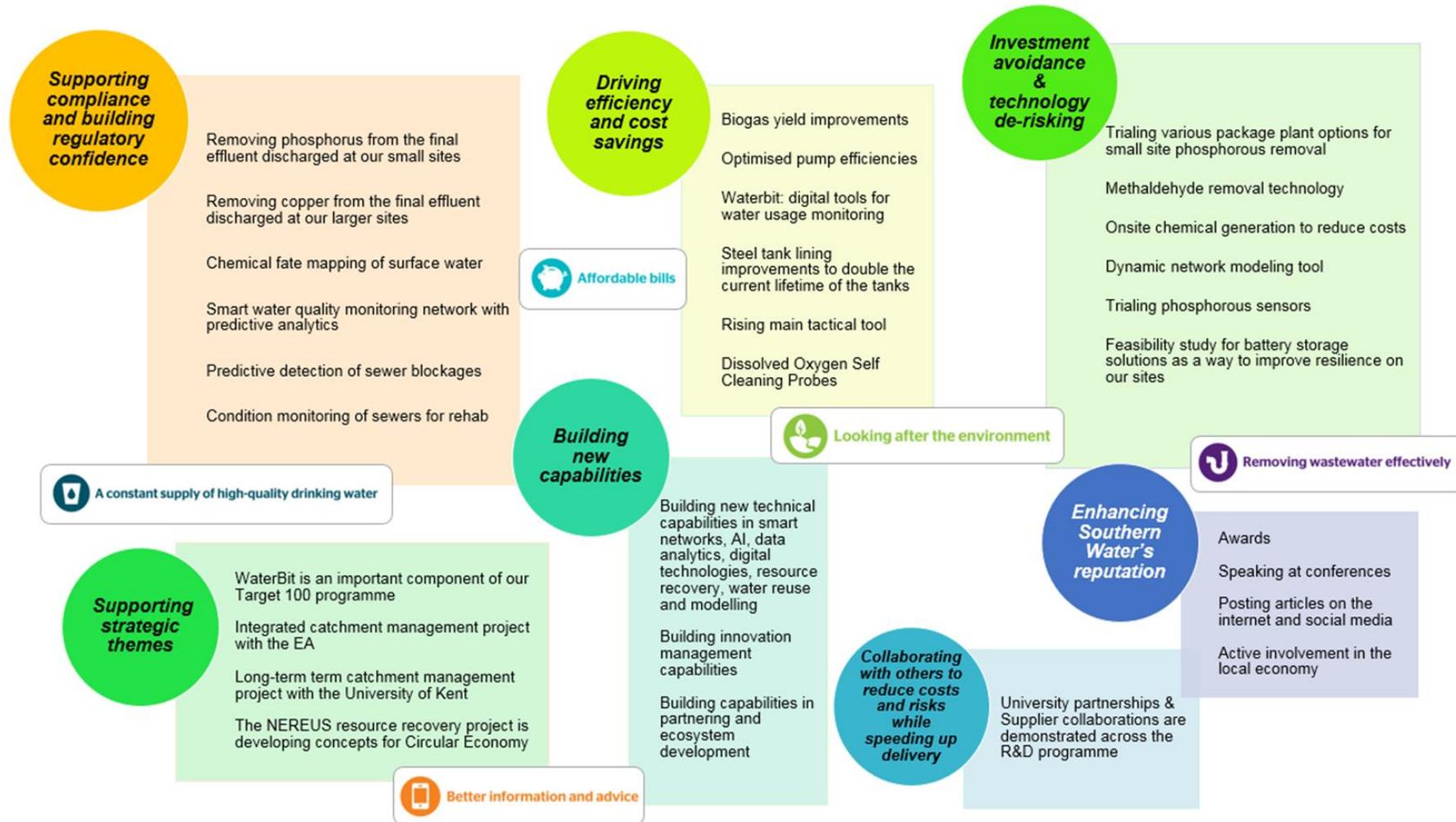


Figure 9: R&D Programme focus areas

4. Drivers for Change

4.1 Future Trends & Pressures

A number of drivers will impact and shape the AMP7 R&D programme

- New demands from regulators to be more innovative, collaborative and customer-focussed
- Tightening legislation and emerging contaminants
- Customer needs and expectations are changing and how they interact with organisations
- New approaches needed to address population growth, climate change and water scarcity
- Need for water efficiency and water reuse solutions
- Low carbon & sustainability agenda
- Increasing pace of technological change
- Open Innovation and ecosystem thinking

Ofwat have also made “Innovation” a key theme in the 2020 to 2025 regulatory review.

They say: ‘Meaningful innovation leads to new benefits for customers, companies and the environment. It contributes to resilience through better management of risks and opportunities. Innovation will be embedded in the culture, the processes and the people of the company. It will not be limited to the use of new technology or new services. It could involve, for example: new ways of encouraging customer participation in service design and provision; new and more collaborative ways of working with customers, communities, the supply chain and other stakeholders; redesign of business processes utilising technological development to deliver better outcomes at lower costs; and further development of markets and new catchment management approaches.

Furthermore, in September 2017 we published “Water Futures in the South East” – an independent report, written by global experts, exploring six critical factors which will impact our water future.

They are: changing climate, ecosystem thinking, collaboration redefined, digital transformational change, nanotechnology advances, and cultural and social changes. The report outlined six challenges requiring innovative thinking and action.

