

Innovation report 2016



Introduction



Welcome to Wessex Water's 2016 innovation report

Major geopolitical events in 2016, such as the UK referendum on European Union membership and the outcome of the US presidential election, appear to support the idea that change is the only constant in life.

The UK water sector is also undergoing some of the biggest changes since privatisation nearly three decades ago. Most notably, we are entering a new competitive environment – from April 2017 all non-household customers will be able to choose who provides them with water retail services, which will result in formal separation of wholesale and retail functions. As well as this, we are expecting an opening up of sludge operations and separate price controls for water resources.

Alongside these transitions there are some wider risks and opportunities. These include changes in customer expectations, household finances and inequality, work patterns, workforce skills and knowledge, the water environment, emerging pollutants, extreme weather and climate change, new technology and the state of the economy in the UK and internationally. It is vital that we actively respond in the interests of customer service, public perception, environmental management and our financial performance.

As the world changes, conventional approaches are unlikely to serve us in the future as well as they did in the past – in fact they could pose bigger risks. So innovation is crucial and this report gives examples of how we are trying to stay ahead of the curve.

We hope you find it an interesting read and look forward to hearing your views.

David Elliott
Group Director of Strategy and New Markets

Innovation in a changing world



In a world where, it seems, everything is changing, it's more important than ever that we don't stand still. The business of looking after water, harnessing resources, ensuring quality and giving excellent service to our customers, is also changing fast. As a leading water company we are looking ever further ahead to anticipate the changes that may come and to ensure that we make good, sustainable decisions from which everyone – including our environment – will benefit.

This annual report of the innovation work we're doing at Wessex Water shows how quickly we are moving forward. Earlier innovation trials are now becoming established ways of working – trenchless pipe replacement, for example and working with farmers to minimise pollution of water supplies at source. This year we report on ambitious plans to reduce phosphorus discharges from sewage plants and the use of algae to manage phosphorus, emerging trading plans for nitrogen which could liberate opportunities for more ambitious catchment management, and ever more clever ways of reducing energy consumption.

We also report on innovation in the way we do things: engaging our customers in thinking about the long-term future, involving young people in our stakeholder groups and growing our apprenticeship programme to ensure we have the people and skills we need to meet future challenges.

Innovation is central to our ability to do our job and adapt as circumstances change. We hope this report will encourage everyone to play their part in ensuring we're as ready as we can be for a future none of us can predict.

Fiona Reynolds DBE
Independent non-executive director and chair of the Futures Panel

Our aims

We aim:

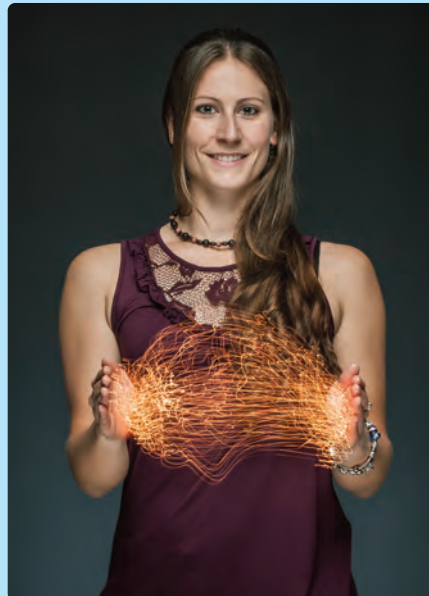
- to provide customers with excellent affordable services and contribute to wider society
- to protect and improve the environment
- to be a great place to work in which all employees can work safely and reach their full potential
- to deliver the best possible returns to investors.

These four aims are matched by the broad themes that underpin our sustainability vision – customers and communities, environment, employees and finances. We revised and relaunched the vision this year, 20 years after we first committed to becoming a genuinely sustainable water company.

First produced in 2004, our sustainability vision has always expressed the ultimate outcomes that we aim to achieve, distinct from the various ways of working that need to be adopted. This focus on outcomes has since been adopted as the key way of understanding what we do for society and the environment.

Demonstrating excellence in the areas that people most readily associate with water companies is clearly critical if we are to maintain credibility as a competent company.

However, to be fit for the future we also need to be ready to innovate. As the world rapidly changes, we must adapt and evolve accordingly, rather than just relying solely on tried and tested methods.



