Welsh Water 2050

March 2018


“
Welsh Water 2050 – to become a truly world class, resilient and sustainable water service for the benefit of future generations
”

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Cover (Page 1) Image - Figure 1: Ystradfellte Reservoir. © Arup

Page 2 Image - Figure 2: Original photo: Mount Snowdon by Sam Stockman, Creative Commons Licence

Foreword

Planning ahead to 2050 to enable us to earn the trust of future generations of customers

At Welsh Water, our Vision is simple;

> *"To earn the trust of customers, every day"*

That vision reflects our unique ownership structure: We have no shareholders and so can concentrate solely on delivering the best possible value for money to our customers. All the profits that we make are reinvested in the business to improve outcomes for our customers and the natural environment, or are used to benefit customers, for example in helping to fund lower prices for over 100,000 of our most disadvantaged households.

We believe that a further benefit of our "not for profit" ownership model is that it makes it easier for us to really focus on the long-term, which is particularly important for us as the provider of an essential public service, with very long lived assets. This opportunity to plan for the next thirty years differentiates us from the water sector as a whole, which traditionally only plans for the next five years.

This long-term focus is not new for us at Welsh Water. Back in 2008, we published a long-term vision document "Our Sustainable Future", to guide our future business planning. This document set out, for example, our innovative RainScape approach, which has the challenging aspiration of preparing urban sewage systems across the area we serve for the flooding challenges that they will face in future due to the effect of climate change. Guided by the RainScape strategy, we are now nearly ten years into a programme of retrofitting sustainable urban drainage solutions (SUDs) into post-industrial communities such as Llanelli, western Swansea and the Grangetown area of Cardiff. Whilst this internationally recognised work will need to continue for at least a further generation, it well demonstrates the importance of making a start to address such long-term emerging challenges, so that we do not store up problems for future generations, just because they cannot be fully addressed in any single investment planning period.

Building on this long-term approach, in 2016 the Board of Welsh Water took the decision to accept a new challenge:

> *Welsh Water 2050 – to become a truly world class, resilient and sustainable water service for the benefit of future generations"*

We published a detailed "*Welsh Water 2050 Consultation Document*" in the spring of 2017, following an extensive review of international best practice in resilience planning, aided by independent consultants Arup and by Cardiff University. An important output of this preparatory work had been the formulation of a bespoke Welsh Water Resilience Framework (the "Resilience Wheel") which captures all aspects of what it is to be a truly resilient and sustainable water service for the long-term.

We have had a great response to our Welsh Water 2050 consultation exercise and we are really grateful to all those customers and institutions who took the time to share their views with us.

We received:

- Over 20,000 customer responses to our survey, through an innovative variety of digital and face to face methods;
- Detailed and ongoing input from customers through our online community, a range of customer focus groups and our new 'Youth Board';
- A very successful Stakeholder launch event, and another event involving around 50 of the Members of Glas Cymru; and
- 17 detailed responses from Stakeholder Groups and other interested parties.

We have been able to discuss all of this input over the period with our Customer Challenge Group and we are particularly grateful for their time and input into this complex process.

Through this engagement process, we have received a wide variety of very useful feedback. The overwhelming response from customers is that they do support us in taking a long-term approach to planning for the future of the water service we provide. As they become more engaged with the potential issues, most customers do expect Welsh Water to be taking the right long-term decisions today, so as to protect the public health and natural environment that will be enjoyed by future generations of customers. In most, but not all cases, this is seen as a higher priority than minimising the cost of the water service to current customers.

Figure 3 : Engaging our customers. © Welsh Water

Foreword

Planning ahead to 2050 to enable us to earn the trust of future generations of customers

However, customers do rightly expect us to be as efficient and innovative as possible in planning future investment in the business, so that we can minimise any future increased cost to customers. A clear theme amongst customers is that they generally have very high levels of trust in Welsh Water, in part due to our "not for profit" ownership model, which in turn is reflected in generally high levels of support for our long-term plans.

We have also taken on board very useful specific feedback from customers and stakeholders, so that our final document reflects the key themes raised by respondents; it:

- Explains the eight key challenges and opportunities ("trends") that we need to respond to in our long-term planning
- Sets out 18 strategic responses (including four additional ones following consultation) that we will need to pursue over the coming decades to meet these challenges and take advantage of these opportunities; grouped around the water cycle elements of "drinking water", "customer and communities" and "environment"
- Makes clear the significance attached to aspects of particular importance to stakeholders, including affordability, serving customers in circumstances which can make them vulnerable, and our role in helping to promote healthy ecosystems and biodiversity,
- Demonstrates the crucial role of efficiency and innovation, if we are to be able to invest at the rate necessary to meet our long-term challenges, whilst keeping future bills affordable for customers, and
- Illustrates the crucial importance of working with others to help us deliver our responsibilities more efficiently and also to help us play our part in delivering wider social "Well-being Goals", as set out in the Welsh Government's Well-being of Future Generations Act.

The final Welsh Water 2050 document now sets out our vision of what a truly resilient and sustainable water service might well look like in 2050. Key deliverables for customers within that vision include:

- Good value for money for customers as a whole – with any increase in bills being affordable in relation to the movement in average household disposable incomes;
- Affordable services for all, with every household receiving a bill which is fair and which they can afford; and
- A fully resilient business – in terms of its people, assets, governance, finance and culture – which is ready to meet the challenges beyond 2050.

"*Welsh Water 2050"* now provides a clear, long-term framework for our future business planning. The next step for Welsh Water is to publish our Business Plan for the next three, five-yearly Asset Management Periods (AMPs), with particular detail and emphasis on our plans for customers in the five years to 2025. Each AMP plan will need to set out clear deliverables which demonstrate appropriate progress towards the achievement of the 18 strategic responses set out in Welsh Water 2050, in a way that is prioritised by the issues of greatest risk or importance to customers, and at a rate of improvement which is affordable for customers given the expected financial environment over that period.

The Business Plan will include a wide ranging suite of Measures of Success (MOSs), which will measure the progress that we are making against each strategic response and also against each segment of the "Resilience Wheel". We will be publishing an annual performance report to customers, showing outturns for each of these measures against the targets contained in our Business Plan, so that customers and observers can form their own judgement as to how well we are doing in making progress towards our Welsh Water 2050 objectives.

We also envisage a substantial exercise each five years to review our long-term vision and resilience model, with specialist independent input and a wide-ranging opportunity for customers and other stakeholders to get involved and influence our decision making. This wide ranging review will need to include, in particular:

- How is international best practice in resilience planning developing?
- How are the challenges and opportunities first identified in Welsh Water 2050 evolving?
- Do we still have the correct strategic responses?
- What progress have we made towards the achievement of those strategic responses and how do we now benchmark our overall business resilience against the attributes of the "Resilience Wheel"?
- What should be our priorities for progress in the then forthcoming AMP periods? and
- What is an affordable rate of progress over the coming period, in light of the views of customers?

Welsh Water is committed to this ongoing process of consulting, reviewing, adapting and improving our long-term vision and plans. On that basis, we will be able to say with confidence to our customers that they can place their trust in us to provide them with a good value, resilient public service, both now and long into the future.

Chris Jones
Chief Executive,
Welsh Water

Executive Summary

Introduction

Welsh Water is proud to provide essential public services in the management of the water cycle to over three million people across most of Wales and some adjacent parts of England. As an essential public service provider, we must:

- Plan for the very long-term, so that we can aim to protect future generations from potential challenges (such as climate change) and take full advantage of potential opportunities (for example, new technology and data analysis);
- Be customer-led in everything we do – both in terms of our day to day activities and also in developing our plans for the future;
- Work in partnership with many other organisations, to ensure that we play our part in delivering society's wider goals;
- Have the best people to deliver the best outcomes for our customers;
- Constantly look for opportunities for research, innovation and adoption of best practice to help us deliver a better and more efficient service to our customers;
- Provide a high quality service in which all of our customers can place their trust; and
- Ensure that this service represents good value for money and is affordable for all of our customers.

In 2013, following the involvement of 1,000 of our colleagues, we adopted a clear vision for our business, which is:

> *"To earn the trust of customers, every day"*

This strategy, Welsh Water 2050, is part of our plan to realise this vision in a rapidly changing world.

From our extensive customer research and continued tracking of customer sentiment, we understand that we serve many differing groups of customers, with individual wants, needs and expectations of our services.

We have developed six customer promises to reflect the service we should provide to all of our customers:

1. Clean, safe drinking water for all;
2. Safeguard our environment for future generations;
3. Personal service that's right for you;
4. Fair bills for everyone;
5. Put things right if they go wrong; and
6. A better future for all our communities.

Above all, customers place a particular emphasis on the reliability of essential services – the provision of safe drinking water, and the protection of the environment. They expect us to protect them against short-term shocks (for example, extreme storms or unexpected technical failures in assets) and longer-term stresses (for example, population change and climate change).

They also need to know that they can trust us to anticipate future trends that present challenges to service reliability, and opportunities to improve it. They want to be sure that we are taking the necessary action to ensure that the services we provide are resilient to future trends.

We have developed Welsh Water 2050 to respond to these customer priorities, and to ensure that we can continue to deliver our customer promises and achieve our vision in the context of a changing world. This is encapsulated in our Welsh Water 2050 mission statement:

> *"Welsh Water 2050 – to become a truly world class, resilient and sustainable water service for the benefit of future generations"*

Welsh Water 2050 is built on five key elements:

- The Welsh Water customer promises;
- A review of future trends;
- The Welsh Water Resilience Wheel and assessment;
- Welsh Government policy and strategy – with particular alignment to the Well-being of Future Generations Act; and
- Extensive feedback from customers and stakeholders collected during the Welsh Water 2050 consultation in summer 2017

Figure 4 : Our colleagues at an engagement event with our customers. © Welsh Water

Executive Summary

The development of Welsh Water 2050

The Welsh Water Resilience Wheel

The process used to develop this strategy is based on global resilience best practice set in the context of Welsh Water's operating area, including the legislation and policy of the Welsh Government.

Working with Arup (a global multi-disciplinary consultancy firm) and Cardiff University, we have undertaken horizon scanning to identify significant future trends for our customers and our business, and developed a Resilience Wheel. In this context, resilience encompasses all aspects of our business, including assets, systems, people and governance.

The Resilience Wheel was developed by drawing on best practice from a range of institutions and cities around the world, including existing resilience guidance, methodologies, frameworks and strategies. This included the City Resilience Index, developed by Arup with support from the Rockefeller Foundation, and Ofwat's Towards Resilience, developed to challenge the water utilities sector and to inform Ofwat's work.

The Resilience Wheel provided an independently facilitated assessment of Welsh Water's current resilience performance, and forms the basis for the strategic responses identified in Welsh Water 2050. We will regularly assess our progress against this Wheel, and set ourselves objectives to improve our resilience in line with the Welsh Water 2050 mission statement.

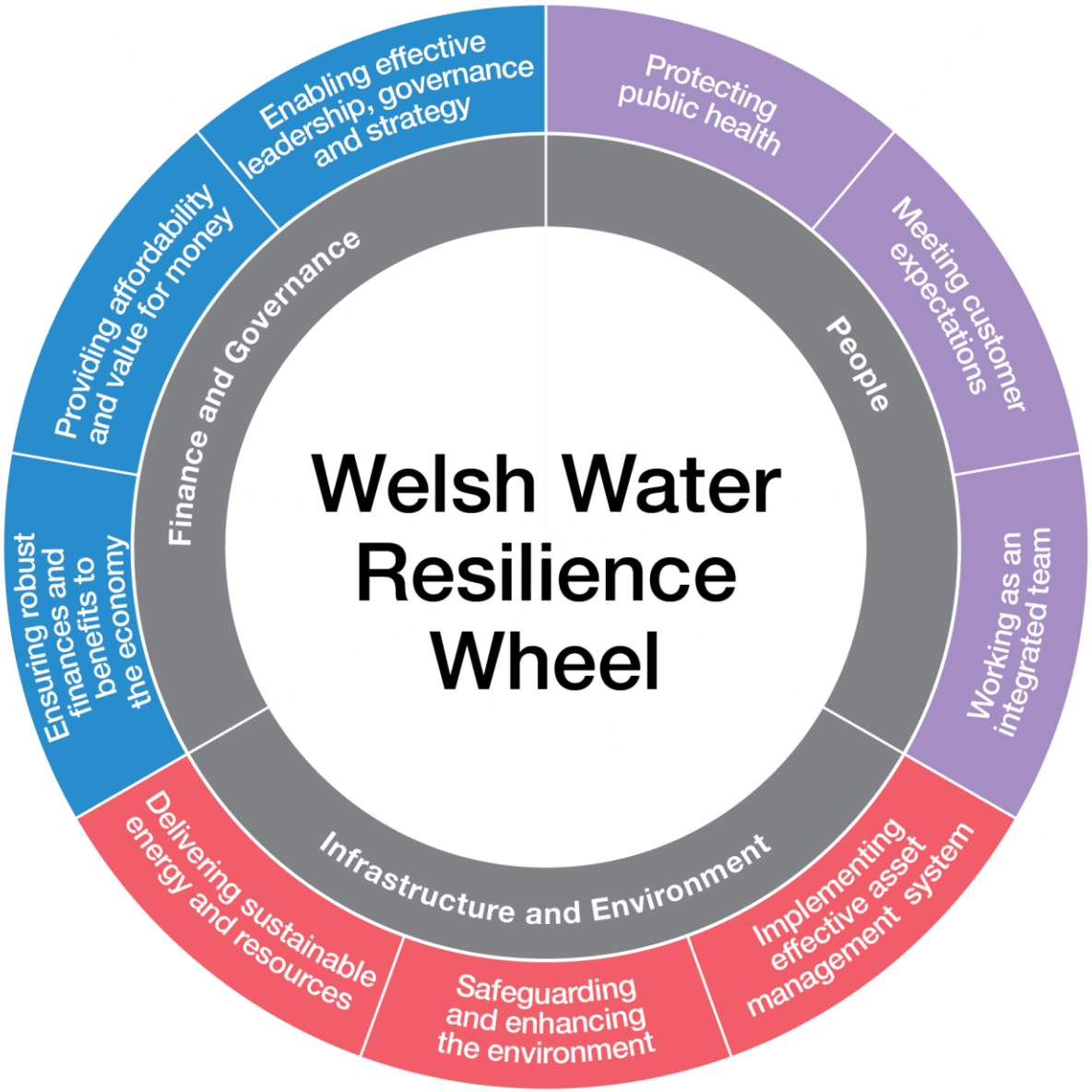


Figure 5 : The Welsh Water Resilience Wheel. © Welsh Water

Executive Summary
Future trends

There is a great deal of uncertainty around the future environment within which we will be operating, but there are several foreseeable future trends that are likely to have a significant impact on our service provision. It is essential that we consider the challenges and opportunities presented by these trends in Welsh Water 2050, so that we can continue to meet our customer promises into the future. The future trends are:

Demographic change

Population growth will lead to increased water demand in certain areas and an ageing population may lead to more customers in vulnerable circumstances. However, opportunities will emerge to develop a more diverse age profile in the workforce.

Climate change

Climate change will result in more extreme rainfall events, which could lead to an increased risk of flooding and pollution. Drier, hotter summers are projected, which could result in water supply deficits and the potential for increased water demand.

Change in customer expectations

Customer expectations are likely to change dramatically with a desire for a more personalised service and control over their use of services and less tolerance of service outages. This will particularly be the case for business customers.

Changes to the structure of the economy

The growth of the digital, knowledge-based economy will create opportunities to provide services in more efficient ways. However, it could also have an impact on the nature of society, and present a challenge to continuing to meet the needs and expectations of our customers.

Environmental change

Invasive species, land use change and an increased risk of environmental pollution may lead to a reduction in water quality and biodiversity. However, co-operative approaches for the delivery of enhanced ecosystems services could lead to better environmental outcomes.

Protecting essential infrastructure

Ageing infrastructure, a limited supply chain and cyber security are key concerns for future service provision. Technological advances could lead to significant efficiencies in the planning, delivery and operation of new assets.

Policy and regulatory change

Changes in policy and regulation are expected due to the UK leaving the European Union, devolution and changing quality standards; this creates uncertainty, but provides the opportunity for us to help shape future policy. Improved regulatory methods and innovative policy developments could lead to more efficient delivery of services to our customers.

Protecting public health

Regulatory standards to protect drinking water quality are likely to continue to tighten in the future. We will have a role to play in promoting healthier and more sustainable lifestyles for our customers.

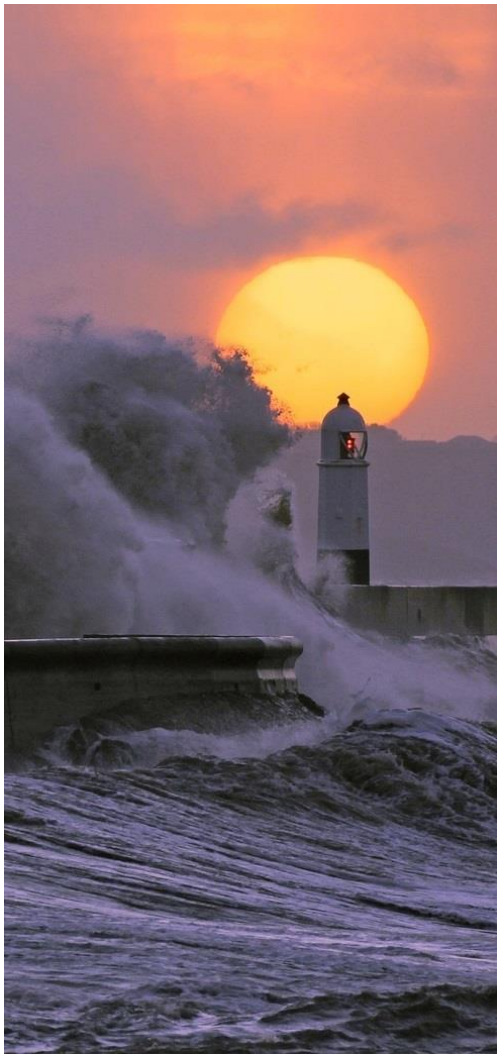


Figure 6 : Porthcawl. By Gareth Thompson, Creative Commons License (CC BY 2.0)

Executive Summary

Our strategic responses

Our future trends identify challenges and opportunities that we expect to face between now and 2050. We initially developed 14 strategic responses (shown overleaf in Table 1) which show *what* we will do to respond to these challenges and opportunities. The 14 strategic responses are grouped into three key areas, which align with the water cycle:

- Drinking water;
- Customers and community; and
- Environment.

These strategic responses were further developed following feedback from our customers and stakeholders. In particular, we developed four new strategic responses, reflecting views that these issues were not prominent enough in the previous version. These are:

- Ensuring affordability of services delivered to customers;
- Supporting customers in vulnerable circumstances;
- Working with customers and communities; and
- Supporting ecosystems and biodiversity.

Strategic responses

For each strategic response we have considered a range of possible actions, from research to investment, and set out a direction of travel. This direction of travel indicates the types of actions that we will focus on in the future, along with a range of likely investment. However, it acknowledges that we need to be flexible and adapt our actions as future challenges and opportunities evolve. It also acknowledges that we must monitor the effectiveness of our actions and adjust our approach accordingly.

For each strategic response, we outline the outcomes that we expect to achieve by 2050, the investment required and how the outcomes meet the customer promises and the goals of the Well-being of Future Generations Act.

There is huge uncertainty when considering future trends as far out as 2050, particularly in respect of future technological advances and future customer expectations. Therefore, our approach in Welsh Water 2050 puts emphasis on maintaining flexibility in how we respond to trends, and in making 'no regrets' decisions, taking first those steps which address the urgent priorities of our customers, whilst targeting research to address longer term potential challenges and opportunities. In addition, we will revisit this strategy every five years, to review the suitability of each of the strategic response's direction of travel, our progress against the direction of travel, and new arising trends which we need to respond to. At each review we will then map out our planned activities and priorities for research and innovation for the coming 15 years.