- Changing climate:
 - Climate change is already a major driver of policy change, and our region will experience its effects more severely than others. To address this we cannot view the South East’s infrastructure in isolation, but see it as part of a “system of systems”.
- Ecosystem thinking:
 - All ecosystems are interconnected and interdependent. The idea of “zero harm” has been replaced by a drive towards environmental improvements. There is a need for a more holistic approach to understanding the environment – in both rural and urban areas.
- Collaboration redefined:
 - Greater integration is driven by cost-saving. Applying ecosystem thinking approaches at regional, city and local levels will become the new normal to deliver resilience and accelerate innovation.
- Digital Transformational Change:
 - Conventional approaches can no longer guarantee resilience. New digital technology such as machine learning and artificial intelligence will increase the strength of our services.
- Nanotechnology advances:

- Nano-filtration could transform the way we treat and supply water. Pollutants could be removed from water at the molecular level without using as much energy as current methods. It could also make end-of-tap filtration viable in the future.
- Cultural and social changes:
 - Attitudes towards climate change, environmental standards and pollution will change over time, presenting challenges to water companies and policy makers. The challenge is to anticipate the needs and demands of future customers.

The report can be found [here](#)¹¹.

4.2 Customer & Stakeholder Insight

We have consulted, challenged and reviewed our strategy for AMP7 with stakeholders and CCG.

Our R&D Manager presented to the CCG in February 2018, the minutes can be found [here](#)¹². The CCG was pleased with the progress and new initiatives and felt the groundwork was underway laying the foundations for PR19.

In April 2018, our R&D Manager presented at a stakeholder workshop on “Innovation” to 34 stakeholders representing 31 companies. The presentation is available to download [here](#)¹³.

Organisations represented included Age UK, Atkins Ltd, Confederation of British Industry, Consumer Council for Water, Country Land and Business Association, Customer Challenge Group, Engineering Construction Industry Training Board, Environment Agency, Forestry Commission, Future Water Association, Green Alliance, Hampshire & IoW Wildlife Trust, Hampshire County Council, Institution of Civil Engineers, Kent County Council, MARCOM Defence, Marine Conservation Society, Medway Council, Network Rail, Ricardo, RSPB, South Downs National Park Authority, South East Rivers Trust, Southern Regional Flood & Coastal Committee, Stantec, Sussex Inshore Fisheries and Conservation Authority, The Rivers Trust, The Rural Services Network, Water Policy International and WaterAid.

The publicly available report on the workshop by consultancy EQ noted: “Stakeholders were enthusiastic about many of the projects presented to them, particularly smart sensors and digital tools in the home. Most felt that smart metering that monitored the cost of water for customers would deliver benefits by driving down demand. Stakeholders also believed that further education was needed on non-flushable products. Several stakeholders suggested that the company should consider schemes that recycle grey water”.

It was widely felt we ought to do more to identify examples of best practice from overseas. Projects in France and Finland that used sewage to generate energy were cited, as was the use of grey water for flushing toilets in Japan. A topic that was raised by many stakeholders related to the need to prevent microplastics from polluting rivers and getting into the water supply. Alongside improved filtration techniques, it was widely felt that more should be done to put pressure on manufacturers to stop using this material. It was also noted that blockages, either down to wet wipes or fats, oils and greases, were a real problem facing water companies and it was felt that educating customers was the best way to address this.

The use of machine learning (artificial intelligence) to gather customer data and personalise billing was a popular topic, as was improving techniques for the monitoring of sewers. Stakeholders were

¹¹ <https://www.southernwater.co.uk/media/default/PDFs/water-futures.pdf>

¹²

<https://www.southernwater.co.uk/Media/Default/PDFs/050318%20Notes%20of%20the%20March%202018%20CCG%20Meeting.pdf>

¹³

<https://www.southernwater.co.uk/Media/Default/PDFs/Southern%20Water%2020%20April%20Workshop%20-%20Slides.pdf>

supportive of greater collaboration in innovation through crowdsourcing and the creation of innovation teams and partnerships with those outside of the water industry.

Stakeholders were broadly very positive about many of the innovative ideas we presented. When asked to vote on what proportion of customers' bills should be given to research and development, the most popular answer, with 43% of the votes, was more than 3%.

Sample quotes from the workshop:

"What about sensors on the waste network, it would be great to know what's happening on the whole network." Environmental group

"More collaboration on project innovation, working with people who are removing chemicals out of the systems, removing microplastics, chemicals, stopping stuff before it gets into the systems." Environmental group

"Crowd innovation: start releasing 10 years of pump data publicly and making it available for anyone from any background to draw and report conclusions." Business representative

"I've looked at a project in the south of France where they are taking on and processing sewage, turning it into natural fertiliser, and they are running a business producing medicines." Business representative

"Innovation could be informing customers about the water usage, catchment monitoring, logging into your phone to find out about water usage and also access information about the state of water resources." Environmental group

5. AMP7 Strategy

5.1 Investment Strategy

Table 2: AMP7 R&D Investment Summary

(£'m)	AMP6 Actual	AMP7 Total
TOTEX	13.444	15.364
CAPEX	11.771	13.137
OPEX	1.878	2.227

AMP7 R&D Programme

The current strategy is that we will continue to lead on R&D into the future keeping at current proposed budget levels of c.£15m.