Major trends to 2020 and beyond

The following are some of the emerging trends that we face. Some are challenges, others are opportunities, while some are a combination of both.

- changes in **customers' expectations** with moves towards 24/7 availability, immediate response to issues and greater personalisation of service. Also, customers are increasingly comparing what we do with companies and service providers outside the water sector
- the rise of **digital communication and social media** – speeding up reaction to events and increasing public awareness of companies' activities
- the expectation of high standards of **public engagement** plus growing scrutiny of companies' practices and performance
- changing **consumer patterns**, such as the increasing use of so-called 'flushable' products which has led to increased numbers of sewer blockages
- concerns about **affordability** and household finances alongside wealth inequalities, affordable housing shortages and changes to benefits
- more **flexible work patterns**, enabled by better information technology.
- an **ageing workforce** and the need to recruit and retain people with **technical skills** and knowledge
- the need for a **more diverse workforce**, partly so we are seen as an attractive employer by potential employees
- implementation of **European water regulation**, in particular concerning nutrient loading in rivers and estuaries
- more attention on **emerging pollutants** in sewage such as pharmaceuticals and microplastics
- growing interest in **natural capital and catchment management**
- continued impacts of **intensive farming** on water quality
- **extreme weather events**, plus gradual effects of climate change and urbanisation on our infrastructure
- the introduction of **competition** for non-household customers and formal separation of wholesale and retail functions from April 2017
- **security threats**, including cyber attacks, that can affect utilities as well as society as a whole
- the rapid development of **sensors and data processing** that allow real-time checks on water mains, sewers and treatment processes
- the increasing ability to **simulate and then fine tune** our assets
- the application of **big data**, the **internet of things** and improved **visualisation**.

Innovation – our approach

For us innovation is the introduction of new technologies, products or ways of working that offer a clear benefit – a better service to customers, a healthier environment, lower costs or reduced risk. The things we introduce can range from fairly small modifications to a completely different way of addressing an issue. There are also a number of different starting points, including the following.

Employees' ideas. Our employee suggestion scheme, Eureka, helps implement original ideas and suggestions and then offers a reward depending on their success. Improvements can potentially be scaled up to help reduce operating costs or improve our performance. We have also begun a programme of specific challenges, set by our directors, that is open to responses from anyone in the company.

Technology trials. We are often approached by external companies to trial new products and occasionally completely new technologies at one or more of our operational sites. This can occur through direct contact or via

third parties such as Isle Utilities' technology approvals group and representative bodies such as British Water and the Future Water Association.

Placements. As part of our links with universities we host students on placement, principally from the University of Bath. Their fresh perspective and focused attention on specific areas of our work offer us clear benefits while also helping develop the skills of individuals. In some instances the students have become full-time employees.

Specific projects. Some innovations have arisen simply because it is clear that a new way of working or incorporation of a new technology is needed to best deal with a problem or an opportunity.

Internal collaboration. Having individuals from different departments working together or sharing experience is central to our innovation work. An example of this is our innovation and technology forum which guides technology trials and keeps track of other projects.

Research

There are knowledge gaps in some areas of our work that need to be tackled. By carrying out initial research we can often ensure that our choices of working practice or types of investment are better informed. Our research is carried out via more than one route.

Environmental investigations. We carry out field based environmental investigations to make sure that subsequent improvement works are well-targeted and proportional. Between 2015 and 2020 we are conducting 40 environmental investigations covering a range of issues. These include:

- the occurrence and removal of hazardous and emerging substances from sewage effluent
- new, sustainable treatment solutions for phosphorus removal
- the ecological impact of our reservoirs and abstractions
- the influence of our sewage treatment works on nutrient levels within rivers, compared to other sources, at a catchment scale.

The investigations include a number of leading edge projects:

- two UK-first trials of new methods for removing phosphorus from wastewater as part of a water industry-wide research project:

- BioMag, which employs magnetite to improve sedimentation
- a high-rate algal pond with the University of Bath (see page 14)
- vibrating wire piezometers to give better detail about groundwater flows
- controlled release of spate flows from Durleigh reservoir to remobilise phytoplankton and improve ecological conditions downstream.