There are many synergies between the activities and outcomes of different strategic responses. For example, working with customers and communities to reduce water demand, will support the strategic response focused on providing enough water for everyone. As we put the strategy into action, we will be conscious of these secondary effects that activities have on other strategic responses, and take them into account as we update our strategy in the future.

Figure 7 : Wales Millennium Centre. CC BY 2.0 by Col Ford and Natasha de Vere

Executive Summary

Our strategic responses

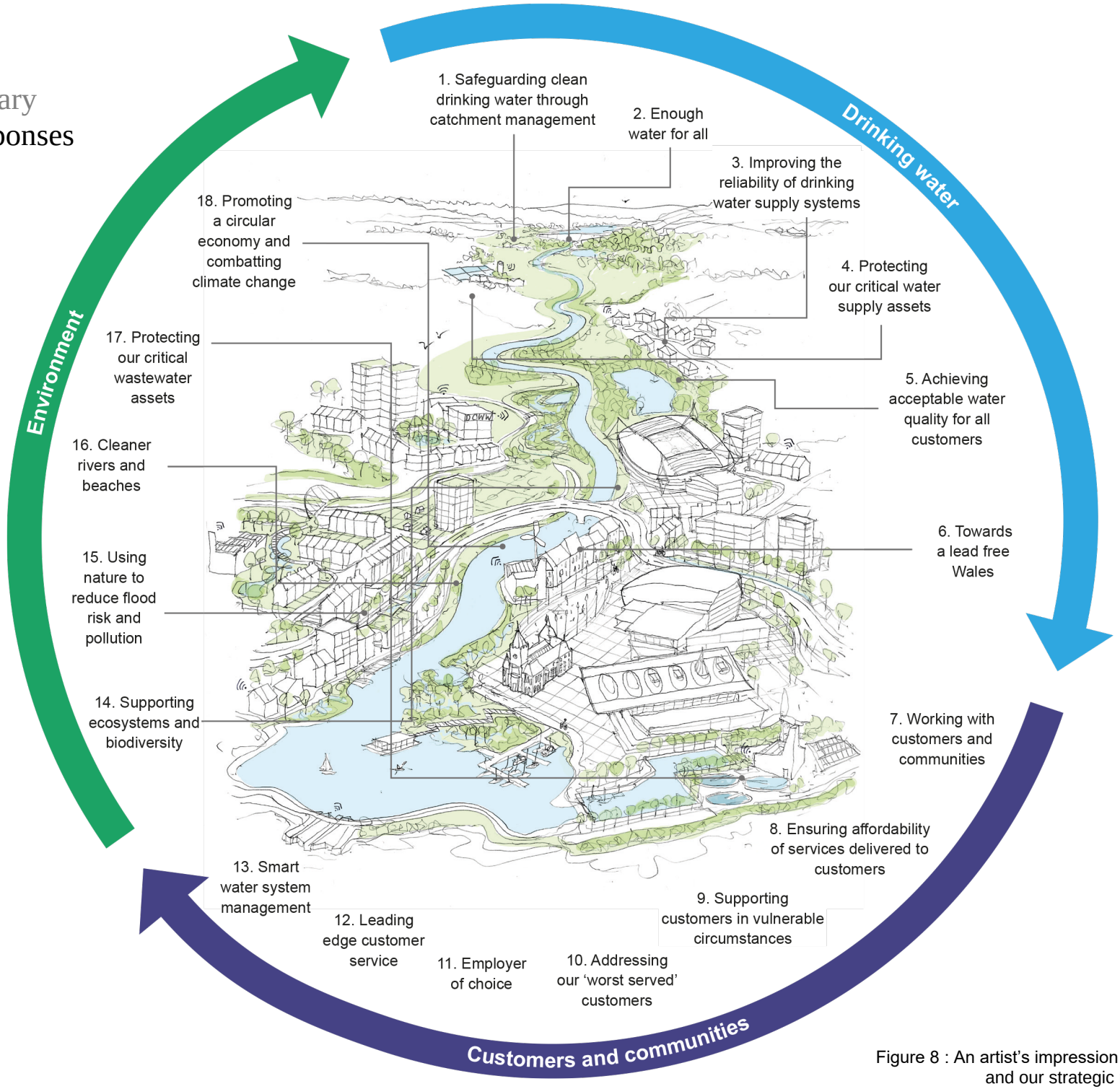


Figure 8 : An artist's impression of the water cycle, and our strategic responses. © Arup

Executive Summary

Our strategic responses

To respond to the challenges and opportunities that the future trends present us, we have developed 18 strategic responses (Table 1). Outlines of each of the strategic responses are included overleaf.

	Strategic responses	Demographic change	Climate change	Changes in customer expectations	Changes to the structure of the economy	Environment change	Protecting essential infrastructure	Policy and regulatory change	Protecting public health
		Future trends							
Drinking water	1: Safeguarding clean drinking water through catchment management		−		+ −	+ −		+ −	+ −
	2: Enough water for all	−	+ −		+ −	−		−	
	3: Improving the reliability of drinking water supply systems		−			−	−		
	4: Protecting our critical water supply assets		−		−	−	+ −		+
	5: Achieving acceptable water quality for all customers	−	−				−		
	6: Towards a lead free Wales		−	+ −			−	+ −	+ −
Customers and communities	7: Working with customers and communities	−		−		+			
	8: Ensuring affordability of services delivered to customers	+ −		−	+ −	−		+	−
	9: Supporting customers in vulnerable circumstances	+ −		+ −	+ −				+
	10: Addressing our 'worst served' customers	−	−	−	+		+ −		
	11: Employer of choice	+ −		+ −	+ −			+ −	
	12: Leading edge customer service	−		+ −	+ −				+
	13: Smart water system management	+ −				+	+ −	+ −	
Environment	14: Supporting ecosystems and biodiversity		−			+ −		+ −	
	15: Using nature to reduce flood risk and pollution	−	−		−	−	+ −	+ −	
	16: Cleaner rivers and beaches	−	−		+ −	−		+ −	+ −
	17: Protecting our critical wastewater assets		−	−	−		+ −		+
	18: Promoting a circular economy and combatting climate change		−	+	+ −			+ −	

+ Opportunities associated with this future trend are harnessed by the strategic response

− Challenges associated with this future trend are mitigated by the strategic response

Table 1 : Responding to the future trends

Executive Summary

Our strategic responses

Drinking water

1. Safeguarding clean drinking water through catchment management

Catchments as a first line of defence: we will face increased levels of pesticides, fertilisers, nutrients and pathogens in raw water, and increased turbidity of water reaching our water treatment works due to the intensification of agriculture and greater intensity of storms. We will co-create an extensive, innovative programme of catchment management with landowners and partners.

2. Enough water for all

Confronted with an increasing water supply demand gap due to population growth and drier summers due to climate change, we will use our Water Resource Management Plan to ensure the water supply demand balance to 2050. We propose to implement water transfers, demand management measures and leakage reduction programmes to address any deficits, whilst recognising the possible need to support other parts of the UK.

3. Improving the reliability of drinking water supply systems

Faced with an increased risk of outages due to agricultural run-off, extreme weather events, terrorism, and cyber attacks, we will build more flexibility and integration into our water treatment and supply systems.

4. Protecting our critical water supply assets

With increasing risks of disruption (for example, from severe weather events resulting from climate change and increased reliance on technology) and limited customer tolerance of supply outages, we will improve the resilience of critical water assets which have high consequences of failure.

5. Achieving acceptable water quality for all customers

Ageing water mains and more extreme weather events increase the risk of supplying water which is discoloured or has a poor taste. This will be addressed through a targeted replacement of iron mains.

6. Towards a lead free Wales

We have the opportunity to help improve public health, and propose a targeted replacement of lead communication and supply pipes, as part of a wider societal effort to address lead in drinking water.

Customers and communities

7. Working with customers and communities

We will work with customers and communities to co-create solutions, share knowledge, and support initiatives which reduce water use, prevent sewer abuse, and provide wider benefits for communities and the environment.

8. Ensuring affordability of services delivered to customers

With inequality, debt, and poverty on the rise we aim to ensure that our services remain affordable for all customers: both in terms of average bills and for those on social tariffs. We will ensure that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our customers.

9. Supporting customers in vulnerable circumstances

We need to use data effectively, provide personalised customer service and work in partnership with other service providers to give appropriate and effective support to customers in vulnerable circumstances.

10. Addressing our ‘worst served’ customers

Faced with increasing customer expectations for a good service at all times, we will address the longstanding service complaints of ‘worst served customers’ to ensure that everyone receives an acceptable level of service.

11. Employer of choice

With an ageing population, an increasing shortage of technically skilled employees and increasing demand for more flexible approaches to working, we will need to continue to be an employer of choice; attracting, developing and inspiring people from a diverse range of backgrounds, to deliver an excellent service for our customers.

12. Leading edge customer service

Changing customer expectations, the digital revolution and demographic and lifestyle change are all leading Welsh Water to further develop our customer service culture. We will harness technological change to provide a personalised service for customers through their preferred contact channel.

13. Smart water system management

With the opportunity to capitalise on technological advances, we will improve the service performance and resilience of our assets through remote sensing, data analysis and automation; solving problems before they impact on our business, our customers, or the environment.

Environment

14. Supporting ecosystems and biodiversity

Biodiversity faces threats including habitat loss, fragmentation and over-exploitation. In the longer term, temperature and changed rainfall patterns will also impact biodiversity. We will look for ways to help nature, enhance biodiversity and promote ecosystem resilience while we carry out our water and sewerage activities. Welsh Water has a duty under the Environment (Wales) Act (2016) to enhance biodiversity and promote the resilience of ecosystems in the exercise of our functions.

15. Using nature to reduce flood risk and pollution

RainScaping our communities: confronted with urban creep due to demographic change and increased intensity of rainfall due to climate change, Welsh Water is proposing to reduce the risk of sewer flooding and pollution through sustainable urban drainage systems.

16. Cleaner rivers and beaches

With increasing pressure on the natural environment from increased population, changing land use, climate change and new sources of pollution, we will improve our wastewater assets to do our part to help achieve ‘good’ environmental status for our rivers, lakes and coastal waters.

17. Protecting our critical wastewater assets

Faced with an increased risk of disruption, for example, from an increase in severe weather as result of climate change, and reduced customer acceptability of pollution events, we will improve the resilience of our critical wastewater assets, which have high environmental and customer impacts of failure.

18. Promoting a circular economy and combatting climate change

Faced with a changing climate and increased energy costs, we will aim to become an energy neutral business, whilst maximising the opportunities to reuse treated water and other potentially valuable natural materials, contributing to the circular economy in our local region.

Executive Summary
The future of Welsh Water

Long-term investment to achieve Welsh Water 2050

For each of the strategic responses, we have set out a direction of travel over the coming decades, giving a sense of the range of possible actions that may be required as our experience develops. Whilst it is difficult to be certain at this stage of the precise actions required over the next 30 years, it is clear that significant capital investment will be needed to deliver many of the strategic responses, notably to:

- Improve water catchments, in partnership with other landowners;
- Make our upland reservoirs safe and our supply systems resilient, in the face of a changing climate and customer demand;
- Join up supply systems to reduce the number of customers that can only be served from one supply source;
- Undertake a “generational” programme to replace aged iron mains and other pipes in an unsatisfactory condition;
- Equally, embark on a “generational” shift to Sustainable Urban Drainage Systems (SUDs), upgrading the combined foul and surface water systems of the past; and,
- Upgrade our wastewater treatment works and reducing outflows from our sewerage network, where these have a material role to play in achieving good ecological quality for our rivers and beaches.

However, for many of the strategic responses, there will also be offsetting efficiency savings once investment has been made to upgrade the infrastructure. For example, more reliable assets will have lower breakdown and maintenance costs, and cleaner upland catchments can reduce treatment costs at water treatment works. For each strategic response, we give an indication of the net cost (investment less future efficiencies) that might accrue over the next 30 years, depending on how far along the direction of travel we ultimately go.

Overall, a net cost over 30 years of between £4.5 billion and £9 billion may be required. To put this in context, we presently spend in the order of £0.5bn to £1bn in each 5-yearly period on improving our services and resilience and have held price rises for households at or below (RPI) inflation for 9 consecutive years. Therefore, the direction of travel set out in Welsh Water 2050, whilst ambitious, is not implausible. Appendix B sets out an analysis of potential costs against the backdrop of future bills.

Continuing to deliver affordable services for customers

Through the wide ranging feedback to our Welsh Water 2050 consultation exercise, it became clear that there is overall strong support amongst customers for the need to invest to address long-term challenges. Customers are concerned about the future state of the environment and essential public services that they will leave for future generations, and this generally has a higher importance for most but not all customers than minimising the current level of bills. This response was also echoed by most stakeholders and reflects the long-term approach to securing the well-being of future generations that is enshrined in the policy framework in Wales in particular.

However, it was also very clear that customers expect Welsh Water to be as efficient and transparent as possible in investing on behalf of its customers, so that they can trust us to keep down the future cost to customers and they can see where their money is being spent.

Welsh Water 2050 is designed to meet this challenge from customers, so that we can continue to earn their trust as we invest to deliver the future well-being outcomes that we all desire. We will need to be flexible and prioritised in our future expenditure plans, so that we can keep the overall level of bills affordable for customers, in light of potential but uncertain increases in society’s wealth over the period. We will also need to drive significant further efficiencies into our business activities, in order to keep costs down to the sorts of levels set out in this document. We will need to be flexible in the pace of improvement, putting an emphasis on “no regrets” decisions at early stages, together with prioritised research and innovation to help address some of the biggest challenges in a more cost effective manner in the future.

We will also need to ensure that every household faces a bill which is affordable, recognising that it is already difficult to afford the water bill today for many households in financial or other vulnerable circumstances. Research and engagement have shown consistent support amongst household customers for giving financial support to those disadvantaged households who will struggle to pay their equal contribution to the cost of delivering the improvements to service, resilience and the environment that are desired by society as a whole. Crucially, this financial support through lower social tariffs for some customers is funded by contributions from other customers and also directly by Welsh Water itself, reflecting our unique non-shareholder ownership model.

Research and innovation

The costs of mitigating the challenges and harnessing the opportunities from now until 2050 will only be affordable for our customers if we are committed to innovation.

The rapid pace of technological change offers the prospect of providing services more efficiently and reliably in the future. Moreover, new methods of working together, including co-creation between water companies, their customers and other organisations could enable society to deliver its goals more efficiently.

One of the primary purposes of Welsh Water 2050 is to help us shape and prioritise our long-term science and research agendas, to ensure that the considerable expenditure that we make is focused and efficiently invested on the issues that will matter most to our customers in the long-term.

Figure 9 : Snowdonia. Image by Blazing Minds, Creative Commons License (CC-BY-2.0).

Executive Summary

The future of Welsh Water

		Wales' Well-being of Future Generation Acts well-being goals						
		A prosperous Wales	A resilient Wales	A healthier Wales	A more equal Wales	A Wales of cohesive communities	A Wales of vibrant culture and thriving Welsh language	A globally responsible Wales
Drinking water	1: Safeguarding clean drinking water through catchment management	■	■	■				■
	2: Enough water for all		■	■				
	3: Improving the reliability of drinking water supply systems	■	■			■		
	4: Protecting our critical water supply assets	■	■	■				
	5: Achieving acceptable water quality for all customers		■		■	■		
	6: Towards a lead free Wales		■	■	■			
Customers and communities	7: Working with customers and communities	■	■	■		■		
	8: Ensuring affordability of services delivered to customers		■		■			■
	9: Supporting customers in vulnerable circumstances	■		■	■			
	10: Addressing our 'worst served' customers	■			■	■		
	11: Employer of choice	■		■	■		■	
	12: Leading edge customer service				■		■	■
	13: Smart water systems management	■	■					
Environment	14: Supporting ecosystems and biodiversity	■	■	■	■	■		■
	15: Using nature to reduce flood risk and pollution	■	■	■	■	■		■
	16: Cleaner rivers and beaches	■	■	■				■
	17: Protecting our critical waste water assets	■	■	■				
	18: Promoting a circular economy and combatting climate change	■	■					■

Table 2 : Links between Well-being goals in the Well-being of Future Generations Act and our strategic responses

Contributing to the future of Wales

Welsh Water 2050 considers both the direction for our own business and outlines the impact we want to have on the people, economy and natural environment of our operating area in Wales and England in the long-term.

Welsh Water 2050 contributes to the wider goals of the Well-being of Future Generations Act 2015, the Environment (Wales) Act, and the Water Strategy for Wales. It also contributes to addressing the risks and opportunities outlined in the State of Natural Resources Report.

Co-creating our responses with customers and stakeholders

We know that we can't respond to the huge challenges facing us and the wider world alone. We will work closely with our customers and our stakeholders to create affordable solutions to challenges. We know that this is particularly true at a catchment level.

Equally, our actions can have wider benefits to other societal agendas with our commitment to recreation and education services contributing to public health and well-being. Again, this co-operative and catchment based approach to solving society's potential issues is very much in line with the approach set out in the Environment Act (Wales) 2016 and could make a significant contribution towards delivering the environmental improvements discussed in the first State of Natural Resources Report (published by Natural Resources Wales in 2016).

Our next steps and business planning

Following the consultation period, we have published this final version of Welsh Water 2050. The final Welsh Water 2050 document sets out a vision of what a truly resilient and sustainable water service might look like in 2050 and it provides a long-term framework for our future business planning.

The next step for Welsh Water is to publish our business plans for the next three Asset Management Periods (AMPs), covering the period 2020-2035. These will be submitted to Ofwat in September 2018. Each AMP plan will set out clear deliverables which contribute towards the progress of the 18 strategic responses set out in Welsh Water 2050.

Over the next 30 years, we intend to use our Measures of Success (outlined in our business plan) to monitor progress annually against each of the strategic responses in Welsh Water 2050 and against each segment of the "Resilience Wheel" and we will publish the results in an annual performance report to customers. Every five years, we will carry out a review of our long-term vision and, where necessary, revise our strategic responses as the future trends evolve. At each review we will then map out our planned activities and direction of travel for the coming 15 years, reflecting further input from our customers and wider stakeholders.

Executive Summary
Value to customers

This final Welsh Water 2050 document sets out our current view of what our customers can expect from us over the course of the next 30 years, so that we are able to earn the trust of future generations of customers.

Ultimately, through Welsh Water 2050 our aim is to deliver value to our customers both now and in the future. The grey box represents the outcomes we aspire to achieve by implementing the 2050 vision.

The outcomes of Water 2050 we aspire to achieve include:

- Good value for money for customers as a whole – with any increase in bills being affordable in relation to average household disposable incomes;
- Affordable services for all, with every household receiving a bill which is fair and which they can afford;
- A fully resilient business – in terms of its people, assets, governance, finance and culture – which is ready to meet the challenges beyond 2050;
- All customers will receive a defined, acceptable service for drinking water supply and drainage – or else they won't have to pay for that service;
- Individualised customer service delivery, reflecting their preferences and choices as to the services that they wish to receive – integrated with other essential services to contribute to smart homes and smart cities;
- Business customers will receive a range of high quality services that match the best available in the rest of the UK and beyond;
- Good ecological quality for all water bodies affected by our activities, with a wider contribution to enhance biodiversity and promote the resilience of ecosystems;
- A business that is adapted to meet the challenges of climate change (from droughts to flooding);
- All key assets meet prescribed resilience standards to maintain service to customers irrespective of shocks and stresses and the potential for increased outages in the future;
- Smart network management for our assets, that pro-actively identifies problems and deals with them before customers are affected;
- Exposure of the public to lead in drinking water is significantly reduced, particularly for the young;
- A circular economy business that will make full use of wastewater and other opportunities to maximise energy generation and the recycling of valuable materials;
- A business which uses its land holdings and other assets to maximise the well-being of its customers, encouraging healthy lifestyles and recreation, and supporting biodiversity and ecosystems; and
- A business which contributes to Welsh society and the local economy, by providing high quality jobs, both directly and through its supply chain.