Table 3: AMP7-9 R&D Investment Proposal

(£'m)	AMP6	AMP7	AMP8	AMP9
TOTEX	13.444	15.364	15.364	15.364
CAPEX	11.771	13.137	13.137	13.137
OPEX	1.878	2.227	2.227	2.227

Principles of approach, we have developed five key principles which underpin our approach to R&D in AMP7:

- We will continue to seek ideas and input from colleagues, customers, and stakeholders, and from other sectors and geographies
- We will continue to collaborate on cross-industry initiatives and leverage our networks to rapidly execute projects, at a lower cost and lower risk. We will also look to directly engage with more stakeholders and NGOs in our catchment.
- We will continue to seek grants and funding opportunities from external sources
- We will track and communicate all benefits delivered by R&D, and communicate more openly with customers about the innovations we are working on
- We will share success stories both internally (to help catalyse our organisation’s culture), and externally to position ourselves as an innovator, and attract new ideas and partnerships

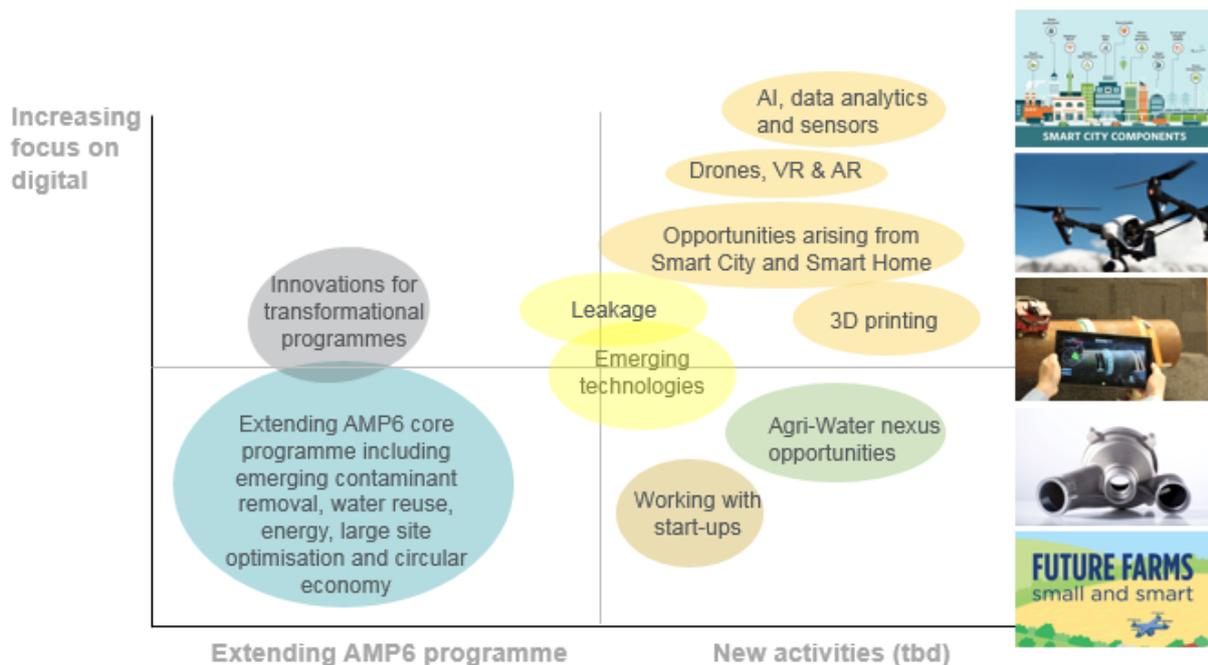
Programme direction

As is the case in AMP6, all R&D candidate projects will follow our structured process for approving R&D projects. Ideas will be prioritised and developed into business cases articulating the strategic fit, drivers, benefits, risks, timeline to realise benefits, costs and project plans.

The AMP7 programme will build and extend the AMP6 programme, focusing on supporting our five transformational programmes and expanding into new areas of R&D. We are currently defining the AMP7 programme, see Figure 10: Capex spend focus.

We need to build a stronger portfolio for AMP 7

Diagram reflects some new areas of focus



1
Figure 10: Capex spend focus



The Figure 11, Figure 12 and Figure 13 highlight key areas for extending the current AMP 6 programme & developing new AMP7 initiatives.



Extending the AMP6 Programme



Figure 11: AMP7 focus - Extending the AMP6 programme

Expanding in new areas of AMP7 (currently being defined)