UK Water Industry Research (UKWIR). This is the main vehicle for collaborative research between water companies. The programme comprises projects addressing common interests and concerns, providing a sector wide perspective and enabling larger scale research to take place than would otherwise be achieved.

Links with universities. We work directly with academia where there are clear benefits for our activities as well as new insights for researchers. We have an established partnership with the University of Bath, with projects led by academic staff as well as postgraduate research and undergraduates working with us on one-year industrial placements.

Customers of tomorrow

Engaging young people in our work and future plans

We engage extensively with our customers and stakeholders, both in our day to day business and for specific programmes of work, such as preparation of our five-yearly business plan.

In the last year we have established a new format for stakeholder liaison, including the formation of the Wessex Water Partnership which will meet three to four times each year to oversee our year to year performance and scrutinise our future plans.

We have panels focused on catchments and future issues, both of which bring together a wide range of interests, and for our 2019 business plan we have devised an engagement strategy called 'your say, your future'.

We aim to make the best use of everyday engagement with customers as well as carrying out specific research projects. We also run an online panel called Have your say, which gathers customers' opinions on various ways we might improve our services.

However, we want to widen participation further by including those who have not been involved much in the past when water companies are seeking customers' views. One such group are younger people who are not yet billpayers but are forming their own views and opinions about water, wastewater, the environment, and what good service looks like. So we have formed a young

people's panel comprising 21 people aged between 16 and 18.

The principal reasons for the panel are to give the opportunity to experience running a business while helping us to understand more about what matters most to our customers of the future.

The first panel meeting took place in September this year at our operations centre in Bath. Before the meeting the panellists watched a video explaining our current investment programme and priorities, joined the panel event on social media and interviewed an adult to obtain their perspective.

In the meeting their first task was to consider the three things they think we should prioritise, and what aspects

of our future planning will have the greatest impact on their generation.

Their feedback pointed to five main themes:

- affordable services
- environmental protection
- high quality drinking water
- adopting new technology as it evolves
- preventative measures that help us prepare for the future.

We look forward to future meetings of the young peoples panel and seeing how we can incorporate the insights of its members into our current and future work.

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Catchment permitting

Smarter regulation of phosphorus discharged from sewage treatment works

Too much phosphorus in rivers and streams can lead to algal blooms, which in turn reduce oxygen levels in water. The usual response is to strip out phosphorus at sewage treatment works, usually by adding a coagulant such as ferric sulphate. This is what we do at the larger sewage treatment works in the Bristol Avon catchment. However, elevated phosphorus remains one of the main reasons why only a quarter of the rivers and streams in this catchment have good ecological status.

How to remedy this? More chemical treatment is an option, but the capital cost alone of upgrading treatment works that have not already had phosphorus removal installed is becoming disproportionate – well in excess of £0.5m per additional tonne of phosphorus removed.

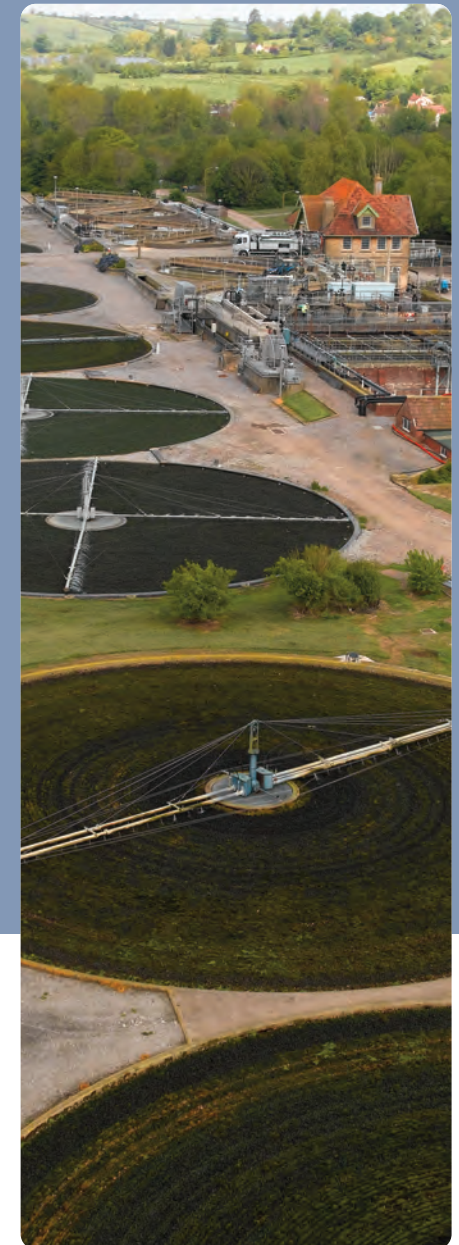
This was recognised by the Environment Agency who agreed that we should explore alternative, more innovative approaches. The resulting plan is to look at the overall tonnage of phosphorus entering the Bristol Avon and its tributaries from our sites, to use a mix of improvement measures and decide where each is best employed.