1. The Development of Welsh Water 2050

1.1 Context

Introduction

Welsh Water is part of the Glas Cymru Group. We are a not for profit company without shareholders, and therefore we retain all financial surpluses for the benefit of our customers. We are responsible for the provision of statutory water and wastewater services to around 1.3 million households and businesses across much of Wales, Herefordshire and parts of Deeside. We also contribute £1.1 billion to the Welsh economy every year (Welsh Economy Research Unit, 2013).

Customers promises

Welsh Water provides a vital public service for its customers. Our customers expect us to anticipate future trends to ensure a resilient service, long into the future.

This is captured in Welsh Water's vision, which is to *'earn the trust of customers every day'*. Through listening to our customers and understanding their priorities (Welsh Water, 2016), we have developed six promises. They are:

1. Safe, clean water for all;
2. Safeguard our environment for future generations;
3. Put things right if they go wrong;
4. Personal service that's right for you;
5. Fair bills for everyone; and
6. A better future for all our communities.

We must continue to deliver these promises in order to earn our customers' trust.

Welsh Water 2050 mission

The desire to continue to deliver the customer promises in the context of a changing world in order to earn the trust of our current and future customers is encapsulated in our Welsh Water 2050 mission statement:

> *"Welsh Water 2050 – to become a truly world class, resilient and sustainable water service for the benefit of future generations"*

The definitions of resilience and sustainability are:

> *Resilience is the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.*

(Adapted from: 100 Resilient Cities, 2017)

> *Sustainable development is meeting the needs of the present without compromising the ability of future generations to meet their own needs.*

(Brundtland Commission 1987, also adopted by The Well-being of Future Generations Act (Welsh Government, 2016c) and Ofwat)

Figure 10 : Welsh Water's operating area. © Welsh Water

1. The Development of Welsh Water 2050

1.2 Purpose

This document, Welsh Water 2050, identifies significant trends over the next 30 years, how these will impact on us and our customers, and how they will be addressed.

In order to mitigate the challenges and harness the opportunities of these trends, we have developed 18 strategic responses.

In this document, we are largely concerned with the current legal responsibilities of Welsh Water – to provide essential public services to a wide range of customers. However, we recognise that the current business scope and responsibilities of regulated water and sewerage companies could change significantly during the period to 2050. In some cases, it is conceivable that water companies in Wales could be tasked by the Welsh Government with taking on new legal duties, particularly in terms of urban flooding management or new responsibilities for customers' water supply pipes.

Equally, new regulatory methods and the introduction of market mechanisms could lead to other organisations seeking to provide parts of the value chain that are currently provided exclusively by us. There is also the possibility that we, and the wider Glas Cymru Group, could consider the provision of new commercial services to our customers.

At this stage, this report is concerned with what customers should expect to be delivered for them over the course of the next 30 years, including the exploration of some actions which fall outside our current responsibilities. As a consequence, we need to be open minded, and maintain a high degree of flexibility in terms of the delivery of actions to 2050.

Given the uncertainty of predicting the future to 2050, our plans need to emphasise flexibility. We need to be prepared to make the right "no regrets" decisions for urgent actions, whilst prioritising our research and innovation to build our understanding of significant future trends. The size of some of the challenges and the inter-generational nature of some of the required responses means that doing nothing in the face of uncertainty is not an option.

It is also essential that we maintain the deep involvement of customers when planning for the future, both in terms of the long-term, as set out in Welsh Water 2050, and prioritising our business planning for five-yearly regulatory reviews.

Figure 11 : Cardiff wastewater treatment works advanced digestion facility. © Arup

1. The Development of Welsh Water 2050

1.3 Welsh Water 2050 at a glance

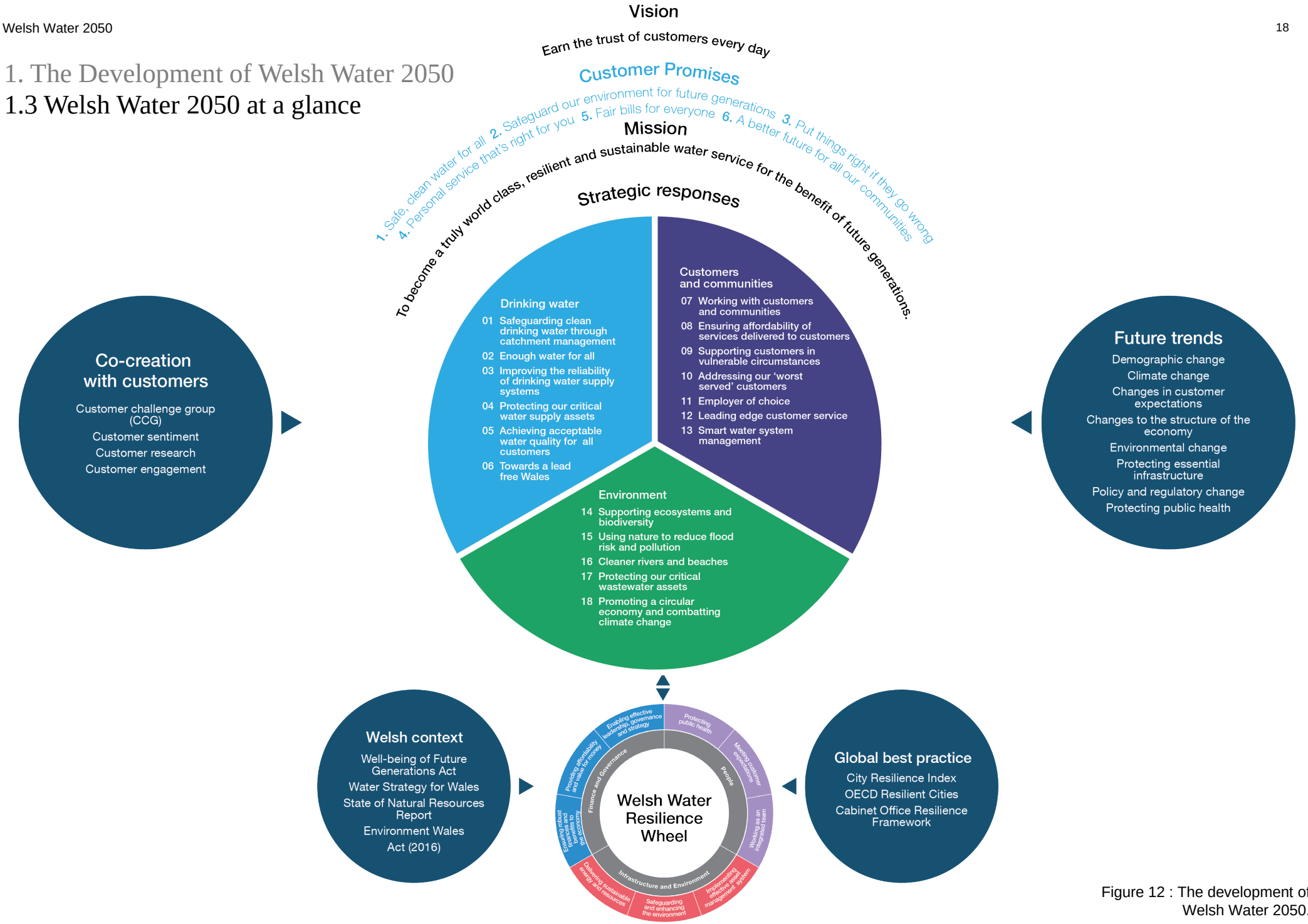


Figure 12 : The development of Welsh Water 2050.

1. The Development of Welsh Water 2050

1.4 Approach

Welsh Water 2050 methodology

Welsh Water 2050 is built on five key elements:

- Welsh Government policy and guidance, including the Well-being of Future Generation Act and the Environment (Wales) Act;
- Meeting customers' changing expectations;
- The Welsh Water Resilience Wheel;
- A review of future trends; and
- Stakeholders' and customers' views from the summer 2017 Welsh Water 2050 consultation.

Building on these five elements, we have developed 18 strategic responses, to respond to the future trends over the next 30 years.

The Welsh Water 2050 methodology is summarised in Figure 11, on page 18.

Welsh policy and context

Welsh policy and guidance was reviewed with a particular focus on the Well-being of Future Generations Act (Welsh Government, 2016c), the Water Strategy for Wales (Welsh Government, 2015a), and the Environment Wales Act (2016), with the National Natural Resources Policy and Area Statements to follow.

We have also ensured that we are planning in the context of the Nature Recovery Plan for Wales (2015), and the State of Natural Resources Report (Natural Resources Wales, 2016), which provide a baseline of the scope for improvement in the environment in Wales and the priorities for co-operative action.

The Well-being of Future Generations Act places a duty on public bodies in Wales to consider the long-term and work more cohesively with people, communities, and other public bodies to achieve outcomes. To ensure that Welsh public bodies are working towards the same vision, the Act puts into place seven well-being goals:

- **A prosperous Wales** - An innovative and productive society, which recognises the limits of the global environment and uses resources efficiently and which develops a skilled population in an economy which generates wealth and provides employment opportunities;
- **A resilient Wales** – A nation which maintains and enhances a biodiverse natural environment that supports resilience;
- **A healthier Wales** – A society in which people's well-being is maximised and in which choices and behaviours that benefit future health are understood;
- **A more equal Wales** – A society that enables people to fulfil their potential no matter what their background or circumstances;
- **A Wales of cohesive communities** – Attractive, viable, safe and well-connected communities;
- **A Wales of vibrant culture and thriving Welsh language** – A society that promotes and protects cultures, heritages and the Welsh language; and
- **A globally responsible Wales** – A nation which takes account of whether doing such a thing may make a positive contribution to global well-being.

Although Welsh Water is not a public sector body and does not fall within the scope of the Act, we have developed our approach in Welsh Water 2050 in close alignment with the Government's strategy for the public sector. We believe that these seven well-being goals are equally desirable for our customers in England, as well as those in Wales.

Welsh Water aims to play a significant role in achieving these goals, as outlined in section 4 (Helping to Create a Better Future for Communities).

We will inform public policy, with a view to finding better ways to achieve beneficial outcomes for society as a whole – including contributing to addressing issues such as urban flood management and minimising the exposure of the public to lead in drinking water. However, we recognise that our contribution to progressing such agendas is necessarily limited and we can only hope to achieve societal outcomes by working in close and open co-operation with other institutions, including regulators, local government and customer groups.

In some cases, legal changes may be needed to enable progress, or to transfer responsibilities, so as to deliver outcomes more efficiently, but this is ultimately a matter for Government.

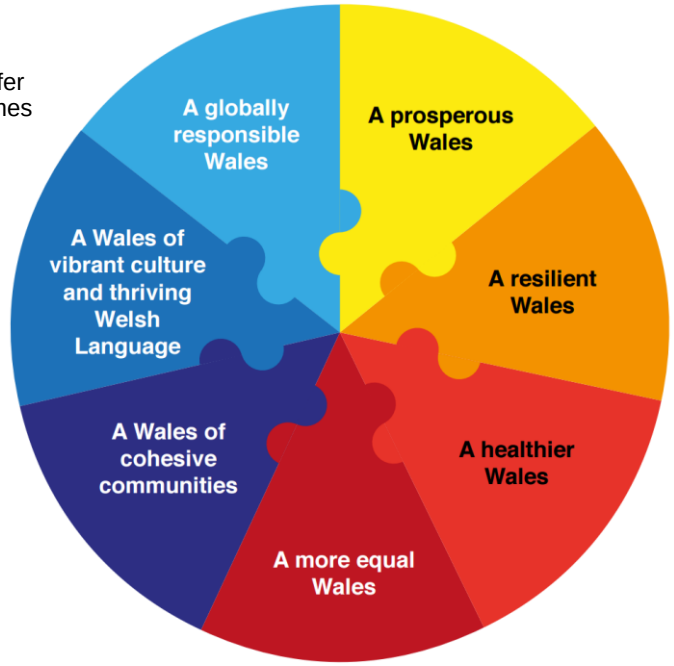


Figure 13: Well-being goals from the Well-being of Future Generations (Wales) Act 2015. © Welsh Government (Welsh Government, 2016c)

1. The Development of Welsh Water 2050

1.4 Approach

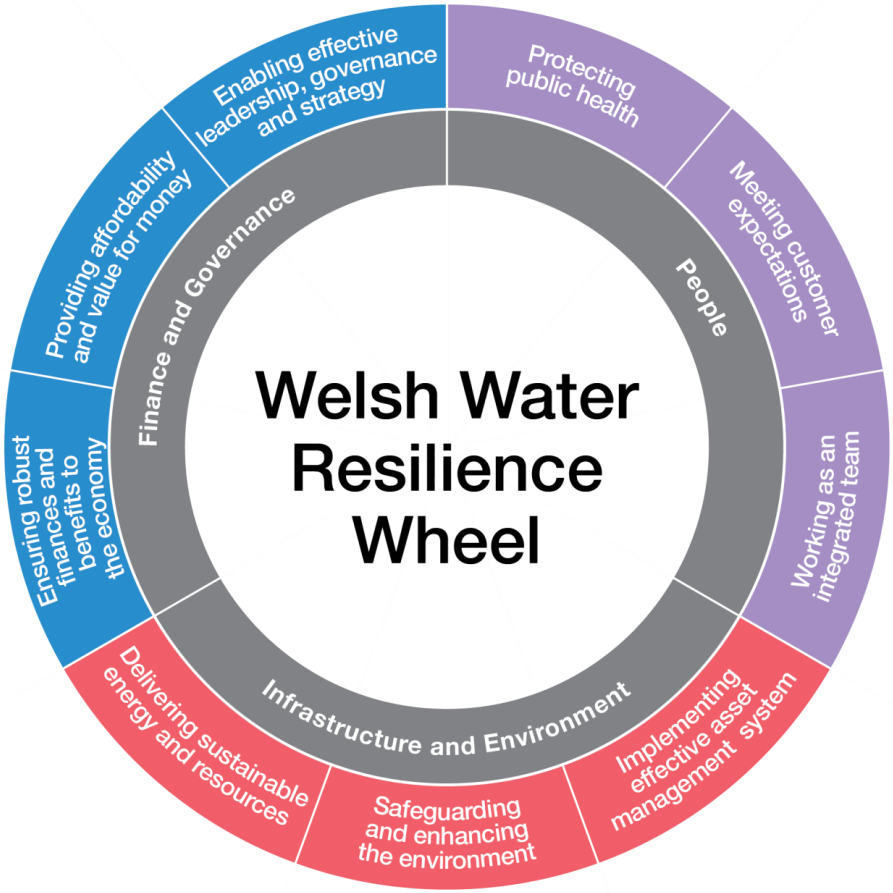


Figure 14: The Welsh Water Resilience Wheel. © Welsh Water

Welsh Water Resilience Wheel

The process used to develop Welsh Water 2050 is based on global resilience best practice set in the context of our operating area, including legislation and the policy of the Welsh Government.

We have worked with Arup, a leading multidisciplinary consultancy, and others to develop a Resilience Wheel and strategy for our business, drawing on best practice from a range of institutions and cities around the globe.

Being resilient to future challenges, both shocks and stresses, is a key part of Welsh Water 2050. However, we also aim to maximise the benefits that can arise from future opportunities within our approach. Resilience in this context must encompass all aspects of our business, including assets, systems, people, finances, governance and consider economic, social, cultural and environmental perspectives. This allows us to be prepared and adaptable when faced with unexpected shocks and stresses.

Resilience is not an end in itself but an essential contributor to our continuing to earn the trust of future generations of customers.

Arup has, on Welsh Water's behalf, undertaken a review of resilience guidance, methodologies, frameworks and strategies. This included the City Resilience Index (developed by Arup with support from the Rockefeller Foundation) and used by the 100 Resilient Cities network including cities such as Vejle, Rotterdam, Bristol and New York to inform the development of their strategies and approaches to resilience. In addition, Welsh Water visited Velje, Denmark in 2016 to meet with the Velje municipality and wastewater Company to understand their approach to providing resilient water supply and wastewater services.

This review led to the development of the Welsh Water Resilience Wheel (see Appendix 1) which provided an independently facilitated assessment of Welsh Water's current resilience and developed recommendations for the improvement of Welsh Water's resilience performance. They have formed the basis of Welsh Water 2050.

We will regularly assess our progress against this Wheel and set ourselves objectives for the highest level of resilience against global standards, in line with our Welsh Water 2050 mission statement.

This Wheel was a pre-cursor to Ofwat's Resilience in the Round, which hadn't been released at the time we were developing our Resilience Wheel. In incorporating best practice from other expertise, we believe our Wheel is aligned with, and goes above and beyond, the Resilience in the Round.

1. The Development of Welsh Water 2050

1.4 Approach

Application of the Welsh Water Resilience Wheel

The Welsh Water Resilience Wheel provides an overview of the elements of Welsh Water that need to be considered in improving resilience. It comprises three dimensions.

People are at the heart of the wheel; ensuring the health and well-being of Welsh Water's customers and colleagues, including during shocks and stresses. Infrastructure and environment explores Welsh Water's role managing man-made infrastructure and working with and protecting the natural environment, which they depend upon, to provide critical services. Finance and governance explores the Welsh Water's governance, accountability and assurance processes to anticipate trends and help avoid, cope with and recover from disruption, as well as their ability to withstand disruption to their finances.

The Welsh Water Resilience Wheel includes nine outcomes that Welsh Water wish to achieve and 40 indicators which detail what areas need to be considered to meet these outcomes. The maturity of Welsh Water's approach to each of these indicators was assessed using a maturity matrix. This identified focus areas to be addressed in Welsh Water 2050. These focus areas are:

- Protecting public health: identified that Welsh Water could improve the reliability of service through reducing the number of customers with a single sources of supply and renewal of ageing water supply pipes, which are leading to frequent bursts. This led to the creation of strategic responses 3 and 4 on reliability. In addition, it identified that there were sometimes water quality issues (relating predominantly to taste and clarity). This led to the creation of strategic response 5 on water quality.
- Meeting customer expectations: identified that Welsh Water's co-creation and customer education could be improved, leading to strategic response 7 on 'Working with customers and communities'. In addition, it was identified that the process for sharing information with customers, particularly during service interruptions, could be improved, leading to strategic response 12, 'Leading-edge customer service'
- Working as an integrated team: identified that Welsh Water attract and retain a strong workforce with low turnover and the majority of our people feel pride in their work. This is potential for improved training and development as well as communication between teams, which led to the development of strategic response 11, 'Employer of choice'.
- Implementing effective asset management systems: identified that there was the opportunity to further improve the resilience of assets as well as adopt smart technologies to improve asset operation to protect and respond to future trends. This led to the creation of strategic responses 4 and 17 on 'Protecting critical water and wastewater assets' and strategic response 13 on 'Smart water system management'.
- Safeguarding and enhancing the environment: identified that there were opportunities to work with the environment to improve Welsh Water's resilience . This includes expanding the use of catchment management to reduce the risks to raw water quality and expanding the use of Rainscape to reduce pollution of rivers and beaches. This led to the development of strategic response 1, 'Safeguarding clean drinking water through catchment management', strategic response 15, 'Using nature to reduce flood risk and pollution', and strategic response 16, 'Cleaner rivers and beaches'.
- Delivering sustainable energy and resources: identified that the resilience of Welsh Water's supply chains and energy provision needed improvement leading to the creation of strategic response 18, 'Promoting a circular economy and combatting climate change'.
- Ensuring robust finances and benefits to the economy: focused on long term financial viability. Costs for Welsh Water 2050 were assessed alongside different scenarios for bills and efficiencies to ensure that Welsh Water are financially resilient in the long-term.
- Providing affordability and value for money: focused on ensuring affordability for all customers including those in vulnerable circumstances as well as providing innovative and inclusive collection methods and providing transparency for customers. This led to the creation of strategic response 12, 'Leading-edge customer service', strategic response 8, 'Ensuring affordability for our customers' and strategic response 9, 'Supporting customers in vulnerable circumstances'.
- Enabling effective leadership and strategy: identified that Welsh Water should develop a long-term strategy that aligns with local, national and international policy and includes collaboration with third parties and innovation. This led to the creation of Welsh Water 2050, a 30-year strategy, which includes alignment of all actions with the Well-being of Future Generations Act and the Environment Act (Wales) as well as highlighting opportunities for collaboration and innovation.