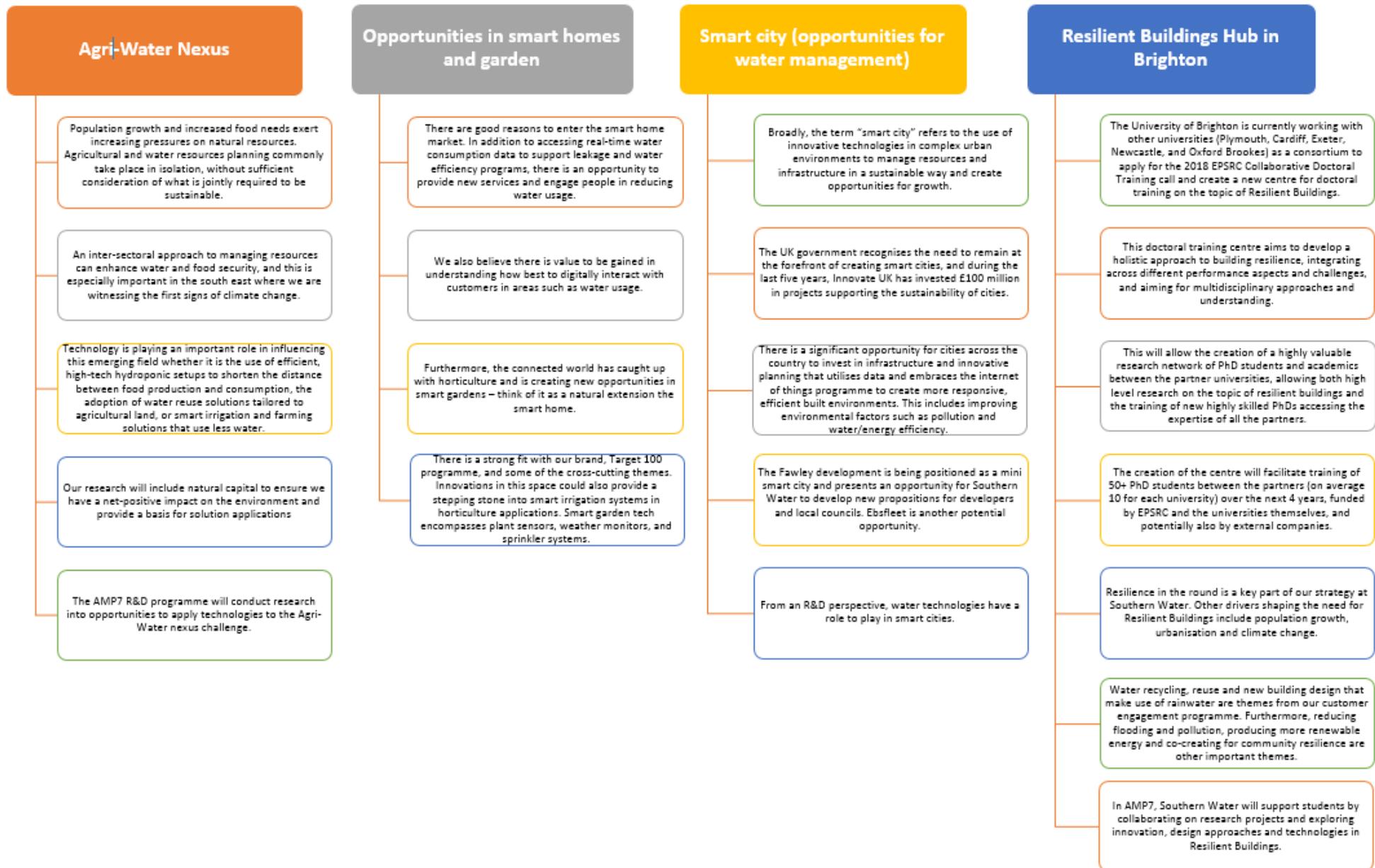


Figure 12: AMP7 - Expanding into new areas

Expanding in new areas of AMP7 (currently being defined)



Figure 13: AMP7 – Expanding into new areas cont.

5.2 Plan Options

We have challenged ourselves by considering the following options:

Outsourcing R&D

Although some people think that outsourcing R&D should be an efficient process, the opposite can occur. The verdict on outsourced R&D is not all positive.

Though the costs of working with outsourced companies can seem low initially, contract modifications, unforeseen spending and a number of other unplanned circumstances can quickly add to the total bill. For example, the requirements of an R&D project often change once the research and development is underway, and this requires a lot of communication with the outsourced company. Compared to having in-house R&D function, expectations can easily be mismanaged and differences of opinion can arise about the nature and quality of the work when working with an outsourced provider. This increases the cost of R&D when outsourced and is not consistent with Ofwat's, or indeed our customers' expectation for PR19.

The fact that outsourced companies often work with several companies simultaneously means that solutions can sometimes end up being generic as opposed to innovative and bespoke to our sites and customer context.

Communication is also another challenge when it comes to working with third party entities. It can be much more difficult to maintain company standards and goals when working with an outside business.

Even if R&D was outsourced, we would still need to conduct our own site trials.

In summary, outsourcing R&D is not a viable option due to the higher costs, increased complexity and risk of having less innovative solutions.

Collaborating with other water companies to reduce R&D costs

As demonstrated in this document, we already collaborate with other water companies through UKWIR projects and are involved in many cross-industry initiatives to help reduce our costs. Collaboration is successful in these environments, not when looking for direct relationships due to both regional and business driver diverse requirements.

Adopt a fast-follower approach to R&D

Before AMP6, we have spent over a decade pursuing a "fast follower" strategy of technology and innovation, relying on the market to provide business-ready solutions to our problems. It is now clear that the business is at the leading edge of new challenges – a "fast follower" strategy is no longer appropriate and would weaken our resilience.

Different proposed spend

Our approach to the financial proposal for R&D is based on how we see the programme developing. To decrease the value of R&D spend would limit our ability to deliver our proposed leading edge strategy. The long term aim is to deliver value within the R&D programme; to benefit from contributions through collaboration rather than seek a higher financial value for the programme looking forward to AMP7 and beyond. As demonstrated in Figure 8: Collaboration Contributions.