As a first step, we have identified the sewage works that have the greatest influence on phosphorus levels in the water environment due to their size and location, and also those with the most scope for improvement. Consequently, there will be new investment or operational changes at 24 sewage treatment works by 2020, reducing our overall discharge of phosphorus by 46 tonnes to 216 tonnes per year across the catchment.

This approach will cost £20m less than the traditional method, so it is much more cost beneficial. Indeed, if we had not advocated this novel approach, there would have been significantly less phosphorus removal in the Bristol Avon catchment during 2015-20, as it was deemed not to be cost beneficial at many sites according to criteria for investment to comply with the Water Framework Directive.

Depending on the success of this trial, we believe this approach could be applied on a much wider scale. The Environment Agency is encouraging other water companies to look at similar proposals and it's possible that it could be combined with other methods such as nutrient trading, or applied to dealing with other environmental pressures.

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EnTrade

Our pioneering nitrogen offsetting programme

Poole harbour is a notable waterbody with numerous environmental designations. However, nutrients in the water – particularly nitrogen – can promote the growth of algae under certain conditions which, in turn, can adversely affect biodiversity.

In 2008 we installed nitrogen removal at Poole sewage treatment works, reducing our nitrogen discharge by 927 tonnes every year so that our contribution fell to 15% of the annual inflow of nitrogen into the harbour. This came at a cost of £12 million and annual running costs of £0.5m.

We could go further with nitrogen removal at upstream sites, such as Dorchester sewage treatment works

where 40 tonnes of nitrogen could be removed each year, costing around £6m to install and £0.4m each year to operate.

However, environmental regulators and others have agreed that we can try out alternative methods to prevent 40 tonnes of nitrogen entering Poole harbour annually by 2020.

Consequently, our catchment advisers are extending their work with farmers in the area and we estimate that 15 tonnes of nitrogen leaching was avoided last year simply by calibrating fertiliser sprayers nearby.

This year we also successfully trialled an innovative nutrient trading system we have devised called EnTrade. This is

an online platform where farmers offer, for a price, to grow cover crops such as oil radish that absorbs nitrogen from topsoil that would otherwise be bare, and reduces leaching especially during wetter winter months. Cover crops can also improve soil quality and structure while preventing soil erosion.

EnTrade automatically estimates the nitrogen saved by each bid offered, based on the crop type and sowing date, which tells us the most cost effective way of meeting our targets. During the trial, 19 farmers placed 147 bids, with a potential saving of 48 tonnes of nitrogen in total.

The combined cost is nearly one third less than previous catchment management work and less than a quarter of the cost to add nitrogen removal at Dorchester sewage treatment works. The trial also created a market price for nitrogen reductions – in itself an interesting development.

As well as further nitrogen auctions, we want to see whether EnTrade can be used for biodiversity, phosphorus and sediment management and also influence investment decisions and allocation of funding to different activities that affect the health of river catchments.

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Dynamic demand

Trialling methods to save energy while helping the local electricity network

Behind the scenes of the country's electricity use, the companies that operate national and local power grids work to make sure that electricity supply and demand are in balance in real time. The potential consequences of not doing this are serious: power surges if there is excess supply, or brown-outs if there is not enough.

With the growth of less predictable types of generation such as wind and solar, balancing the electricity grid has become more complex. However, there are tools to manage this issue, helping the UK move from centralised, fossil fuelled generation to a more distributed, lower carbon energy mix, without jeopardising the reliability of the network.