The resilience outcomes that are addressed in Welsh Water 2050 are detailed in Table 3 overleaf.

1. The Development of Welsh Water 2050

1.4 Approach

Application of the Welsh Water Resilience Wheel

Strategic responses	Welsh Water Resilience Wheel outcomes	People			Infrasturucutre and environment			Finance and governance		
		Protecting public health	Meeting customer expectations	Working as an integrated team	Implementing effective asset management systems	Safeguarding and enhancing the environment	Delivering sustainable energy and resources	Ensuring robust finances and benefits to the economy	Providing affordability and value for money	Enabling effective governance and strategy
Drinking Water	1 Safeguarding clean drinking water through catchment management	■		■		■	■			■
	2 Enough water for all	■						■		■
	3 Improving the reliability of drinking water supply systems	■	■		■					
	4 Protecting our critical water supply assets	■			■					■
	5 Achieving acceptable water quality for all customers	■	■							
	6 Towards a lead free Wales	■		■						■
Customers and Communities	7 Working with customers and communities		■	■						■
	8 Ensuring affordability of services delivered to customers		■						■	
	9 Supporting customers in vulnerable circumstances	■	■						■	■
	10 Addressing our ‘worst served’ customers	■	■							
	11 Employer of choice			■				■		
	12 Leading edge customer service		■	■					■	
	13 Smart water system management		■		■			■		
Environment	14 Supporting ecosystems and biodiversity	■				■	■			
	15 Using nature to reduce flood risk and pollution			■		■		■		
	16 Cleaner rivers and beaches	■		■		■				
	17 Protecting our critical wastewater assets	■			■					■
	18 Promoting a circular economy and combatting climate change					■	■	■	■	

Table 3: Alignment of the 18 strategic responses with the nine Welsh Water Resilience Wheel outcomes

1. The Development of Welsh Water 2050

1.4 Approach

Future trends

Whilst we can't accurately predict the future, the world is changing and Wales and England will be affected by a number of future trends. We know that they will create both challenges and opportunities for us between now and 2050. We have identified future trends from a range of sources, including the World Economic Forum Global Risks Report 2017 and work undertaken on horizon scanning by Cardiff University.

These future trends include:

- Demographic change;
- Environmental change;
- Climate change;
- Changes to the structure of the economy;
- Changes to essential infrastructure;
- Policy and regulatory change;
- Change in customer expectations; and
- Protecting public health.

In responding to these trends, we have a key role to play in mitigating the challenges or harnessing the opportunities, for the benefit of our customers.

Strategic response

Water 2050 describes 18 strategic responses to address these future trends. These provide a vision for a sustainable water service in 2050 which can continue to meet our customer promises in a changing and uncertain world.

For each strategic response we have considered a range of possible actions, from research to investment and set out a direction of travel. The direction of travel includes a range of response, which provides flexibility for Welsh Water to adjust their actions based on their effectiveness and the future trends they experience.

We have aligned our 18 strategic responses with relevant legislation and guidance including the goals of the Well-being of Future Generations Act, the Environment (Wales) Act, and drawn on guidance provided by Welsh Government in their Water Strategy for Wales, and from Natural Resources Wales in the State of Natural Resources Report (SoNaRR) (Welsh Government, 2015a; Welsh Government, 2016c; Natural Resources Wales, 2016).

Working with others

New methods of working together, including co-creation between us, our customers, land users (such as agricultural businesses), and other organisations could enable society to deliver its goals more efficiently.

To date, we have partnered effectively with other organisations to achieve benefits for communities. For example, on the Greener Grangetown project, we have partnered with the City of Cardiff Council and Natural Resources Wales to deliver a RainScape solution for managing rainwater and improving the public realm.

For each strategic response, we have identified potential partners that we could align our objectives with, to deliver the solution more effectively or efficiently.

In addition, we will continue to consult with customers in the formulation of our plans and look for opportunities to work with local communities to find holistic solutions to their particular needs.

Figure 15 : A visualisation of the Taff Embankment, Grangetown. Welsh Water are working with the City of Cardiff and Natural Resources Wales, supported by the Landfill Communities Fund, to better manage rainwater in the community. © Arup

1. The Development of Welsh Water 2050

1.5 Innovation

The need for innovation

One of the primary purposes of Welsh Water 2050 is to help us shape and prioritise our long-term science and research agendas, to ensure that the considerable investment that we make is focused on the issues that will matter most to our customers in the long-term.

The rapid pace of technological change holds the prospect of providing services more efficiently and reliably in the future. It is clear that significant efficiencies will be required over the course of the next 30 years if we are to meet the expectations of our customers and mitigate the challenges ahead, whilst keeping bills at an acceptable level. In particular, we will be seeking to become a smart business in all that we do, harnessing new advances in technology, data and science, both through our own research programme and also through the rapid adoption of emerging best practice from other utilities, sectors and countries.

This will be achieved through six main approaches:

- Creating a strategy for innovation;
- Helping to inform decisions through science and research;
- Encouraging research internally;
- Co-creation across the water cycle;
- Creating resilience; and
- Sharing ideas internationally.

Creating a strategy for innovation

In Welsh Water 2050, we have developed key areas for innovation aligned with the 18 strategic responses to address research and knowledge gaps, encourage the trial of near-market technologies and the adoption of new technologies.

We will publish our Innovation Strategy worldwide, and seek ideas globally as to how to progress our priorities. We will update that strategy every five years.

Helping to inform decisions through science and research

We will work with research partners to gather data and apply rigorous evidence to make sure we are making the correct investment decisions on behalf of our customers. This includes research to better quantify the effects of climate change on our water resources, monitor our treatment systems and networks more effectively, investigate resilient localised treatment systems and build an understanding of the effects of emerging contaminants on our ability to provide safe water into the future, amongst many others.

We have developed relationships with well placed research partners, including UK Water Industry Research, Cardiff University Water Research Institute, and the Natural Environment Research Council (NERC) with whom we have a strategic Memorandum of Understanding.

Encouraging innovation internally

A key part of innovation is the fostering of ideas and the development of an environment in which our people are encouraged to innovate and take reasonable risks to test their ideas. One of our company values is to be ‘open to new ideas’.

Continuing to build improved capacity and resilience in our people is key. We support and sponsor qualifications such as MSc’s and other courses through local universities.

Our colleagues can share ideas through our innovation web portal, ‘ilab’ and through our internal innovation forums, both of which encourage colleagues from across Welsh Water to come together to discuss new ideas, technologies and products. Managed by our Heads of Service, they act as a catalyst to bring innovation into the business. Each project considered by the forum must contribute towards meeting the challenges set out in our 2050 Vision. Examples of innovation projects that have been developed by our people are included in Appendix C.

Figure 16 : We will work with our colleagues to bring innovation to every aspect of our business. © Welsh Water.

1. The Development of Welsh Water 2050
1.5 Innovation

Co-creation across the water cycle

Partnership working and third-party collaboration will support the delivery of this strategy. We will engage with key stakeholders, such as Welsh Government, Natural Resources Wales and Local Government, in the co-creation and delivery of the strategic responses and the delivery of our customer promises to 2050.

In order to reap the multiple benefits of many of the strategic responses and contribute to the Well-being Goals from the Well-being of Future Generations (Wales) Act 2015, a co-ordinated approach with our stakeholders will be required. We will participate in partnerships with a range of stakeholders, including Public Service Boards, Green Seas Partnership, the Independent Environmental Advisory Panel (IEAP) and catchment scale partnership groups. We will also work closely with communities to co-create and deliver solutions such as RainScape sustainable drainage systems.

Our partnerships with the Natural Environment Research Council (NERC) and other research councils help us to tackle environmental challenges, as well as gain the data to make decisions for the future.

The WISDOM project has seen us working with international partners to research how new technologies can help us to improve the services we deliver to our customers. Part of the pilot project involved the installation of digital smart meters which measure water usage wirelessly in selected properties in Cardiff.

Welsh Water will continue to encourage their Alliance Partners and their supply chain to pursue innovation through appropriate incentivisation and by developing honest and mutually beneficial partnerships.

Creating resilience

We know that strengthening the resilience of our networks, systems and people is key to achieving our vision. We've been making improvements to our service by using data and analytical modelling to better target our problems. For example, we have invested heavily in data analysis and innovative remediation techniques in the Zonal Studies programme to understand and address the causes of discoloured water in affected communities.

Sharing ideas internationally

We will work with water companies, research bodies and product developers globally to find solutions to our local problems. Past experience has shown us that gaining an international insight helps us to develop the most sustainable solutions. For our award-winning RainScape work we looked around the world, from Malmö, Sweden to Portland, USA to help us develop a sustainable system for reducing sewerage flooding and pollution.

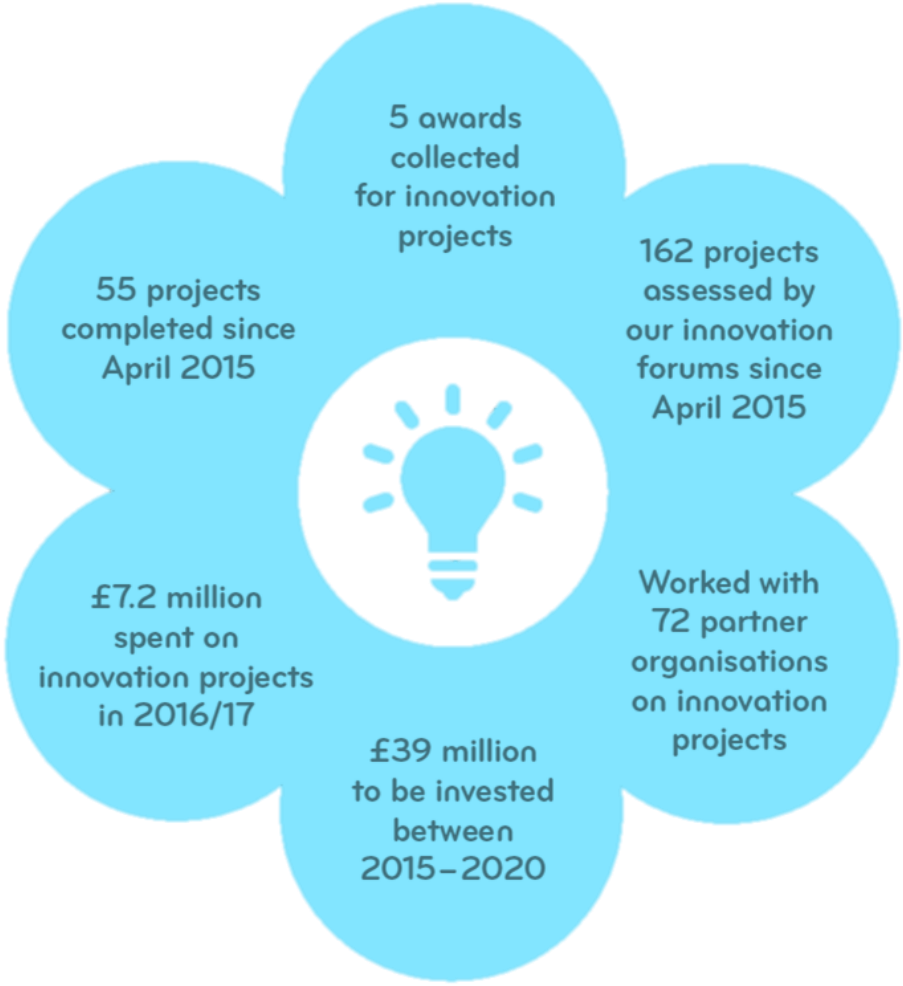


Figure 17 : Innovation at Welsh Water during 2015/16. © Welsh Water

1. The Development of Welsh Water 2050

1.6 Stakeholders' and customers' views

In developing Welsh Water 2050, we have used existing customer research, for example, consultations on the 2014 Price Review, Return of Value research and early engagement for 2019 Price Review.

In addition, in summer 2017, we published Welsh Water 2050 for consultation. We received over 20,000 responses from customers through the Welsh Water website; public events; an online chat bot; an 'online community' panel, and in-depth interviews, all developed and applied in co-operation with our Customer Challenge Group.

Thirteen stakeholders provided their written feedback and we connected with many more at a launch event. These stakeholders included the Consumer Council for Water Wales, Natural Resources Wales, British Trust for Ornithology, Citizens Cymru Wales, Waterwise, Wildlife Trust Wales, RSPB Cymru, Salmon and Trout Conservation UK, The Canal & River Trust, Chartered Institute of Plumbing and Heating Engineering, Brecon Beacons National Park Authority, Arcadis, Campaign for the Protection of Rural Wales.

We have taken on board the input from customers and stakeholders in our updates to this document. Some of the main messages which you shared with us were:

1. Customers and stakeholders are supportive of the development of the long-term strategy by Welsh Water, and are pleased that they were provided with the opportunity to shape these plans.

   "I am really grateful to Welsh Water for actually asking people what they think about ideas- I actually feel as though I have a voice and that it has been listened to." (Female customer, Aged 38, Have Your Say Consultation)

2. Customers and stakeholders felt that Welsh Water had identified the key future trends and supported all of the strategic responses.
3. Stakeholders and customers welcomed the collaborative approach to addressing the future trends Wales will face. Additional examples of these partnerships and collaborations were requested and are included in the updated version of Welsh Water 2050.
4. Customers, the Consumer Council for Water and Citizens Cymru Wales requested that Welsh Water's response to the challenges of poverty, debt and income deficiencies were given equal emphasis as the other strategic responses. In addition, helping people who struggle to pay their bill was seen as important by two-thirds of young people consulted. Two new strategic responses are included in the updated Welsh Water 2050: 'Ensuring affordability for our customers' and 'Supporting customers in vulnerable circumstances'.
5. Our customers told us that safeguarding the natural environment was important. NRW and Wildlife Trusts Wales requested that Welsh Water 2050 include the future trend of the decline in biodiversity across Wales and Welsh Water's biodiversity duty under the Environment (Wales) Act. In the updated Welsh Water 2050, the future trends on environmental change has been strengthen to include the impact of the decline in biodiversity and a new strategic response, 'Supporting ecosystems and biodiversity', has been included.
6. Our customers told us that safeguarding the natural environment was important. Brecon Beacons National Park, Waterwise, the Chartered Institute of Plumbing and Heating Engineers, and the Wildlife Trusts Wales suggest that there should be additional focus in the document on working with customers to reduce demand. A new strategic response entitled 'Working with customers and communities' has been included. This focuses on working with customers to reduce water demand through water efficiency technologies, behavioural change and education.

Figure 18. Some of our younger customers.
© Welsh Water

1. The Development of Welsh Water 2050

1.6 Stakeholders' and customers' views

The feedback from customers and stakeholders has been triangulated to map out which of the strategic responses were seen as a priority. This triangulation is shown in Figure 18.

The strategic responses regarded as a priority by customers and stakeholders included 'Cleaner rivers and beaches', 'Enough water for all' and 'Safeguarding clean drinking water through catchment management'. 'Protecting our critical wastewater assets' and 'Protecting our critical water supply assets' was also seen as key for customers as they are vital to continuation of our service provision. These priority areas are these are shown in group A in Figure 18.

Strategic responses 'Addressing our Worst Served Customers' and 'Towards a lead free Wales' (group B) polarised customers' opinions with some customers strongly supporting the strategic responses (often aligned whether they had experienced poor service) and others prioritising other investment areas.

'Smart water system management', 'Employer of choice', and 'Leading edge customer service' (group C) were given lower priority by customers. Feedback suggests that they were seen as 'business as usual' activities by customers.

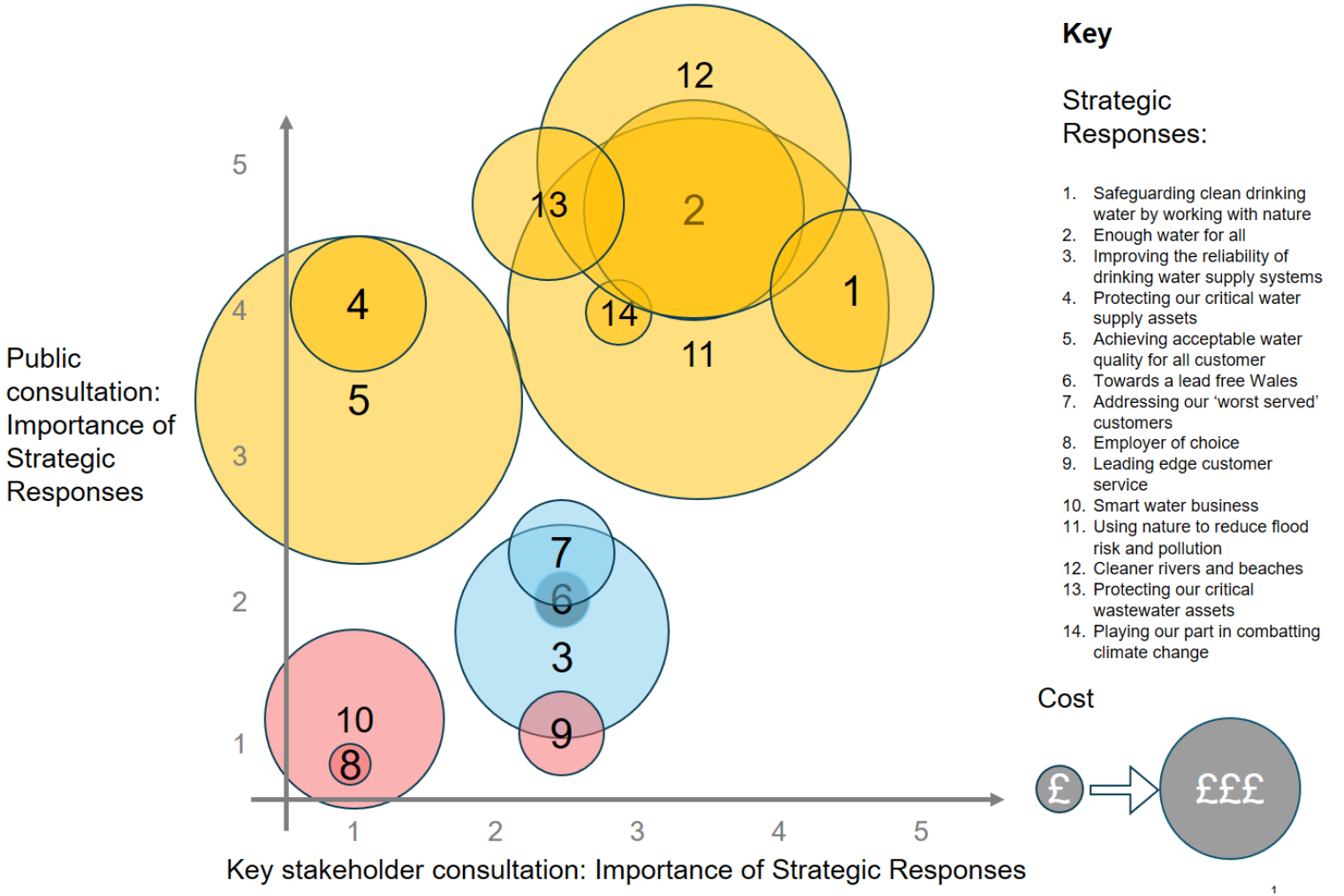


Figure 19: Triangulation of customers and stakeholder feedback of the perceived importance of original 14 strategic responses. The circle size is based on investment amount of the comprehensive scenario in consultation - i.e. the biggest investment proposed. © Welsh Water

2. Future Trends
Challenges and opportunities

Predicting the future is very difficult but there are a number of currently foreseeable future trends. These will impact on the way Welsh Water will operate now and in the future. It is essential that we consider these in our future plans, so that we can continue to meet the service requirements of our customers long into the future.