Market Mechanisms

We support Ofwat's efforts to introduce markets and competition to drive innovation in the water sector. The introduction of competitive processes and tenders encourages companies to deliver more for less, and to find new ways to work together. This is why, when developing our strategy for AMP7, we will explore R&D's role in enabling new options to use incentives, structures and frameworks that mimic competitive markets. For example, our Waterbit project which will provide customers with real-time information on water usage, could be used as a mechanism to encourage competition between users / communities to reduce water consumption. New opportunities could arise from our work on resource recovery, circular economy, and energy.

5.3 Innovation

As discussed in the previous sections and supported by examples, innovation is a key component of our R&D programme. We will continue to promote innovation in AMP7, there's more on our plans detailed in **Chapter 10 - Innovation**. 'Bluewave', our innovation hub, will include initiatives on encouraging more ideas from staff, crowdsourcing ideas and exploring open innovation programmes. The R&D programme will work as part of this 'hub' continuing to investigate opportunities arising from emerging technologies, processes and approaches.

5.4 Customer Benefits & Resilience

We have identified a number of challenges to resilience and opportunities, as shown below, and innovation is one of the opportunities we see to address these challenges, see Figure 14: Challenges to resilience.

Clearly, R&D is aligned with our resilience agenda, whether it's through projects to address water shortages (e.g. water reuse), investigating battery and alternative energy solutions to address power outage issues, providing solutions to help customers reduce water usage, developing smart networks, and building innovation ecosystems with partners.

Regarding Serviceability, in 2020-2025 we will start to reap the benefits of the AMP6 R&D programme as we rollout smart water networks and smart sewer network solutions, reduce leakage, reduce bathing water pollution incidents, ramp up the deployment of digital water usage tools for customers, have de-risked solutions for phosphorous removal on small sites, have installed software solutions to optimise our large plants.

Challenges to resilience

- Water shortages
- Population and housing growth
- Flooding
- Economic shocks
- Extreme weather events
- Climate change
- Terrorism
- Cyber security
- Skills and labour markets
- Financing and corporate structure
- Power
- Access to materials and resources



Figure 14: Challenges to resilience

5.5 Value for Customers

The R&D programme is seeking to enable £10s millions of benefits during AMP7, this is demonstrated for a selection of projects in *Figure 15*.

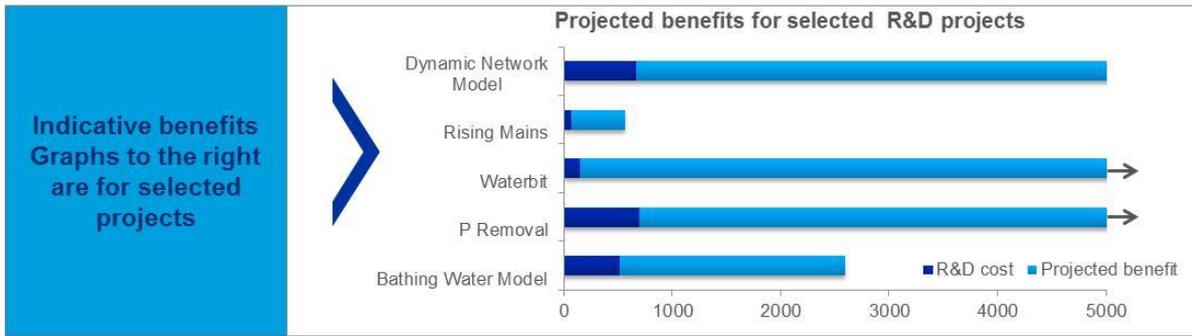


Figure 15: Indicative benefits

Illustrative examples are shown in Figure 16- Figure 19.

Smart Ball has demonstrated a tool to provide insight to underpin £25m AMP investment.