One example is Open Energi's Dynamic Demand technology, which we have been trialling at Taunton sewage treatment works. Dynamic Demand automatically switches blowers and pumps on or off in seconds in response to changes in grid frequency. During a peak in demand, equipment may temporarily reduce consumption, but when supply exceeds demand it may increase consumption. Overall our energy consumption is unchanged, but by shifting demand intelligently in this way it provides capacity on the electricity network when needed most.

An initial concern was that turning equipment on and off might adversely

affect sewage treatment and we had questions regarding how Dynamic Demand would fit in with the operation of our sites. We decided that the only way to check these would be to carry out a trial, working closely with Open Energi.

In the end, the trial showed that there are no visible effects at all, giving us the confidence to roll out the technology more widely. Consequently, we have identified 18 more sites which together could provide up to two megawatts of flexible capacity. Across all our sites,

this figure could be as large as 10 megawatts.

Meanwhile, National Grid has launched a campaign called Power Responsive to encourage demand-side tools such as this on a large scale. Overall, we see Dynamic Demand as a very innovative way to help address some of the UK's biggest energy challenges; displacing older power stations and building a smarter energy system which is more efficient, reliable, affordable, cleaner and secure.

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Algae

Growing algae on purpose to remove phosphorus in effluent

As explained previously, excess nutrients such as phosphorus and nitrogen that can cause algal blooms in the water environment are a major challenge. With the prospect of tougher end-of-pipe nutrient standards, water companies are currently trialling a range of potential methods for reducing phosphorus to very low levels in sewage effluent.

Our work with the University of Bath is helping address this issue via an innovative method that harnesses the very thing we aim to prevent in the water environment – algae. If algae feed on phosphorus in rivers and streams, why not get them to do this in a contained unit at a sewage treatment works?

Firstly, we needed to find the best species of algae for our purposes. The ideal variety would be native to our region, good at taking up phosphorus, and would also readily settle to the bottom of the water in which it lives, so that the clean water can be taken away and the algae reused.

To do this, university researchers embarked on a process called ‘bioprospecting’ in which different varieties of algae from one of our sewage treatment works were isolated and grown in laboratory conditions, and their characteristics compared. One particular algae species emerged as a clear frontrunner.

Having found a good variety of algae, the university set about designing the

ideal structure in which to cultivate them. They focused on devising a high rate algal pond – a system of shallow channels where effluent is circulated by paddles and algae extract nutrients from the wastewater. The water and algae mixture then flows to a separation tank in which the algae settle out. The low nutrient water left behind can be returned to the environment and the algae can be reused for fertiliser or energy. While this method has been used overseas for sewage treatment, this trial is a first for the UK.

We chose Beckington sewage treatment works near Frome – a small site serving 1,000 people – to host a one-year trial. A number of high rate algal ponds have been installed and over time we will be able to see how well algae remove phosphorus in different seasons with varying light levels and air temperatures. If successful, further work will be needed to test the technology at a larger scale. Results will be shared with other water companies and should in turn help to inform future investment decisions.



Low nutrient water left behind can be returned to the environment and algae reused for fertiliser or energy...

Trenchless technology

Surveying large sewers with a remote controlled raft

Our sewer rehabilitation team is a leader in finding innovative ways to manage and repair sewers, of which we have 34,700km in total. The team is constantly on the lookout for new systems and technologies, often using methods that avoid digging down from the surface of the ground. These trenchless techniques are more cost effective, generate less waste, are less disruptive for local people and have a lower carbon footprint especially where pipe replacement is avoided. They are also very helpful when sewers are deeper than usual or sited in difficult locations.

A recent example involved large diameter sewers, some of which are 90m underground with stretches of

more than one kilometre between access shafts. We survey these sewers periodically, looking for structural defects or other problems. Wherever possible we do this with remote controlled vehicles, equipped with closed-circuit TV cameras and other imaging devices.

However, the tunnels often have very shallow gradients which mean sewage flows slowly, allowing sediment to build up. Survey vehicles can struggle to get through deep sediment and if they become stuck we have to send in a person to retrieve them.

Consequently, we decided to look for a floating platform that can travel more than a kilometre at a time and carry all the survey equipment that we

use. The team began with a worldwide search, holding webinars with potential suppliers or partners from Australia, New Zealand, the UK and the US. It became aware of the MSI Profiler offered by Draincare, which was tested by inspecting eight kilometres of tunnel below Bournemouth during winter 2015-16.