In Welsh Water 2050, we have focused on eight future trends that are likely to have significant impact on Welsh Water's service provision. These eight future trends are shown in Table 4.

They were identified as important in both the research undertaken by Cardiff University in the report 'First steps towards a resilience strategy for Welsh Water' and Arup's good practice literature review of guidance documents, including the Global Risk Report from the World Economic Forum.

The eight overarching future trends encompass a range of individual challenges from short-term shocks to longer-term stresses and opportunities. We recognise that some of these challenges and opportunities overlap and there are interdependencies between some of them. Our opportunities and challenges are presented in Table 4.

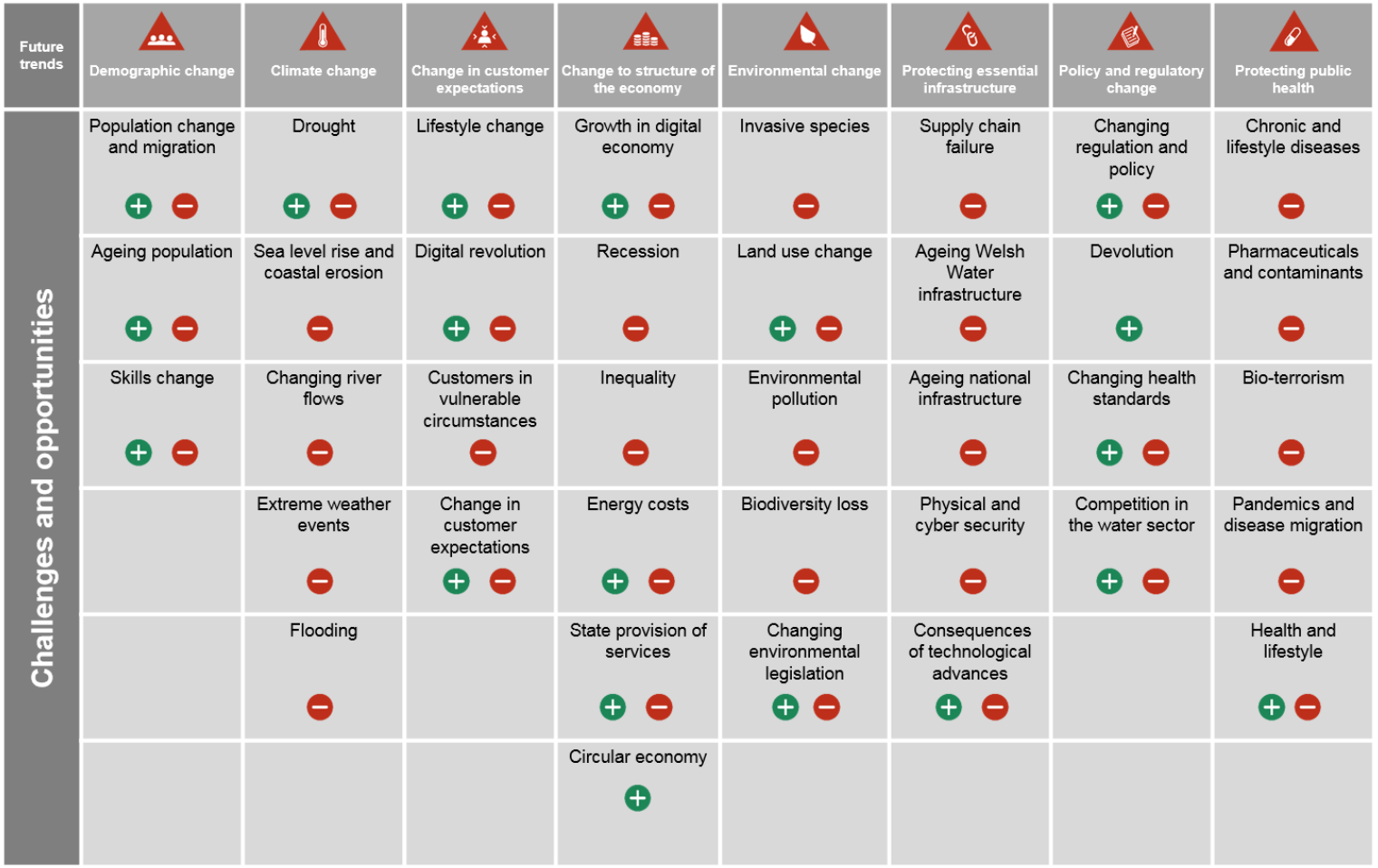


Table 4 : Challenges and opportunities associated with the future trends

2. Future Trends

2.1 Demographic change

Population growth will lead to increased water demand in certain areas and an ageing population may lead to more customers in vulnerable circumstances. However, opportunities may emerge to develop a more diverse age profile in the workforce.

Population change and migration

Demographic change is widely recognised as one of the key drivers of future demand for water and sewerage services.

In Wales, the population is predicted to increase from 3.1 million to 3.28 million between 2014 and 2039. The largest population increases in Welsh Water's supply area, between 2014 and 2039, are predicted for Cardiff (90,000), Swansea (22,000), Herefordshire (20,000), Cheshire (17,000) and Wrexham (13,000), shown in Figure 18, (Office of National Statistics (ONS), 2015). There are projected population shrinkages in other communities, for example, Anglesey, Blaenau Gwent and Powys. This population growth is projected to result in an increase in number of households from 1.35 million in 2016 to 1.49 million by 2036, predominantly consisting of one and two person dwellings. This will increase the demand for water but will also increase our customer base; allowing us to take advantage of economies of scale and meet the needs of our customers more efficiently. In addition, the seasonal variation in population of towns and villages in Wales due to tourism may add additional stresses to our water environment and the services we provide.

Ageing population

In addition, in common with many developed nations, Wales has an ageing population. The number of working-age people is predicted to decrease by 95,000 (5%) between 2014 and 2039, with a corresponding increase in over 65's of 292,000 (44%) (ONS 2015). This trend is expected to result in higher water consumption so could place additional strain on our services.

However, changing life expectancy will enable people to work later in life, maximising the benefit of their skills and experience.

Skills change

This ageing population is likely to lead to the retirement of senior skilled employees. There is a risk that we will lose a large proportion of our most experienced and skilled workforce in the next two decades as our employees reach retirement age. Industry experts have identified a current and potential future skills shortage in the water sector, particularly in instrumentation, control and automation skills (Chartered Institution of Water and Environmental Management (CIWEM), 2016).

Flexible working practices, later retirement, and investment in the development of our people all represent opportunities for maintaining a skilled and diverse workforce into the future (Arup, 2012). New generations of employees will have strong skills in new areas, such as familiarity with digital communication and control.

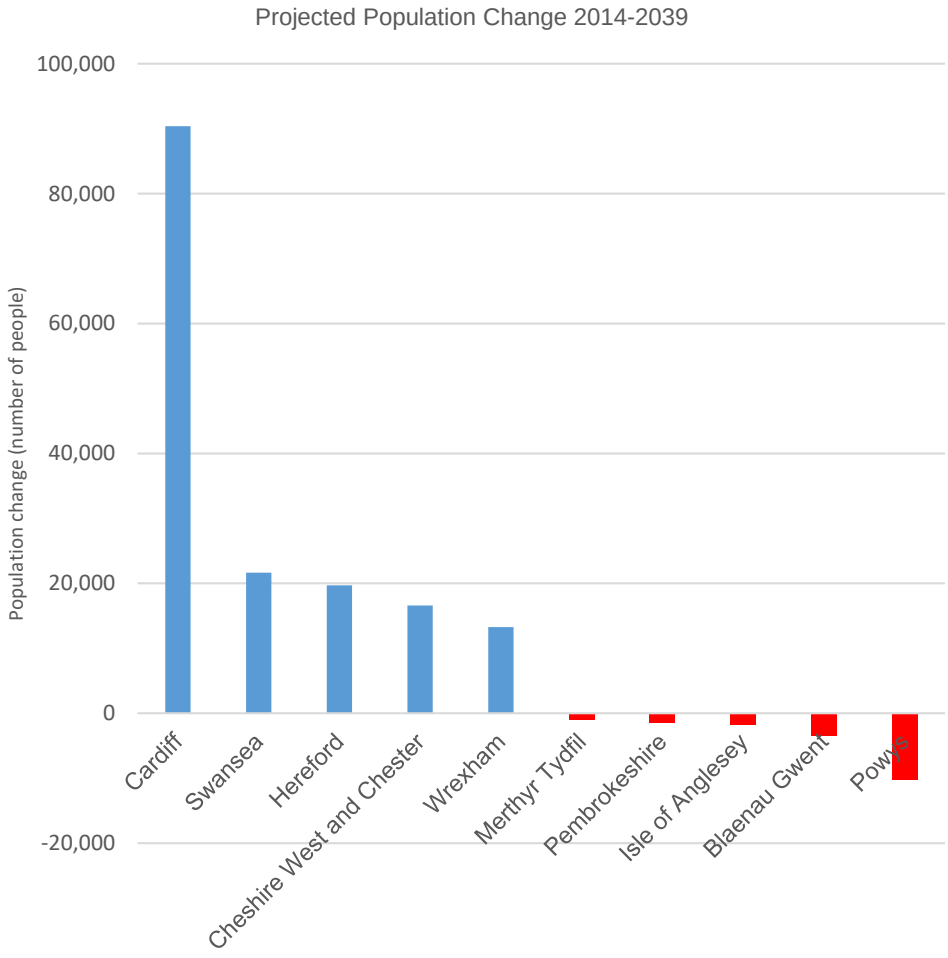


Figure 20: Projected population change in Welsh Water's operating area from 2014-2039 (showing the areas with the five greatest increases in population growth and the five areas with decreasing population growth). © Welsh Water, originally from the Office of National Statistics.

2. Future Trends
2.1 Demographic change

Figure 21 : A boy drinking water. The next generation will have changing expectations of us. © Welsh Water

Impact on our business

1. Clean, safe water for all

Increased water demand: Increasing population size, ageing population, and a reduction in household size, will increase water demand in South Wales and the Wrexham area. With the number of dwellings projected to rise by 140,000 in our supply area over the next ten years, there needs to be a clear strategy for network upgrades and expansions.

Welsh Water has identified two water resource zones that are likely to fall into water deficit between 2020 and 2050 (Welsh Water, 2018). We will address the supply-demand balance challenges in these zones using demand management, water reuse, water metering, leakage reduction, water transfers, catchment management and water resource optimisation.

Reduction in water demand: In some areas of Welsh Water's operating area, for example Blaenau Gwent, there is predicted to be a decrease in population. This results in a risk of oversized water mains and a reduction in water quality in these areas.

2. Safeguard our environment for future generations

Increased combined sewer overflow spills and flooding: On the wastewater side, increasing demand, housing development and urban creep are expected to increase the inflow of rainfall into the system, leading to increased risk of sewer spills and flooding events.

Increased pharmaceuticals in wastewater: With an ageing population, there may be an increase in usage of pharmaceuticals and hence pharmaceutical contaminants in wastewater (Willis, 2010).

3. Personal service that's right for you

Increased diversity of communication: With both an ageing population and increasing availability of social media tools and mobile technologies, customers' preferred means of communication is expected to become more diverse.

4. Fair bills for everyone

Increase in vulnerable customers: As the population ages, Welsh Water is likely to have more vulnerable customers who require social tariffs and other special support.

Increase in income inequality: Existing affordability schemes will need to adapt to remain sustainable in the face of changing demographics.

6. Better future for all our communities

Increased demand for recreation: With a more health conscious and ageing population, there may be more demand for recreation at Welsh Water outdoor activity centres.

2. Future Trends

2.2 Climate change

Climate change will result in more extreme rainfall events, which could lead to an increased risk of flooding and pollution. Drier, hotter summers are projected, which could result in water supply deficits and possibly increased water demand.

Wales context

The 2017 UK Climate Change Risk Assessment identified key risks for Wales as:

- Risks to infrastructure from flooding;
- Risk to public water supplies from drought and low flows;
- Risks from some land management practices exacerbating flood risk; and
- Risks to ecosystems and agriculture from changes in climatic conditions.

Sewer Flooding

Climate change interacts with urban creep and increased housing development to increase the expected incidence of sewer flooding (Mott MacDonald 2011). Most sewerage infrastructure has been designed based on historic hydrologic data. Climate change may make this infrastructure unsuitable for future needs as historic data may become less useful to predict the future (O'Hara and Georgakak).

Riverine Flooding

The risk of riverine flooding is expected to increase in Welsh Water's operating area. This is due to increased frequency, duration or magnitude of precipitation events and peak river flows (Olmstead, 2014, Bridgeman, 2011).

Sea level rise and coastal erosion

Average sea levels around the UK are predicted to rise by up to 76 cm by the end of the 21st century (UKCIP, 2010), and the latest research suggests that the effects could be more severe, when combined with increasingly powerful storms (Hansen et al., 2016). These factors are likely to lead to an increase in coastal erosion, with South Wales highlighted as being particularly vulnerable (Zsamboky et al, 2011). Moreover, when combined with the effects of storm surges, coastal assets could be more at risk of flooding.

Changing river flows

River flows in Welsh Water's operating area are projected to show a slight increase during winter, with reductions in summer flows (Jones et al., 2007; Christierson et al., 2012).

Extreme weather events

Climate change is expected to result in greater incidences of extreme weather events, such as high intensity storms, which impacts water networks and increases pollution incidents. These events could result in damage to structures.

Increased temperature

Increased air, soil and water temperatures will accelerate the release of soil nutrients and dissolved organic carbon into water courses and increase the biological oxygen demand.

Drought

A seasonal change in precipitation is projected, with a 20% decrease in summer precipitation by 2050. Overall, Wales and England are projected to experience hotter, drier summers and milder, wetter winters (Christierson et al., 2012). Ofwat has identified that there can be significant mutual benefits to water trading, for water utilities and customers, but that most interconnections currently exist in the south and east of England. Reduced water resource availability in neighbouring areas and regulatory incentives could create opportunities to trade water across company boundaries in the future. Given that Wales is not expected to suffer from drought to the same extent as other parts of the UK, this could result in opportunities for Welsh Water (Committee on Climate Change, 2017), for water trading with adjacent water utilities.

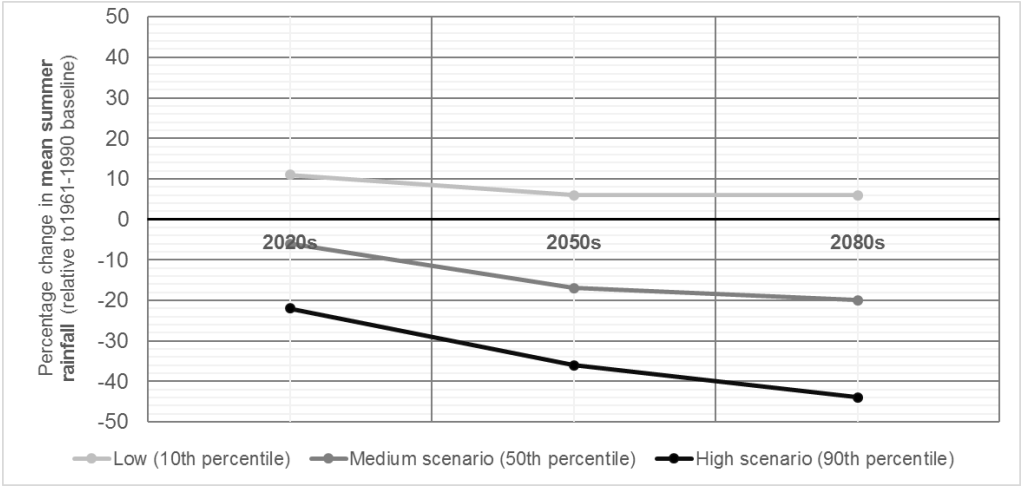


Figure 22 : Percentage change in mean summer precipitation relative to the 1961-1990 baseline. 10th , 50th, and 90th percentiles (DEFRA, 2012).

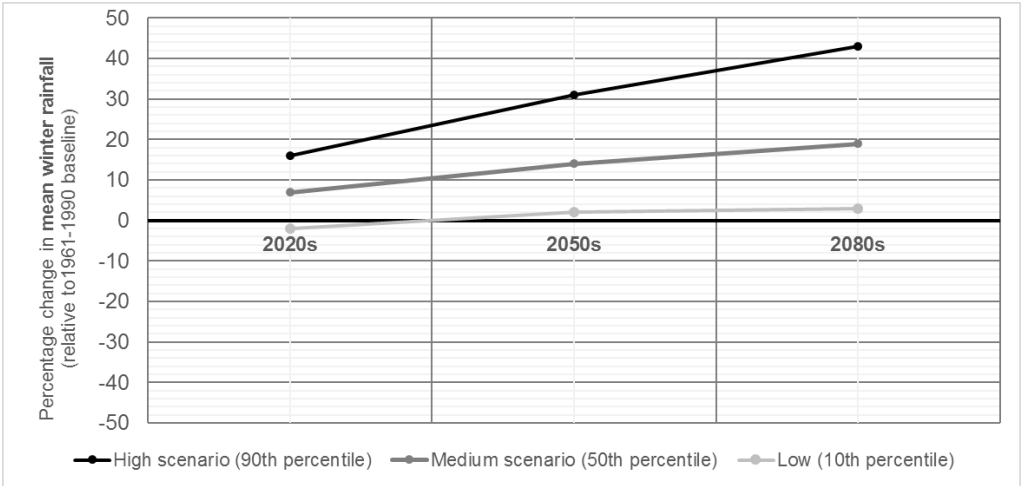


Figure 23 : The projected percentage change in mean winter rainfall relative to the 1961-1990 baseline. 10th, 50th, and 90th percentiles (DEFRA, 2012).

2. Future Trends
2.2 Climate change

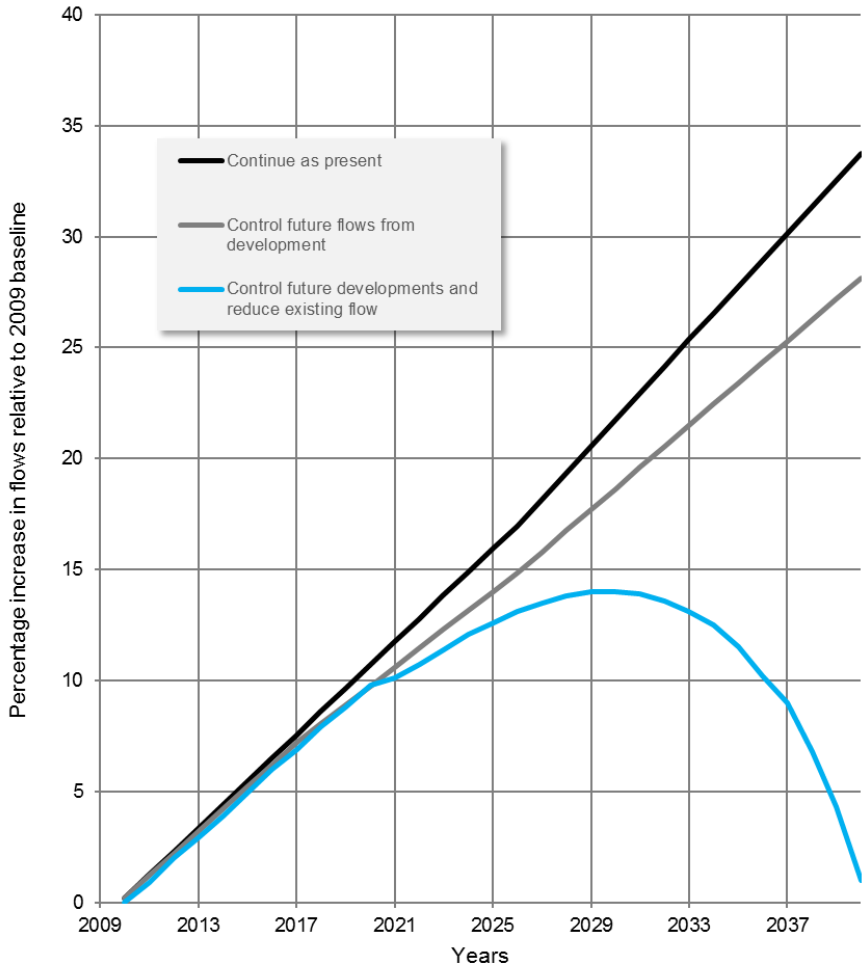


Figure 24 : Change in unit flows in the sewerage system due to climate and demographic change in Welsh Water's operating area, along with the hypothetical impact of interventions (Welsh Water, 2013). Our strategic interventions in this study are designed to help mitigate flow increases in the future.