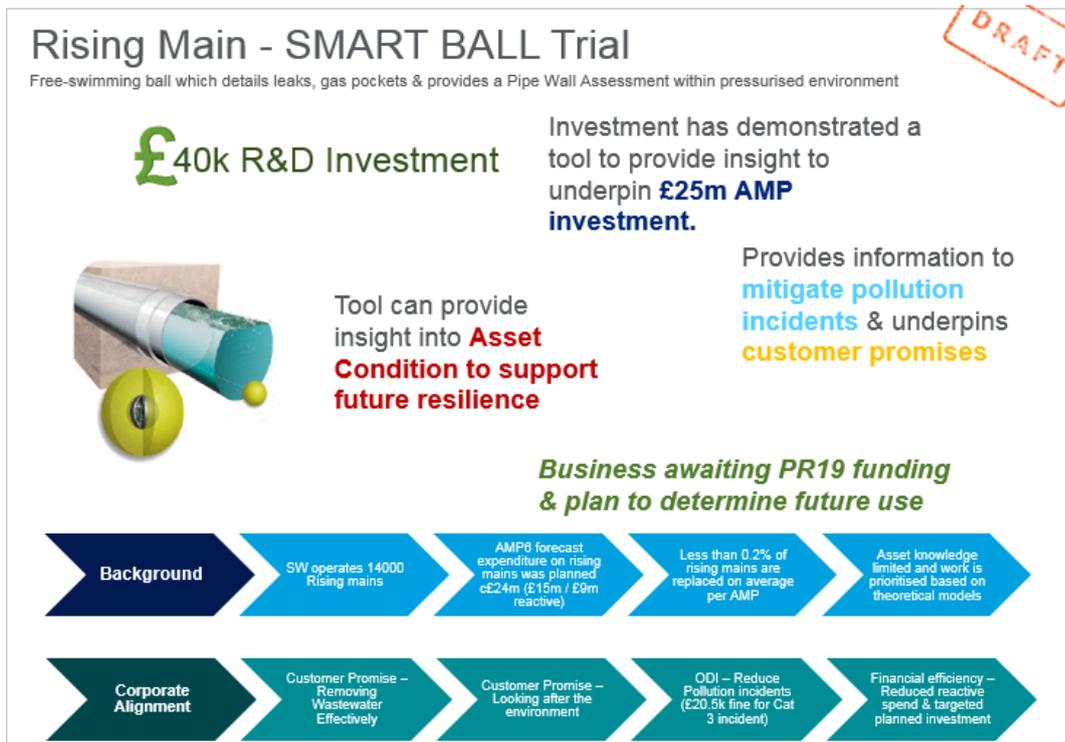


Figure 16: Smart ball trial benefits

The Soneco technology could provide an £8m efficiency

P – Removal - Soneco

UKWIR Sponsored project trialling new technology for the removal of phosphorus

DRAFT

£300k Investment (96% funded by UKWIR)

Financial efficiency up to £8m based on whole life cost of up to **£200k per site** compared to existing methods for P-removal.

Solutions available to **support AMP7 Regulatory requirements.**

UKWIR Collaborative Project.

Supports business mitigate **ODI's** for Wastewater compliance which can be up to **£15m per year.**

Trial was successful in demonstrating benefits but further options needed to improve functionality (e.g. power consumption).

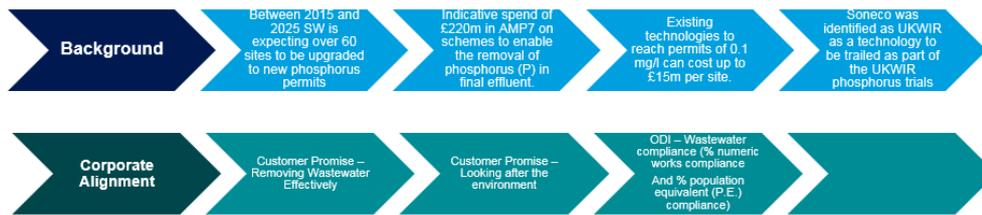


Figure 17: P-removal - Soneco benefits

Waterbit: £10s millions in projected efficiencies compared to Fixed Network Smart Meter Roll out.

Waterbit – Real Time Water Usage Information

Trial in 100 homes of a new device to provide real time water usage information to our customers.

DRAFT

£180k R&D Investment
Additional funding provided by retail & Water efficiency

Projected efficiencies compared to Fixed Network Smart Meter Roll out.



Provides insight to **support T100 strategic target.**

Increases **Customers insight** through **providing further usage information** & ultimately can **reduce customer bills.**

Collaborative working with **local businesses**

Generates **actionable market insight** into Future Smart Meter Strategy

Successful phase 1 prototype has led to phase 2 project progression with devices currently being manufactured.

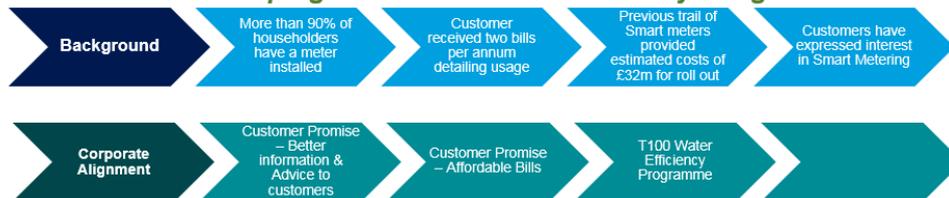


Figure 18: Waterbit benefits

Potential £200k per site saving over the whole life cost compared to existing methods (Up to £8m over 40 sites).

P-Removal – Adsorptive Media

Investigations and trials into Media to support P-removal at Small sites.

DRAFT

£660k R&D Investment

Multiple medias tested, in preparation for AMP7 and future permits, **De-risking potential future investment.**

Supports business mitigate **ODIs** for Wastewater compliance which can be up to **£15m per year.**

Potential £200k per site saving over the whole life cost compared to existing methods (Up to £8m over 40 sites).

Innovation Hub Collaborative project with University of Portsmouth.

Project currently in flight



Figure 19: P-removal - Adsorptive media benefits

6. Key Risks and Opportunities

6.1 Risks

- There is a risk that future unknown and specific changes in river abstraction policies and effluent discharges into the sea/ivers will require R&D to accelerate its Water Reuse programme. This may lead to new areas of investigation and costs which are difficult to deliver.
- There is a risk that new regulation or permits for emerging contaminants such as microplastics will require specific research of a type which is not already included in our existing microplastics work. We will work with other water companies and organisations to accelerate solution development but delivering, resourcing and funding such work may be hard.
- There is a risk that the uncertain 'Brexit' process will have an impact on our ability to tap into EU funding as we have done in AMP6 and UK funded alternatives may take some time to be put in place.
- There is a risk that farming and land-use practices can change in response to factors beyond our control. These include government policy, economic factors, climate change etc. This may impact our catchment management strategy and require new technical solutions which prove difficult to deliver to the timescales asked for by business leaders and our stakeholders.