The MSI Profiler performed well, creating a 3D model of the sewer using sonar, a laser scanner and an arc of three cameras that take four flash photographs every 10 metres, creating a panoramic, zoomable image. It calculated that 28 cubic metres of sediment had accumulated along the eight kilometre distance, and also

successfully endured a high intensity storm that filled the tunnel, underlining the safety benefits of using devices such as these instead of people for carrying out tunnel inspections.

The trial's success secured the best small scheme award at the 2016 United Kingdom Society for Trenchless Technology awards. We will now look to use it in other major sewer surveys, including a transit of the northern storm tunnel in Bristol during winter 2016-17.



...trenchless techniques are more cost effective, generate less waste and are less disruptive for local people...

Apprenticeships

Training the next generation of technical employees

The utility sector's workforce is ageing and it is a challenge to attract and retain enough staff with sufficient technical skills and knowledge. We must make sure that we are seen as an attractive employer and also have a more diverse workforce that better reflects the region and communities we serve. By giving employees opportunities to develop and equipping them with the necessary skills and expertise, they in turn offer outstanding service to our customers, the company and each other.

One approach is apprenticeship programmes which provide young people with career and skill development opportunities. We have taken on more than 100 apprentices since our current programme began, with 41 in place at present and

12 graduating and securing permanent positions during 2016.

We have created new apprenticeship schemes in finance, information services and property searches, complementing apprenticeships in engineering and construction, our laboratory, customer service and operations. We work closely with leading apprenticeship providers to support local women's entry into the engineering and construction industries and ensure all vacancies are well promoted to young people across the region. This year the number of new female employees stands at 12% for our technical apprenticeships, comparing favourably with local and national benchmarks which are between 2% and 7%.

This year Wessex Water have appointed a dedicated apprenticeship co-ordinator. As well as mentoring many of the apprentices, the co-ordinator helps departments develop new apprenticeship programmes and ensures best practice is shared across the business.

In March 2016, to coincide with UK Apprenticeship Week, we held an apprenticeship open day to tell more young people about the opportunities on offer. More than 120 potential apprentices attended and gave overwhelmingly positive feedback.

Wessex Engineering and Construction Services has also teamed up with Bridgwater College to provide a purpose built facility. This enables apprentices to work alongside our current utilities team, for example, practising repair and maintenance of typical water supply pipework.

Our new Construction and Engineering Higher Level Apprenticeship programme gives the opportunity to work in different parts of the engineering and construction department while gaining a university level qualification through a day release course at Weston College.

Together, these initiatives will help us build a strong and skilled workforce for the future and ensure that the talent and knowledge we need are retained.



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Other initiatives

Employee suggestions

Our Eureka scheme recognises suggestions from employees that can lower costs, reduce risk or improve services to customers and the environment. We are increasingly interested in new or alternative working practices, systems and technologies and welcome ideas from all parts of the business, regardless of whether they are part of an employee's regular job. Some of the best ideas from the last two years involved more efficient motors for sewage treatment aeration; smarter chemical dosing systems; installing reset switches to reduce electrician call-outs; a central database to improve the response to potential operational faults; and increasing borehole abstraction where there is a link between groundwater levels and local flood risk.

IT and better ways of working

Our information services team is bringing in systems that support more flexible, mobile and collaborative ways of working. Cloud-based information technologies are being introduced for day to day activity such as office software, hot desking and even smarter

arrangements for room booking. The team staged an innovation showcase day in April to demonstrate these new systems as well as other new technologies such as virtual and augmented reality.

Taunton sewer network

As part of work to increase the carrying capacity of Taunton sewage treatment works, our sewer modelling team have been improving their understanding of the upstream sewerage network. In particular, the team looked at how the system copes during heavy rainfall, when flows can increase to more than 1,000 litres per second. They used a model that simulates flows in the sewer network under different conditions, including extreme rainfall events, and its results compared well with real world data taken from sensors in the sewers. Having an accurate model means they can then test different control procedures, for example changing the way that structures in the sewer are raised and lowered to manage flows. This in turn gives us a better chance of minimising spills from the sewer during storm conditions while also avoiding sewer flooding of properties and optimising use of the downstream sewage treatment works.





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