Impact on our business

1. Clean, safe water for all

Water supply deficit: Drier summers would lead to diminished water supply (Bridgeman, 2011). Welsh Water has identified two water resource zones that are likely to fall into water deficit between 2020 and 2050, due to drier summers (Welsh Water, 2018).

Reduced water quality: Water quality may be impacted by soil erosion and landslips leading to increases in sediment, suspended solids, pesticide and nutrient loadings linked to increased peak precipitation and pollutant mobilisation (Whitehead et al., 2009; Watts et al., 2015).

Hotter drier summers: Reduced average flows could reduce the dilution of pollutants. Higher temperatures may increase the incidence of blue-green algal blooms or outbreaks of infectious diseases (Semenza and Menne, 2009; Verweij et al., 2010). Current water treatment processes may require improvement to treat increased blooms or other forms of contamination.

Increased domestic water demand: Increases in domestic water demand of between 1.5 – 3% are expected, largely related to increased garden watering and increased bathing associated with warmer weather (Downing et al, 2003).

2. Safeguard our environment for future generations

Increased flooding: With a 30% increase in precipitation and more intense rainfall in winter months, there may be higher number of incidents of sewer flooding of properties, increasing call-out and compensation costs, whilst reducing customer satisfaction. There will also be a higher risk of asset flooding, causing service outages and requiring interventions from the reactive operations team (Bridgeman, 2011).

3. Put things right if they go wrong

Increased flood risk to assets: The projected increase in precipitation and higher intensity storms in winter, along with an increased rate of coastal erosion and sea level rise, will increase flood risk to assets. This may lead to a higher number of outages.

Improvements to dams and reservoirs: Increased rainfall will increase the risk of dam overtopping and more frequent droughts will increase the need for flexible operation of dams to conserve limited water resources. Additional investment may be required for improvements, like upsizing spillways and upgrading reservoir pipework and valves.

4. Fair bills for everyone

Water trading: Reduced water resource availability in neighbouring areas could create opportunities to trade water across company boundaries, to the mutual benefit of customers.

2. Future Trends

2.3 Change in customer expectations

Customer expectations are likely to change dramatically, with a desire for a more personalised service, control over their use of services and less tolerance of service outages. This will particularly be the case for business customers.

Given current trends and the pace of change, it is hard to predict how customers' expectations will change by 2050. New technology, particularly in terms of data, automation and remote operation, will transform homes and communities over the next 30 years. This, along with closer integration of the provision of essential services, is expected to lead to the development of 'smart' homes and cities, presenting challenges and opportunities to our business operations.

Customers are likely to expect much greater access to information, more control over their choice of services, a greater emphasis on having a positive impact on the environment through their decisions and actions.

Lifestyle change

As the population ages, domestic consumption is likely to increase as people spend more time at home (Fox et al., 2009; Schleich and Hillenbrand, 2009). The use of water-intensive appliances, such as dishwashers, is likely to continue to increase (Drysdale et al., 2015), compounded by the trend towards living in single households and associated greater appliance ownership (Menon et al. 2010; Borg et al. 2011). Moreover, there is a trend towards more frequent showering associated with more active lifestyles, which could intensify with temperature rise associated with climate change (Downing et al., 2003). Water is viewed as an essential commodity, as opposed to a scarce resource, and thus efforts to limit consumption could be met with strong resistance from the customer base of the future (Jorgensen et al., 2009; Chappells et al., 2011).

The Natural Resources Wales Outdoor Recreation Survey highlights that 60% of Welsh people would like to do more outdoor recreation (Natural Resources Wales, 2014). Welsh Water may have a greater role to play in providing recreation opportunities for its customers, for example, providing appropriate access to sites, visitors centres, and watersports centres at some reservoirs.

Digital revolution

The rate of economic and technical change is expected to increase (Institute of Customer Service, 2016). In particular, the increasing speed of microprocessors (Peldszus, 2017), growth of the artificial intelligence analytics market (Brown, 2015) and the roll-out of smart utility metering to more households across Welsh Water's operating area (Carboni et al., 2016) will have a profound impact on the way we work as a business and communicate with our customers and other stakeholders.

Customers will expect more personalised, instant engagement and will expect us to automatically tailor our services to meet their needs. They may also expect our systems to interact automatically with smart devices in their homes, including smart meters and mobile devices – the internet of things.

In the event of service incidents, such as reductions in water quality or sewage flooding, customers will expect on-going and proactive communications through multiple modes, including social media and mobile platforms (Summary of PR19 Phase 1 Research, 2016).

Figure 25 : A customer engagement event. Meeting the needs of the next generation of our customers is crucial. © Welsh Water

2. Future Trends

2.3 Change in customer expectations

Big data analytics will enable us to build a much more accurate picture of our customers' needs and wants in the future, enabling us to proactively offer them personalised services, without relying on traditional methods of public engagement. Future generations may be willing to share personal data but are likely to be increasingly concerned with the threat of cybersecurity, and want assurances that their data will be kept secure (Institute of Customer Service, 2016). In addition, new General Data Protection Regulations, which will come into force in 2018, require organisations to strengthen and unify data protection for individuals.

Advances in banking technology, and the growth of non-traditional quasi-banking services (including PayPal, Monzo and Revolut) could lead to the introduction of instant billing and rebate systems. Customers may come to expect shorter billing periods, or instantaneous billing, based on data produced by smart metering system.

Customer segmentation

Customer segmentation, differentiating between customers such as businesses and vulnerable customers, may be more important to provide a good service. The increase in data collection and knowledge about our customers may enable this.

Business customers

Business customers have increasing expectations for the service they receive, including better usage data, water efficiency support and more flexible and user-friendly billing.

Over time, business customers may expect to see a closer integration between their use of water services and other essential utility services. For some businesses, their use of water services will also become an important part of their wider environmental responsibility agenda.

Given the introduction of competitive retail services for all non-household customers in England in April 2017, it will be important that all business customers in Wales perceive that they are also benefitting from the new products, and improved customer service and value for money that are expected to result.

Vulnerable customers

In Wales, the number of people aged 16 – 64 is predicted to decrease by 5% between 2014 and 2039, whilst the number of over 65s is expected to increase by 44% (Welsh Government, 2015b). A proportion of these older customers are likely to be vulnerable, have limited mobility, or experience issues with affordability. Moreover, future working age generations are also expected to face greater affordability challenges due to intergenerational wealth inequality (Institute of Customer Service, 2016). There is likely to be a significant gulf between those of working age, who will be highly technologically aware and expect multiple modes of communication, and older generations, some of whom may lack this technology or an awareness of it.

Customer expectations and loyalty

Loyalty towards collective institutions (such as Welsh Water) is likely to fall amongst customers of the future. Individuals may become more informed and critical of our performance, and their trust is likely to be highly conditional on whether their needs are being met. They may expect a very high level of transparency, individually-tailored methods of engaging with us over a wide range of platforms, and for us to automatically offer a personalised service that meets their specific needs (Institute of Customer Service, 2016).

Customers are increasingly intolerant of temporary water quality issues and sewage flooding incidents, and are likely to view Welsh Water as responsible for such incidents (Summary of PR19 Phase 1 Research, 2016).

Reliability and ease of use of technology in other digital sectors will raise expectations for our service and reduce tolerance of any service interruptions (Institute of Customer Service, 2016).

Figure 26 : Engaging our customers as part of behavioural change campaign © Welsh Water

2. Future Trends
2.3 Change in customer expectations

Figure 27 : Online and mobile payment systems are experiencing rapid advances.
© Welsh Water

Impact on our business

1. Clean, safe water for all

Increased water demand: Increased demand due to changing lifestyles and a reluctance to limit consumption amongst the future customer base could limit its affordability and the ability of Welsh Water to continue to provide safe, clean water for all.

2. Safeguard our environment for future generations

Environmental consciousness: There is an increased awareness of environmental and climate change amongst customers, who may increasingly expect us to protect the environment.

3. Put things right if they go wrong

Intolerance of failure: Our customer base is likely to become increasingly intolerant of failure in the future, and this, combined with the expectation of a new personalised relationship with customers could make it more difficult to put things right if they go wrong. However, increased remote sensing and data analysis will make it possible to be more proactive and anticipate problems before they happen.

4. Personal service that's right for you

Responding to diversity in expectations: With a larger amount of customer data and segmentation available, Welsh Water have the opportunity to provide a more personalised service. Differing levels of access and ability to use technology may make providing a personalised service to all more challenging.

Business customers: Expectations of customer service, added value services and value for money will develop in light of the new business retail market in England.

5. Fair bills for everyone

Vulnerable customers: Intergenerational wealth inequality and a growth in the number of vulnerable customers could make it more difficult for Welsh Water to provide fair bills for all.

6. A better future for all our communities

Trust in institutions: Trust in large companies, organisations and politics have all taken a significant hit in the last couple of years (Edelman Trust Barometer, Edelman, 2017), and retaining customer trust will require high levels of customer service, environmental performance and demonstration of good business ethics.

Recreation opportunities: As the retired population increases and with increased health awareness in the general population, there may be an increased desire for recreation opportunities at Welsh Water sites.

Biodiversity and nature: Our customers will expect us to enhance the environment through our activities. This aligns with the Environment (Wales) Act 2016.

2. Future Trends

2.4 Changes to the structure of the economy

The growth of the digital, knowledge-based economy will create opportunities to provide services in efficient ways. However, it could present a challenge to continuing to meet the needs and expectations of our customers.

Changes to the Welsh economy

In the near future, Welsh Water's operating area may see a continued contraction in the primary and secondary sectors (extraction of raw materials and manufacturing) reducing total water demand (Yu et al., 2010). There is likely to be an increase in service industries and tourism, which are focused on rural and coastal regions, and may put pressure on local water supply and wastewater services (Deloitte, 2013).

Growth in the digital economy

Many have observed that the Fourth Industrial Revolution is coming, in the form of a cyber-physical revolution (World Economic Forum, 2017). 45% of activities that workers undertake today could theoretically be automated (Chui et al, 2015). Automated systems are increasingly likely to replace people in the workforce and will be as universal in 2045 as computers are today (World Economic Forum, 2017), putting low income jobs at particular risk and causing a likely increase in the number of vulnerable customers (Ministry of Defence, 2014) but creating new jobs in instrumentation, automation and control, growing the knowledge economy.

Automation will likely improve system efficiency and reduce operation costs. Artificial intelligence and machine learning will enable computers to self-learn and make intelligent decisions with minimal operational human oversight (World Economic Forum, 2017). Training will be needed to help our colleagues to work alongside automated systems. Automation may also increase the amount of leisure time available for colleagues and customers (Ministry of Defence, 2014).

The 'Internet of Things' and smart metering can also offer opportunities to improve our services in partnership with customers. There are opportunities if these are designed in a way which helps customers manage their water use in their own homes.

Recession

Recession and growth are cyclical and Wales is likely to experience periods of recession in the period to 2050. Periods of recession are likely to reduce demand for water by households, industry and agriculture (Duarte et al., 2014) and lead to increased hardship for customers.

Inequality

Rising income and wealth disparity was noted by the World Economic Forum as one of the major global risks in 2017. Since the 1980s, the share of income going to the top 1% in the UK has increased (World Economic Forum, 2017).

Wealth and income disparity is driven in part by unemployment and under-employment which often rises in periods of recession. This may increase the numbers of vulnerable customers and give Welsh Water challenges in collecting revenue. Wales saw unemployment rise from 5.7%, in 2008, to 8.1%, in 2009 and stay above 8% until 2013, due to the global recession. This impacted some areas more severely, with Blaenau Gwent experiencing unemployment over 16% (Welsh Government, 2016a).

Moreover, median hourly earnings in Wales are over £2 less than the average for Britain (Joseph Rowntree Foundation, 2016). Therefore, water customers in Wales spend a higher proportion of their income on water bills than in England, whilst 'water debt' is becoming an increasing concern in both countries (Ofwat, 2015).

Wales also experienced a 21% increase in under-employment between 2010 and 2014 (Trade Unions Congress, 2014). This inequality can impact on customers' health and well-being, which contributes to the stresses described in the Protecting Public Health section.

Energy costs

Some estimates suggest that global energy demand is set to grow by around 37% by 2040 (Anglian Water *et al.,* 2015), putting upward pressures on prices. When combined with geopolitical uncertainties in the oil and gas markets, the expectation is that there is likely to be considerable volatility in the market for energy in the future, with electricity potentially becoming more expensive and less secure up to 2050.

Higher energy costs could also create an opportunity for renewable energy to become more affordable relative to traditional sources, and support the move away from carbon-intensive generation methods. The business case for resilient self-generation could also become more attractive.

State provision of services

In the future, we may take on a larger role in the provision of services as required by government through, for example, the adoption of surface water drainage. This could give us greater control over maintenance and operational expenditure, allowing us to tackle problems more effectively and give us greater opportunities to provide multiple benefits for customers.

Changes, like an ageing population increasing the social care bill and decreasing the tax base, may undermine the state's ability to provide critical services in the future (Ministry of Defence, 2014). Moreover, the trend towards lower public spending as a proportion of GDP in the UK (OECD, 2017) could increase the proportion of vulnerable customers in our service area. Both of these factors could increase the number of customers reliant on our social tariffs.

2. Future Trends
2.4 Changes to the structure of the economy

Circular economy

The circular economy is one which aims to decouple economic growth from finite resource consumption, keeping resources and components at their highest utility and value at all times (Ellen MacArthur Foundation, 2017). There are circular economy applications across the water cycle which could provide business opportunities for Welsh Water. Circular economy opportunities include renewable energy options such as hydroelectric dams, solar PV, microhydro and anaerobic digestion at treatment plants. In addition, there is also the potential for heat recovery from sewage, grey water recycling and aquaculture, and biorefining sewage sludge into bio-polymers for the plastics and chemical industries (Arup, 2016). Regulatory changes and the removal of barriers to trading could promote sludge as a valued resource, for power generation and the production of fertilisers, through anaerobic digestion (Ofwat, 2015).

Impact on our business

1. Safe, clean water for all

Change in demand: A reduction in the primary and manufacturing sectors is expected to reduce total industry demand. However, economic change could result in an increase in demand amongst particular industrial customers or at particular locations, impacting on Welsh Water's ability to deliver safe, clean water.

Increased Tourism: The predicted increase in tourism will result in the food, drink and hotel sector putting more pressure on rural and coastal sewage and water supplies (Downing et al., 2003).

2. Safeguard our environment for future generations

Pollution events and abstraction: An increase in seasonal variation for water demand due to tourism in rural areas may result in increased abstractions and put increased pressure on local sewage treatment works.

5. Fair bills for everyone

Recession: A future recession could increase inequality and unemployment, increasing the number of vulnerable customers who struggle to pay, increasing the need for affordability for customers.

Inequality: Rising income and wealth disparity may challenge perceptions of fairness.

Increased energy costs: Welsh Water's Business Plan 2015-2020 (Welsh Water, 2014a) notes that whilst future power prices remain uncertain, there is a likelihood that they will rise relative to inflation over time. For Welsh Water, uncertainty over future energy costs can be mitigated by increasing the proportion of renewable, self-generation of energy.

Circular economy: Creating value from current 'waste' products should increase the value of our service. An increase in renewable energy production may protect the business to some extent from rising energy costs.

Growth in the digital economy: Automation and digitalisation will provide efficiency for Welsh Water in service provision. Improvements in collecting, analysing and communicating data provide opportunities for better knowledge and planning.

The increased used of digital services will also mean that there is more risk to services from cyber threat, and resource scarcity. Welsh Water will need to plan, implement and regularly update cyber security.

6. A better future for all our communities

Growth in the digital economy: There is the potential for a growth in the knowledge-based economy. More leisure time would provide people with more time to spend on community projects and more demand for recreational opportunities at Welsh Water sites.

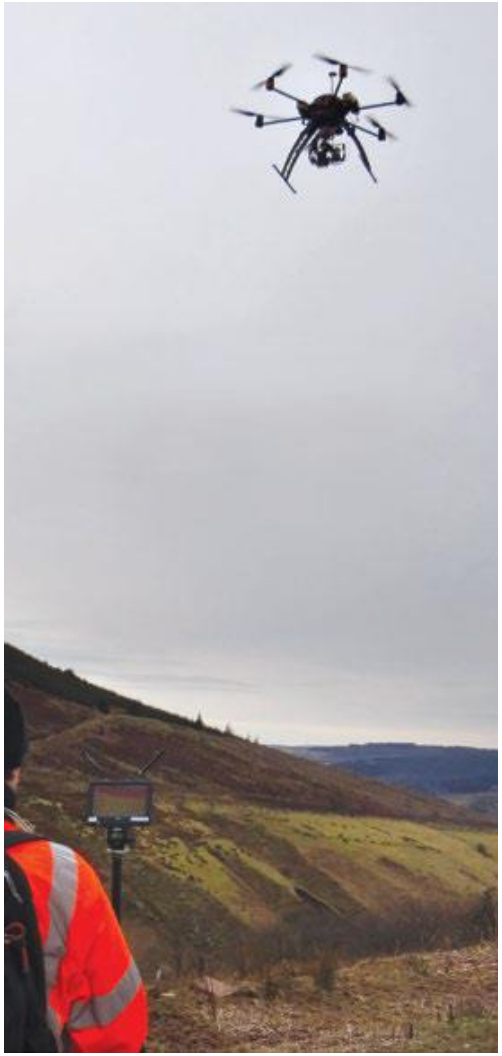


Figure 28 : Use of remote and automated systems such as drones and automated valves will provide efficiency in service provision. ©.Welsh Water.

2. Future Trends

2.5 Environmental change

Invasive species, land use change and an increased risk of environmental pollution may lead to a reduction in water quality and diversity. However, co-operative approaches for the delivery of enhanced ecosystems services could lead to better environmental outcomes.

Land use change

80% of the land in Wales is used for agriculture. Future changes in agriculture are difficult to predict, but most future scenarios predict a decrease in land use by agriculture, greater intensification and a potential shift from livestock to arable due to warmer climatic conditions. Intensification of agriculture and the shift to arable farming are predicted to increase the use of pesticides and fertilisers which could result in a higher concentrations of pesticides and fertilisers in raw water. Land management practices like stock management can also impact nutrients in raw water. Impacts of commercial forestry, including tree felling, may also impact water quality and the wider environment. Land use change, and increased extreme rainfall patterns, have been linked to increasing dissolved organic carbon in raw water, requiring increase chlorine use for disinfection and associated increase in potentially harmful disinfection by-products (Gough 2014).

Expected population increases may lead to urban creep, which will intensify peak runoff volumes. This is likely to increase flood risk downstream and have a detrimental impact on the water quality of receiving waterbodies.

Co-operative working between Welsh Water, Natural Resources Wales, and land users (particularly agricultural) could encourage positive changes to land use, for example through payment for ecosystem services approaches and catchment management partnerships. Such approaches are strongly encouraged by Welsh Government policy including the Water Strategy for Wales and SoNaRR (2016).