6.2 Opportunities

- There is an opportunity that our national and international reputation for excellence in water demand management, leakage control and our investment and sponsorship of our **Target 100** transformational programme enables us to attract the most talented individuals to work in our innovation teams. This will allow us to further accelerate innovation above those levels we are already targeting.
- There is a unique opportunity for us to build on the exceptionally high levels of meter penetration we enjoy to develop novel and new water

management and data reporting techniques, in line with our **Target 100** transformational programme, which may be used in future years by the British water industry to address growing vulnerability, affordability and water usage issues.

- There is an opportunity for us to build on our exceptionally high coverage of event duration monitoring equipment and our 'smart sewer' work on our waste water network to attract leading talent and develop leading sustainable drainage and smart sewer applications.

Appendix A - R&D AMP6 Project summary

Wastewater & environment projects

Project title	Area of focus
Resource recovery solutions for large sites (NEREUS)	We are working with an international consortium of 6 companies and three universities to assess a range of resource recovery technologies for transforming wastewater into valuable resources
We created an Innovation Hub with the University of Portsmouth to trial environmental technologies such as phosphorus removal for small-sized WTW sites	P Removal – Adsorptive media: Trial of new media technologies in AMP6 P Removal – Package Plants: A project to trial different package plants for P removal. P Removal – Portsmouth PhD: researching phosphorus removal in final effluent to reach future permit requirements.
Nutrem’s Phosphorous Removal Process	A UKWIR funded phosphorous removal trial using Nutrem’s biological P removal process at our Petersfield WTW.
Power & Water’s Soneco technology	Full scale trial of the Soneco P removal technology on a WTW. Part funded by UKWIR.
Phosphorus Monitor Trial	Trialling a phosphorus monitor at Eden Vale WTW to assess incoming crude sewerage. Phosphorus readings will be compared against laboratory tested grab samples.
Copper Removal	Trial of an adsorptive media for metal removal in response to a request from the EA
Reactive Media pH Control	A project in collaboration with Cranfield University and other WASCs to examine the relationship between pH control and hydraulic retention time in relation to reactive media and phosphorus permits.
Small Site Resource Recovery	Investigating resource recovery options for small sites
Trickling Filter Optimisation	Funding an EngD from the University of Brighton to utilise existing on-line monitors to optimise the onsite operations for trickling filters
CIP Pilot ASP Plants	Trial of technology for the removal of CIP2 identified substances.
Testwood Environmental Modelling (PhD)	Modelling the influence of flow and other environmental factors on the migration of Atlantic Salmon in chalk streams to provide the basic science to underpin our work
Managing microplastics in wastewater systems (PhD)	We are supporting research costs for a Research Council funded project, to assess the pathways and management/mitigation strategies for microplastics (and other emerging contaminants) within wastewater systems leading to marine environments.

Project title	Area of focus
Water Pollution Source Tracking (MSc)	We are assessing the source of marine pollution in Langston Harbour (Southampton) to support ongoing conversations with community groups and provide quantitative research for future remediation options.
Bathing water modelling	Developing a cost effective, risk assessment modelling framework that integrates our asset data, network data, river catchments models and marine models, to predict and identify evidence to support management actions and investment decisions to support bathing water performance.

Water projects

Project title	Summary
Digital water usage tools for customers	We are co-creating a solution to provide customers with digital tools to manage their water usage.
Smart water quality monitoring network with predictive analytics	We are trialling a smart water quality monitoring network using Intellitect and ATI products
Dynamic network modelling	We are developing an innovative modelling tool with Ricardo. The tool will test scenarios, such as population growth and water supply, and impact on water infrastructure
Metaldehyde risk prediction model	Building a metaldehyde risk prediction model a predict water quality risks for metaldehyde
Metaldehyde Removal	Trialling Arvia technology to remove metaldehyde from water supply at our Burham WSW.
Integrated Catchment Monitoring	We have a pioneering project with the EA to innovate catchment monitoring. The project involves working with multiple stakeholders to co-create a future-proof catchment monitoring solution.
Water Reuse	Developing a stakeholder and regulatory engagement platform for water reuse applications
Long Term Catchment Management	Collaborative project with the University of Kent to apply natural capital models to catchments undergoing accelerated change.
Service Reservoirs	Identifying the root cause and risk factors of bacteriological compliance at service reservoirs to produce a tool set for prioritising sampling, maintenance and investment using failure data from multiple water companies.
Water Source Risk Management (PhD)	Innovative risk management project to establish the risk of microbial contamination in surface waters.
Water Quality Chemical Fate Mapping	PhD studying the journey of chemicals through the water cycle across the river catchment and through the WSW.

Project title	Summary
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Condition monitoring projects

Project title	Summary
Satellite imaging below ground	The project tested the feasibility of specific applications of earth observation techniques and data analysis to the our wastewater below ground network
Condition Monitoring Rising Mains	A new approach to mains surveying, which provides more functionality and features than other products on the market.
Sewer Rising Mains - Tactical Tool	WRc collaboration project to create a practical, tactical solution to enable operational staff attending a sewer rising main failure to undertake an investigation to identify the cause of the failure and to identify the optimum short and medium term actions necessary to manage the risk of further failures and pollution incidents.
Conditioning Monitoring Sewers	A 6 month trial, SMART Sewer is a system to detect developing blockages before they lead to flooding events, with the ability to differentiate between blockages and other causes of level increase.