Environmental pollution

Population and climatic changes may result in an increase in water pollution incidents.

There are emerging contaminants such as human pharmaceuticals and hormones, veterinary medicines, nanomaterials, personal care products and recreational drugs in wastewater due to an ageing population, increasing cleanliness, lifestyle choices and use of pharmaceuticals. Urban wastewater is a key pathway for emerging contaminants to enter watercourses and the water supply system. For example, the synthetic estrogenic hormone EE2 has been linked to the presence of intersex fish in UK rivers (Harris et al. 2011).

Invasive species

Invasive alien species have the potential to have a significant impact on Welsh Water's assets. These species currently include the Zebra Mussel and Asian Clam, which have spread to Wales and are responsible for significant bio-fouling, blocking pipes in water treatment facilities, and an increased risk of cyanobacteria blooms and therefore a decrease in raw water quality. These species are estimated to have cost the electrical and water treatment industries in the US up to $467 million between 1989 and 2004 (Connelly et al. 2007).

Biodiversity loss

Across the world, the rate at which species are becoming extinct is estimated to be 1,000 to 10,000 times higher than the natural rate.

Biodiversity faces threats including habitat loss, fragmentation and over-exploitation. In the longer term, temperature and changed rainfall patterns will also impact biodiversity. We will look for ways to help nature, enhance biodiversity and promote ecosystem resilience while we carry out our water and sewerage activities.

The State of Nature Report (2016) highlighted some significant trends for wildlife in Britain. 53% of freshwater and wetland species have suffered declines over the long term and 13% of freshwater and wetland species are threatened with extinction.

The Natural Resources Wales (NRW) State of Natural Resources Report (SoNaRR) also highlighted how "it is unlikely that ecosystems currently have sufficient resilience and this will impact on their capacity to provide services and benefits into the future".

Welsh Water has a duty under the Environment (Wales) Act (2016) to enhance biodiversity and promote the resilience of ecosystems in the exercise of our functions. We've recently launched our plan for maintaining and enhancing biodiversity in Wales, which outlines our commitments and the plans we'll implement to achieve these.

Changing environmental regulation and government policy

As the UK exits the European Union, there is uncertainty about this changing regulatory and policy area, and the resulting impact on the wider environment. There is an opportunity to shape environmental legislation and regulatory practice to protect and enhance the unique environment of Welsh Water's operating area in new and more efficient ways. This could become more onerous, or could include more flexible regulation methods that are aligned with the principles of the Water Framework Directive, such as the General Binding Rules on land use practice or seasonal consenting for discharges.

2. Future Trends
2.5 Environmental change

Impact on our business

1. Safe, clean water for all

Increase in water contaminants: The increasing use of pesticides and fertilisers in agriculture, the increased presence of emerging contaminants in watercourses and the potential increase in risk of cyanobacteria blooms will have a detrimental impact on raw water quality reaching water treatment works and may require more complex and expensive treatment.

2. Safeguard our environment for future generations

Reduction in water quality: An increase in urban run off due to population growth and urban creep may increase flood risk and have a detrimental impact on the water quality of receiving waterbodies. Lower river flows, due to climatic changes, reduce the dilution of pesticides in watercourses increasing the risk of environmental damage. Changes in temperatures of air, soil and water can also impact water quality through changing precipitation, evaporation and hydrology.

The increase in the number of emerging contaminants in wastewater impacts negatively on aquatic species.

3. Put things right if they go wrong

Reduction in raw water quality: The increased risk of poor raw water quality due to pesticides, invasive species and emerging contaminants may result in water sources being unusable and a reduction in the resilience of water supply. This could lead to outages for Welsh Water customers.

5. Fair bills for everyone

Complex water and wastewater treatment: The increased risk of poor raw water quality due to pesticides, invasive species and emerging contaminants and tighter environmental standards for wastewater discharges may result in a requirement for more complex and expensive water and wastewater treatment processes, which could ultimately lead to a rise in customer bills.

6. A better future for all our communities

Wider environmental benefits: With increased public interest in and better regulatory drivers to protect the natural environment, Welsh Water will have the opportunity to work in partnership with public bodies, other sectors such as agriculture, and the local community to deliver the wider environmental benefits more efficiently, for example, encouragement of biodiversity. The protection of areas like bogs and woodlands is also important as they act as carbon sinks and their destruction could exacerbate climate change.

Growing environmental awareness: There are opportunities to undertake more educational initiatives which encourage healthier and more sustainable lifestyles.

Figure 29 : Sheep farming in the Welsh hills. By tekaybe, Creative Commons License (CC BY 2.0)

2. Future Trends

2.6 Protecting essential infrastructure

Ageing infrastructure, a limited supply chain and cyber security are key concerns for future service provision; but technological advances could lead to significant efficiencies in the planning, delivery and operation of new assets.

Supply chain failure

Welsh Water is reliant on global supply chains, which for some materials and products means we use limited suppliers. Chlorine and phosphates are two examples of chemicals we use which are critical to the business and are of limited supply. Chlorine used in water treatment and distribution is provided by only one supplier in the UK, with an alternative supplier in France. Phosphates are used in water treatment, and there are limited global sources in Turkey and in Mexico.

Ageing water infrastructure

The legacy of industrialisation and urbanisation in parts of Wales led to rapid construction of water supply and sewerage infrastructure in the late 19th and early 20th century. A growing number of physical assets constructed during this period are expected to reach or exceed their design life within the next 30 years. This may result in significantly reduced performance or failure. Therefore, there may be significant pressure on Welsh Water to repair or replace these assets at an increasing rate.

Ageing national infrastructure

Much of the UK's infrastructure, including roads and power distribution systems, is expected to experience more frequent failures due to the age of the infrastructure, and changing weather patterns (IET, 2016).

Physical and cyber security

We will need to continue to maker sure our key assets are secure and protected from physical threats, such as terrorism.

The increasing reliance on digital technology exposes the UK water industry to cyber threats, both for water and sewage networks and customer management systems, such as customer billing information and customer facing information.

Consequences of technological advances

Technological advances may result in increased automation of systems and operator input. This may reduce operational costs (MOD, 2014).

An increased use of remote monitoring, analysis of 'big data' and automated operation should enable a far more proactive service in the future – with greater efficiency and improved service reliability. However, a greater reliance on technology and interconnected control systems for the operation and control of our assets could increase the number of ways assets can fail, and reduce redundancy in our systems. Moreover, increased complexity will require people with specialist skills for maintenance and operation, and there is a risk that only a small number of our colleagues possess these skills, or that we could be reliant on a single or small number of external agencies for certain services. It is also possible that automated systems will replace some human roles in the future, leading to a loss of skills and demotivation of the workforce (World Economic Forum, 2017).

Figure 30 : Investigating ageing assets. © Arup.

2. Future Trends
2.6 Protecting essential infrastructure

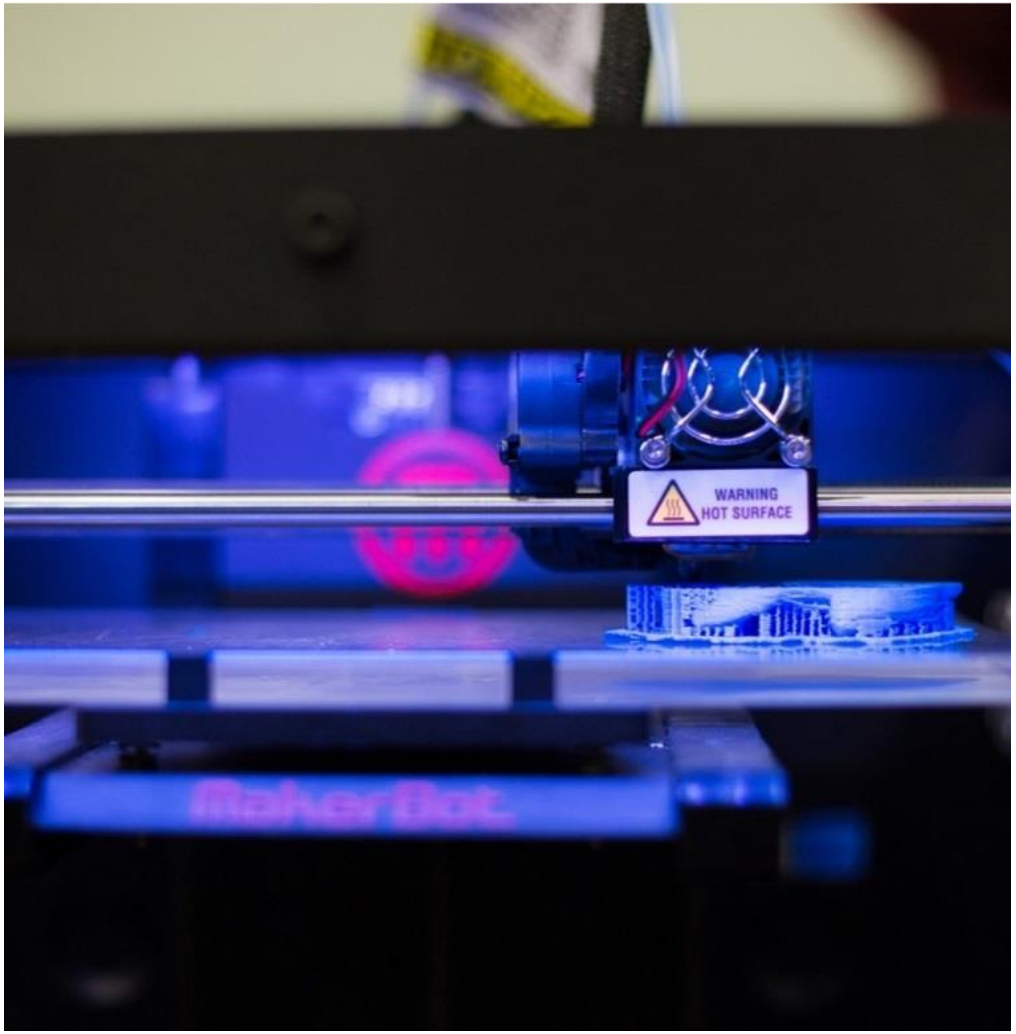


Figure 31 : A 3D printer. 3D printing has the potential to transform the manufacture of components in the future. By The UC San Diego Library. Creative Commons License (CC-BY-2.0)

Impact on our business

1. Clean, safe water for all

Ageing Welsh Water infrastructure: With a large proportion of Welsh Water's assets reaching or surpassing their design life, there is a greater risk of asset failure resulting in an increased number of interruptions to water supply.

Resource scarcity: Energy and chemicals are required for the creation of potable water. Future scarcity in resources and global supply chain issues could increase difficulties in obtaining these and drive price increases.

2. Safeguard our environment for future generations

Ageing Welsh Water infrastructure: With a large proportion of Welsh Water's assets reaching or surpassing their design life, there is a greater risk of asset failure resulting in more spills from combined sewer overflows or pollution incidents.

3. Put things right if they go wrong

Ageing Welsh Water infrastructure: With a large proportion of Welsh Water's assets reaching or surpassing their design life, there is a greater risk of asset failure resulting in an increased number of interruptions to water supply or sewerage services.

Poor reliability of interdependent external infrastructure: Reliance on ageing infrastructure from other utilities (for example, energy and transport), may affect the reliability of Welsh Water's services.

Technological advances: Increased data collection and analysis of the network will highlight network problems sooner, avoiding outages and improving operational efficiency.

5. Fair bills for everyone

Improved capital efficiency investment: New construction materials and techniques, for example, offsite preparation and 3D printing will improve capital investment efficiency. In addition, improved sensing and data analysis will enable Welsh Water to target our investment better.

Aging infrastructure: There will be a need for increased maintenance and replacement rates for essential infrastructure assets (for example, dams). This could put upward pressure on bills.

2. Future Trends

2.7 Policy and regulatory change

Changes in policy and regulatory methods are expected due to the UK leaving the European Union, devolution and changing quality standards; this creates uncertainty, but provides the opportunity for us to help shape future policy. Improved regulatory methods and innovative policy developments could lead to more efficient delivery of services to our customers.

Changing regulation and policy

The environmental and water quality regulatory regimes in which Welsh Water operates are likely to remain the same until 2020, after which regulation may change due the departure of the UK from the European Union (EU). Future regulation and policy after 2020 remains decidedly uncertain.

Industry observers have identified a number of areas of uncertainty regarding the regulatory landscape in the post-European Union era: the future strategic direction of the water sector; possible changes to directives shaping water and environmental policy and regulation; potential effects on regulation and enforcements; pressure for deregulation to ease industry burdens applied to the water sector; the potential for EU directives to be maintained; and delay in implementing new legislation to enable future planned reforms (Grady and McRobb, 2016; MacNee, 2016; Oxera, 2016; Shepard and Wedderburn, 2016).

Overall, it is anticipated that new policy and regulation will put upward pressure on water bills in the future, up to 28% in real terms by 2050 for the worst case combination of scenarios (DEFRA, 2015).

In January 2018, the UK Government's 25 year Environment Plan was launched. It presents intended changes to UK agriculture and land management following the departure from the EU. The plan outlines an intention to move away from the current EU Common Agricultural Policy to a system promoting a natural capital approach, to use public money to deliver public goods.

There is an opportunity to shape water and environmental legislation to protect the unique environment of Welsh Water's operating area. This could include more flexible regulation methods, that are aligned with the Water Framework Directive, such as the use of General Binding Rules or seasonal consenting for discharges.

Devolution

Devolution from the UK to Wales is also a live issue following the introduction of the Wales Act in January 2017. The Act confers additional powers to Wales on water and sewage services, aligning the boundary for legislative competence for water with the Welsh border. In the immediate term, the Water Strategy for Wales (Welsh Government, 2015a) signals a growing expectation for Welsh Water to play a role in delivering government environmental policy.

Welsh Water will need to reflect differing policy and regulatory environments for its operations in Wales and England to ensure customer promises are met.

Devolution is also happening at a more local level, with City Region governance arrangements around Cardiff and Swansea.

Changing health standards

The World Health Organisation (WHO) provides guidance on drinking water standards and bathing water standards. Water is a growing global issue, as recognised by Goal 6 of the UN's Sustainable Development Goals (SDGs). The WHO is responding to this through increased guidance, as seen through the 2016 publication on *Protecting Surface Water for Health* (Rickert B et al., 2016).

Increasing the role of markets in the water sector

We expect that there will be a greater role for markets in the water value chain. Some of these markets may be competitive, for example, a competitive retail market was introduced for all business customers in England in April 2017. Welsh Water is committed to ensuring that its business customers receive sector leading value for money and standards of service, whatever the regulatory and market environment. Other markets will provide better opportunities for "buyers" and "sellers" to interact, for example, the Payment for Eco-system Services approach envisaged by the Welsh Government and Natural Resources Wales.

The next steps in Ofwat's Water 2020 strategy are to open up the treatment and disposal of sewage sludge, new water resources and large capital investment projects to markets and alternative delivery options. These should be in place by 2020 and may provide opportunities for Welsh Water to expand its range of services or to find more efficient ways of procuring or delivering services for customers.

Figure 32 : The flag of the European Union. The regulatory regime after the departure of the UK from the European Union is uncertain. By K.G.Hawes. Creative Commons License (CC-BY-2.0)

2. Future Trends
2.7 Policy and regulatory change

Figure 33 : The Welsh Senedd. Devolution could lead to greater powers for the Welsh Government in the future. By Richard Szwejkowski, Creative Commons License (CC-BY-2.0).

Impact on our business

1. Clean, safe water for all

Changing policy and legislation: Possible changing water policy due to exit from the European Union and future changes in public health regulations worldwide will impact on the provision of safe, clean water.

2. Safeguard our environment for future generations

Changing methods of environmental regulation: The uncertainty around environmental regulation after departure from the European Union may make it harder to plan for post-2020.

However, the post-European Union era offers Welsh Water the opportunity to work with governments and stakeholders to shape future water and environmental legislation and regulatory practice.

5. Fair bills for everyone

Changing regulatory structures: The changing strength of regulation (for example, requirements for water quality) may impact on the cost of water provision.

Retail competition for business customers and opening upstream services for competition, along with a more market-orientated industry driven by cost reduction, could lead to more efficient overall service delivery but also may make it more challenging to protect disadvantaged customers in the future.

6. A better future for all our communities

Co-creation opportunities: Water companies are likely to be expected to play an increasing role in achieving catchment-wide policies, and there is an opportunity for us to co-operate more widely in order to meet governmental goals for improved ecosystems.

2. Future Trends

2.8 Protecting public health

Regulatory standards to protect drinking water quality are likely to continue to tighten in the future. We will have a role to play in promoting healthier and more sustainable lifestyles for our customers.

Chronic and lifestyle diseases

Lifestyle factors are responsible for most illnesses and premature deaths include smoking, stress, alcohol, improper diet, overeating and lack of exercise.

42% of the population in Wales is not physically active (Welsh Government, 2016b) and currently 59% of the Welsh population is overweight and 24% obese, this is predicted to increase to 50% by 2050. Socio-economic deprivation has a significant impact on lifestyle choices (Welsh Government, 2016b; Brownlie et al, 2006).

Pharmaceuticals and contaminants

The predicted ageing population is likely to increase the amount and range of pharmaceuticals consumed. The quantity of cardiovascular drugs prescribed is predicted to double by 2052 (Willis 2010) and the concentrations of pharmaceuticals and oestrogen in UK catchments are predicted to increase by 2050 (Green et al. 2013). In addition, lifestyle drugs such as caffeine and nicotine have been found in UK groundwater. In the natural water environment, these stimulate biological responses in organisms at low concentrations (Arnold et al., 2013; Guo et al., 2016).

Bioterrorism

In the UK, additional drivers for future disease risk include bioterrorism, from both novel pathogens and weaponising current diseases. Bioterrorism could target water networks or animals as vectors of human diseases (Brownlie et al, 2006). They would both have an impact on Welsh Water's operation.

Pandemics and disease migration

Increased travel, an ageing population, altered herd immunity, increasing susceptibility to infections, and overuse of antibiotics and antimicrobials in animals and humans will increase the risk of pandemics and disease migration to the UK. (Karmali et al, 2008).

Pandemics, particularly pandemic influenza, have impacted Wales in recent years (Public Health Wales, 2011). The UK government has predicted that a future pandemic may infect half the UK population and cause 20,000-750,000 deaths (Cabinet Office 2013).

Antimicrobial resistance is increasing, resulting in a worsening ability to treat common infectious diseases, increased transmission between animals and humans, and longer hospital stays (World Health Organisation, 2016).

Animal disease outbreaks may impact on food supply and the rural economy. The most recent serious outbreak of foot and mouth disease in 2001 led to the obstruction of access to some of Welsh Water's assets, and disrupted the application of treated sewage sludge to agricultural land.

Moreover, there has been concern that new waterborne diseases in our catchments, such as cryptosporidium variants could present new challenges for quality control in our water supply treatment systems.

Health and lifestyle

The Natural Resources Wales Outdoor Recreation Survey (Natural Resources Wales, 2013) highlights that 60% of Welsh people would like to do more outdoor recreation and the areas that they most like to visit are woodlands, forests and beaches as opposed to local parks (Natural Resources Wales, 2014). In addition, outdoor activity is worth £480m to the Welsh Economy (Wales Online, 2014).

Some Welsh households have lead supply pipes, owned by customers. Elevated levels of lead consumption has been linked to cognitive dysfunction in children and increased influenza, hypertension and renal failure in adults.

In addition, in some studies, chlorine disinfection by-products in drinking water has been linked to asthma, dermatitis and bladder cancer (World Health Organisation, 2003).

Whilst Welsh Water's drinking water currently meets WHO standards, tightening standards may require both lead and chlorine concentrations to be reduced in drinking water.