Energy projects

Project title	Summary
Energy Storage	A feasibility study looking into the potential of using battery storage solutions at our sites
Dissolved Oxygen Self Cleaning Probes	A pilot study to assess the impacts of a full site-wide installation of self-cleaning DO probes at Budds Farm, following a small scale trial which showed significant potential operational savings
Biogas Yield Improvement	Funding an EngD from the University of Brighton to study and reduce the scientific uncertainty related to the processes and technologies needed to improve biogas yield.
Energy and Sludge	Trialling technologies to increase biogas yield and support the CHP business strategy.
Steel Tank Relining	Trialling a new approach to re-lining steel tanks at Sandown WTW.

Other R&D projects

Project title	Summary
Circular Economy research	We have undertaken various collaborative research projects to identify the potential routes for Circular Economy activity and identify the mechanisms to establish the processes/projects internally.

Project title	Summary
CIRIA cross industry collaboration	Research projects including drones

Appendix B - R&D Cost savings through collaboration

Name of project	Name of partner	Description of collaboration	Results / Cost Savings
Innovation Hub	University of Portsmouth	We've established an Innovation Hub, a suite of laboratories and offices on the site of our Petersfield treatment works, where a full-time team from Portsmouth University test new technologies. It includes trialling different types of material which eliminate phosphorus without using chemicals. This is kinder to the environment and, with over 300 prospective small sites in our region alone, offers a potential saving of £millions. Further trials include the recovery of metal and pesticides from wastewater.	<p>The university has invested £150k into the labs at Petersfield.</p> <p>Our £82k to fund a PhD is match funded by the university.</p>
Predictive Catchment Modelling for Metaldehyde and other emerging contaminants	University of Brighton	Using existing data sets held by both us and University of Brighton, augmented with additional data where required, this project developed a low-cost, predictive catchment model for water quality and aquatic pollutants, leading to the development of in-house predictive capability in catchment modelling	Our investment of £81k. £17k contribution made by the University of Brighton.
Biological progress in service reservoirs	WRc United Utilities, Severn Trent Water, Portsmouth Water, South East Water and Anglian Water.	<p>A collaboration with a number of water companies to identify the root cause and risk factors of bacteriological compliance at service reservoirs to produce a tool set for prioritising sampling, maintenance and investment using failure data from multiple water companies.</p> <p>The project has been completed by WRc using data from all involved water companies.</p>	Our investment of £30k giving access to £120k of research funding & WRc research expertise.
NEREUS New Energy and REsources from Urban Sanitation https://www.intereg2seas.eu/en/nereus	Collaborating with a consortium of water companies, research organisations, consultants and universities in Holland, Belgium and France	<p>Our Nereus Project sees us to recover water, nutrients for agricultural use and energy from wastewater, transforming it into a valuable source while boosting the green economy.</p> <p>The project, which involves nine wastewater plants in four countries and is backed by £650,000 of EEC funding, is aimed at convincing decision-makers that recovering wastewater can help to ease the problem of Climate Change.</p>	<p>Our investment of £350k.</p> <p>EEC funding of £650k.</p> <p>The partnership also gives us access to the technical results of the external collaborating partners.</p>

Name of project	Name of partner	Description of collaboration	Results / Cost Savings
Soneco (UKWIR funded)	UKWIR	<p>Trial of Power & Water's Soneco technology to investigate the potential use of sono-electrochemistry for phosphorus removal at WTWs. The technology is specifically targeted at small to medium-sized plants.</p> <p>This project is part of the National Phosphorus trials.</p>	Total project value £300k, of which UKWIR contributed £270k.
CIRIA research	CIRIA Various construction companies	<p>Through the Construction Industry Research and Information Association (CIRIA) we have funded four projects for developing new guidance covering: the use of unmanned aerial vehicles (UAV) for infrastructure asset management. Archaeology Management Unexploded Ordnances (UXO) Asbestos Management</p>	<p>Total value of all research completed with CIRIA is >£200k, of which We have contributed £20k.</p> <p>We are also at the forefront of construction research through our contributions to these projects.</p>
Test Salmon Modelling	University of Southampton	A collaboratively developed funded PhD study to assess the impact of changing water conditions in the River Test on salmon populations.	Our investment of £48k was match funded by the University
21 st Century Drainage Programme	UKWIR club project involving Southern Water and other water companies	9 individual work streams assessing long term capacity and drainage in sewers.	Our investment of £20K provides access to approx. £200k of resource.
Cost effective techniques for sewer rehabilitation. To start in 2018	UKWIR club project involving Southern Water, Irish Water, Northern Ireland Water, Welsh Water, and Thames Water	Assessing effective sewer rehabilitation techniques to inform our long term future investment needs and performance forecasts.	Our investment of c.£15k provides access to research to the value of >£100k.
Chemical Fate Mapping	University of Portsmouth	A PhD funded project to deploy passive samplers across a catchment To study the journey of chemicals through the water cycle across the river catchment and through the water supply works (WSW).	<p>Our investment of £74k.</p> <p>£53,601 funded by Portsmouth university.</p>
Microplastics research	University of Southampton/ EPRC	The University of Portsmouth have undertaken a PhD research project into identifying the pathways of and management strategies for microplastics.	Our investment of £10,000 across the full four year PhD. This will provide us access to top quality

Name of project	Name of partner	Description of collaboration	Results / Cost Savings
Metaldehyde Removal	Arvia Technology Limited	Trial of a unit based method for the treatment of metaldehyde to below 0.1µg/l.	research to the value of >£100k. Our investment of £246k. £70k from Innovate UK