Figure 34 : Canoeing in the Brecon Beacons. By Phil Dolby, Creative Commons License (CC-BY-2.0)

2. Future Trends
2.8 Protecting public health

Figure 35 : Welsh Water's visitor centre at Llandegfedd Reservoir. © Welsh Water

Impact on our business

1. Clean, safe water for all

Changing water quality standards: Tightening water quality standards for pharmaceuticals, lead, and chlorine treatment by-products will increase the amount of treatment required to provide safe water.

Emerging contaminants: The UK's exposure to pharmaceutical products is classified as 'medium' risk (Kookana et al. 2014b). This will be harder to maintain with increased contaminants in our wastewater and groundwater.

Disease migration: There is the risk of new waterborne diseases in our catchment, such as new variants of cryptosporidium, which could present new challenges for quality control in our water supply treatment systems.

2. Safeguard our environment for future generations

Treatment of pharmaceuticals: A range of pharmaceuticals have been found in wastewater effluent in the UK, suggesting current treatment is insufficient to remove these substances (Roberts and Thomas, 2006; Rivera-Utrilla et al., 2013). New treatment technologies are being developed that better target pharmaceuticals, although the costs of these technologies are likely to be high (Rivera-Utrilla et al., 2013; Nasirabadi et al., 2016). The pharmaceuticals stimulate biological responses, negatively impacting on the natural water environment.

3. Put things right if they go wrong

Pandemics and illness: In the event of a pandemic, a large numbers of our colleagues could be absent from work at any one time affecting the ability to undertake critical maintenance (Cabinet Office, 2013). Antimicrobial resistance may cause longer periods of sickness (World Health Organisation, 2016).

5. Fair bills for everyone

Increasing water contaminants: The increasing amount and range of contaminants in both water and wastewater may require additional treatment which is costly.

6. A better future for all our communities

Improving public health: Welsh Water has opportunities to contribute to improved public health by making green spaces under their ownership available for amenity and recreation. Cheap, safe, drinking water could be promoted further to help combat obesity (Patel and Hampton, 2011).

3. Strategic Responses

Overview

Planning for the delivery of investment, research and innovation in order to respond to future trends and uncertainty.

In order to respond to the challenges and harness the opportunities associated with the future trends, we have developed 18 strategic responses, grouped into three pillars that our services impact:

- Drinking water;
- Customers and communities, and
- Environment.

These are summarised in Figure 37, overleaf. In Table 5 (on page 48) we have outlined how each of the strategic responses responds to the future trends.

Of course, uncertainty remains in our consideration of future trends as far out as 2050. Our approach is both to maintain flexibility and also to make “no regrets” decisions. In part, this is achieved by each of the strategic responses responding to at least two of the future trends, achieving multiple benefits for our customers in the future.

We have outlined each response in more detail through quantified investment scenarios, and explored the outcomes that we expect to achieve by 2050.

For each strategic response, in the section that follows, we have set out:

- The importance of the response to our customers;
- The future trends that the response addresses;
- A detailed description of the response;
- The research and innovation that will be required to deliver the response;
- How we will work with others to deliver the response; and
- The benefits we will deliver to our customers (customer outcomes).

We also set out how each response helps us to meet our customer promises and the goals of the Well-being of Future Generations Act (Welsh Government, 2016c).

For each of the 18 strategic responses, we have set ourselves a direction of travel. The direction of travel includes a range of response, which provides flexibility to adjust our actions based on their effectiveness and the future trends they experience. As a minimum, each responses aims to:

- Meet our legal duties, including our statutory duties (for example, ‘Enough water for all’);
- Maintain the sustainability of our business (for example, ‘Employer of choice’);
- Meet customers’ expectations (for example, ‘Leading-edge customer service’); or
- Mitigate potential low probability-high consequence risks which customers would find unacceptable (for example, ‘Protecting our critical water supply assets’).

The direction of travel for each strategic response has a total cost associated which includes the investment cost plus the additional running costs to operate and maintain the investment net of any offsetting savings that result, and net of forecast improvements in efficiency from new technology and innovative ways of working.

We recognise that there are many synergies between the activities of a strategic response and outcomes of different strategic responses. For example:

- Working with customers and communities to reduce water demand, will support the strategic response focused on providing ‘Enough water for all’;
- Using catchment management to improve raw water quality will also have knock on effects downstream to support cleaner rivers and beaches; and,
- Investing in becoming a smart water business will help us to improve services and reduce impacts on our worst served customers.

To further illustrate what is meant by the likely activity under each strategic response, we also provide case studies of either current activities or likely future investment.

Figure 36 : Upper Lliw Reservoir, Velindre © Welsh Water

3. Strategic Responses
Overview

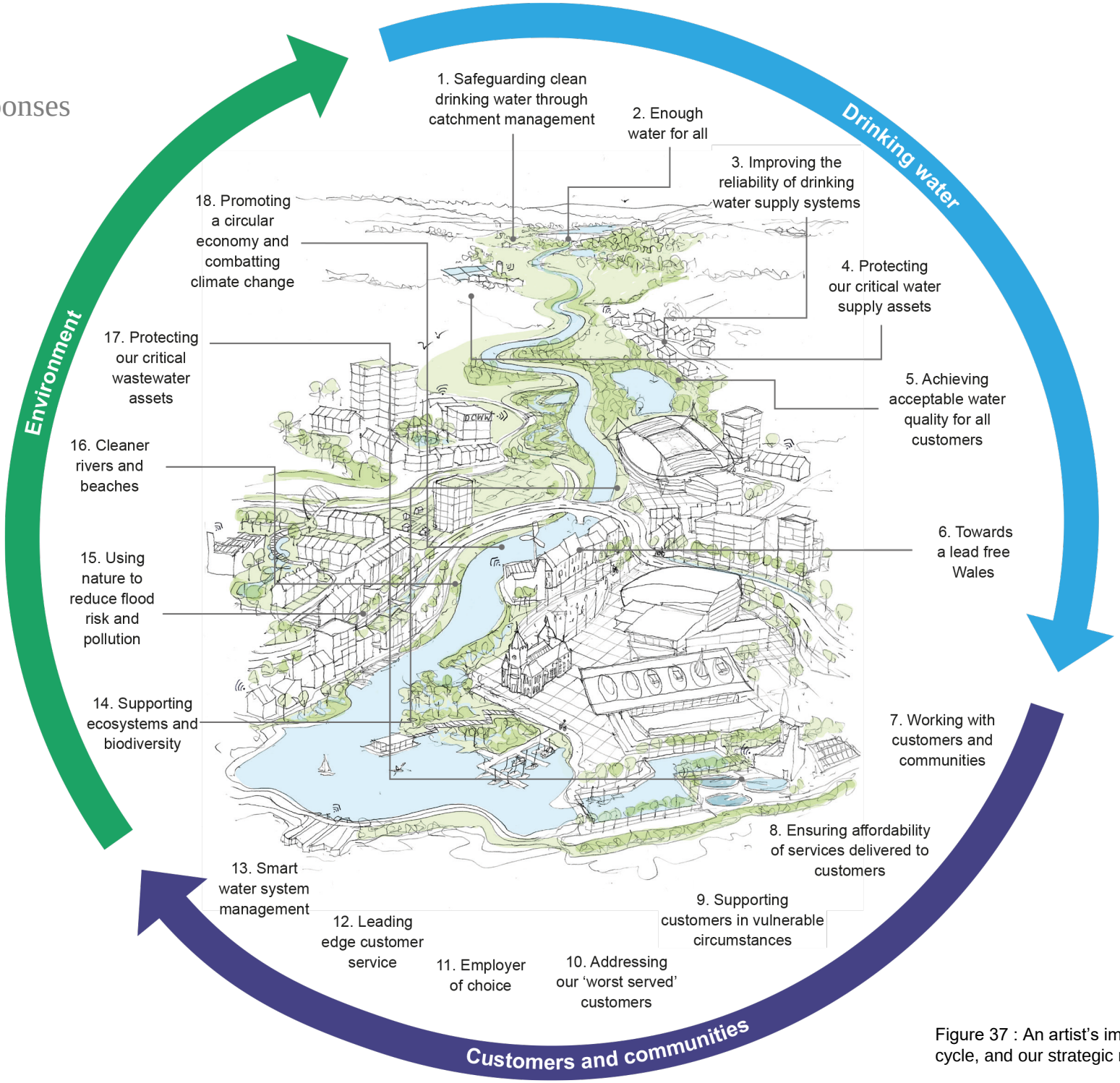


Figure 37 : An artist's impression of the water cycle, and our strategic responses. © Arup

3. Strategic Responses
Addressing the future trends

⊕ Opportunities associated with this future trend are harnessed by the strategic response

⊖ Challenges associated with this future trend are mitigated by the strategic response

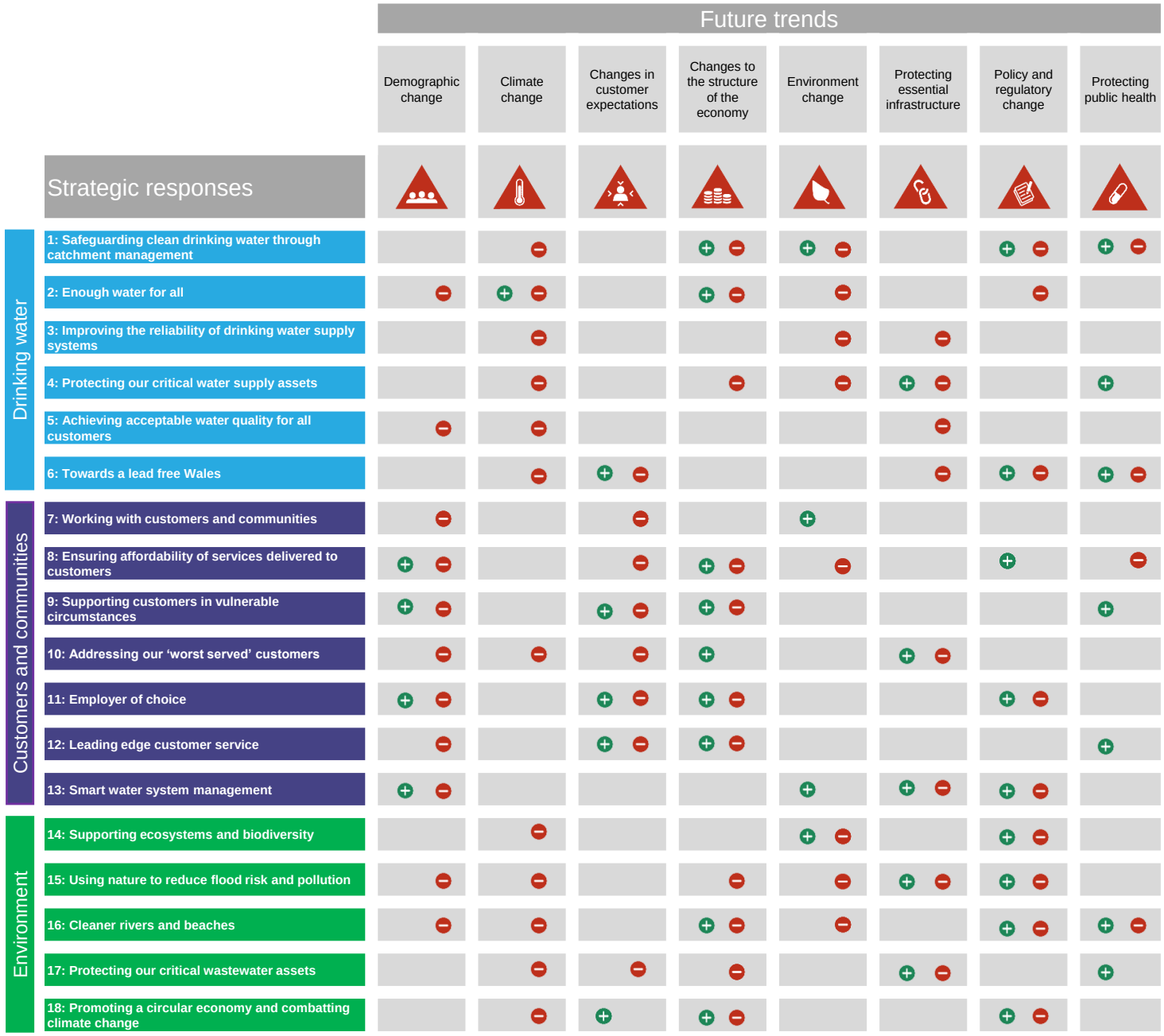


Table 5 : Addressing future trends

3. Strategic Responses
At a glance: Drinking water

1. Safeguarding clean drinking water through catchment management

Catchments as a first line of defence: we will face increased levels of pesticides, fertilisers, nutrients and pathogens in raw water, and increased turbidity of water reaching our water treatment works due to the intensification of agriculture and greater intensity of storms. We will co-create an extensive, innovative programme of catchment management with landowners and partners.

Customer Promises:

Future Trends:

2. Enough water for all

Confronted with an increasing water supply demand gap due to population growth and drier summers due to climate change, we will use our Water Resource Management Plan to ensure the water supply demand balance to 2050. We propose to implement water transfers, demand management measures and leakage reduction programmes to address any deficits, whilst recognising the possible need to support other parts of the UK.

Customer Promises:

Future Trends:

3. Improving the reliability of drinking water supply systems

Faced with an increased risk of outages due to agricultural run-off, extreme weather events, terrorism, and cyber attacks, we will build more flexibility and integration into our water treatment and supply systems.

Customer Promises:

Future Trends:

4. Protecting our critical water supply assets

With increasing risks of disruption (for example, from severe weather events resulting from climate change and increased reliance on technology) and limited customer tolerance of supply outages, we will improve the resilience of critical water assets which have high consequences of failure.

Customer Promises:

Future Trends:

Customer Promises

1. Safe, clean water for all
2. Safeguard our environment for future generations
3. Put things right if they go wrong
4. Personal service that's right for you
5. Fair bills for everyone
6. A better future for all our communities

5. Achieving acceptable water quality for all customers

Ageing water mains and more extreme weather events increase the risk of supplying water which is discoloured or has a poor taste. This will be addressed through a targeted replacement of iron mains.

Customer Promises:

Future Trends:

6. Towards a lead free Wales

We have the opportunity to help improve public health, and propose a targeted replacement of lead communication and supply pipes, as part of a wider societal effort to address lead in drinking water.

Customer Promises:

Future Trends:

Figure 38 : Taps. By Eelke, Creative Commons License (CC-BY-2.0)

Future Trends

- Demographic change
- Climate change
- Change in customer expectations
- Changes to the structure of the economy
- Environmental change
- Changes to infrastructure
- Policy and regulatory change
- Protecting public health

3. Strategic Responses
At a glance: Customers and communities

7. Working with customers and communities

We will work with customers and communities to co-create solutions, share knowledge, and support initiatives which reduce water use, prevent sewer abuse, and provide wider benefits for communities and the environment.

Customer Promises:

Future Trends:

8. Ensuring affordability of services delivered to customers

With inequality, debt, and poverty on the rise we aim to ensure that our services remain affordable for all customers: both in terms of average bills and for those on social tariffs. We will ensure that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our customers.

Customer Promises:

Future Trends:

9. Supporting customers in vulnerable circumstances

We need to use data effectively, provide personalised customer service and work in partnership with other service providers to give appropriate and effective support to customers in vulnerable circumstances.

Customer Promises:

Future Trends:

Customer Promises

1. Safe, clean water for all
2. Safeguard our environment for future generations
3. Put things right if they go wrong
4. Personal service that's right for you
5. Fair bills for everyone
6. A better future for all our communities

10. Addressing our 'worst served' customers

Faced with increasing customer expectations for a good service at all times, we will address the longstanding service complaints of 'worst served customers' to ensure that everyone receives an acceptable level of service.

Customer Promises:

Future Trends:

11. Employer of choice

With an ageing population, an increasing shortage of technically skilled employees and increasing demand for more flexible approaches to working, we will need to continue to be an employer of choice; attracting, developing and inspiring people from a diverse range of backgrounds, to deliver an excellent service for our customers.

Customer Promises:

Future Trends:

12. Leading edge customer service

Changing customer expectations, the digital revolution and demographic and lifestyle change are all leading Welsh Water to further develop our customer service culture. We will harness technological change to provide a personalised service for customers through their preferred contact channel.

Customer Promises:

Future Trends:

13. Smart water system management

With the opportunity to capitalise on technological advances, we will improve the service performance and resilience of our assets through remote sensing, data analysis and automation; solving problems before they impact on our business or the environment.

Customer Promises:

Future Trends:

Future trends

- Demographic change
- Climate change
- Change in customer expectations
- Changes to the structure of the economy
- Environmental change
- Changes to infrastructure
- Policy and regulatory change
- Protecting public health

3. Strategic Responses

At a glance: Environment

14. Supporting ecosystems and biodiversity

Biodiversity faces threats including habitat loss, fragmentation and over-exploitation. In the longer term, temperature and changed rainfall patterns will also impact biodiversity. We will look for ways to help nature, enhance biodiversity and promote ecosystem resilience while we carry out our water and sewerage activities. Welsh Water has a duty under the Environment (Wales) Act (2016) to enhance biodiversity and promote the resilience of ecosystems in the exercise of our functions.

Customer Promises:

Future Trends:

15. Using nature to reduce flood risk and pollution

RainScaping our communities: confronted with urban creep due to demographic change and increased intensity of rainfall due to climate change, Welsh Water is proposing to reduce the risk of sewer flooding and pollution through sustainable urban drainage systems.

Customer Promises:

Future Trends:

16. Cleaner rivers and beaches

With increasing pressure on the natural environment from increased population, changing land use, climate change and new sources of pollution, we will improve our wastewater assets to do our part to help achieve 'good' environmental status for our rivers, lakes and coastal waters.

Customer Promises:

Future Trends:

Customer Promises

1. Safe, clean water for all
2. Safeguard our environment for future generations
3. Put things right if they go wrong
4. Personal service that's right for you
5. Fair bills for everyone
6. A better future for all our communities

17. Protecting our critical wastewater assets

Faced with an increased risk of disruption, for example, from an increase in severe weather as result of climate change, and reduced customer acceptability of pollution events, we will improve the resilience of our critical wastewater assets, which have high environmental and customer impacts of failure.

Customer Promises:

Future Trends:

18. Promoting a circular economy and combatting climate change

Faced with a changing climate and increased energy costs, we will aim to become an energy neutral business, whilst maximising the opportunities to reuse treated water and other potentially valuable natural materials, contributing to the circular economy in our local region.

Customer Promises:

Future Trends:

Future trends

- Demographic change
- Climate change
- Change in customer expectations
- Changes to the structure of the economy
- Environmental change
- Changes to infrastructure
- Policy and regulatory change
- Protecting public health

Figure 39 : Conwy. By alh1, Creative Commons License (CC-BY-2.0)

3. Strategic Responses

Strategic response 1. Safeguarding clean drinking water through catchment management

Catchments as a first line of defence: we will face increased levels of pesticides, fertilisers, nutrients and pathogens in raw water, and increased turbidity of water reaching our water treatment works due to the intensification of agriculture and greater intensity of storms. We will co-create an extensive, innovative programme of catchment management with landowners and partners.

Importance for customers

Safe drinking water is consistently referred to by customers as their highest priority out of the services we provide (Welsh Water, 2016). In the Welsh Water 2050 consultation, 9 in 10 respondents in our summer consultation think it's important that Welsh Water works with nature to improve water quality. They also believe that educating and working with landowners and other stakeholders should form a key part of this, in addition to boosting research in treatment processes that use fewer chemicals.

Responding to future trends

Welsh Water abstracts water for water supply from 120 catchments covering an area of almost 11,000km². Land within these catchments is subject to a variety of land use types and management practices. We have limited land holding across the catchments and consequently we have little control of land activities. Stock management, tree planting and harvesting, and the use of chemicals including pesticides, fertilisers or nutrients can present a risk to raw water quality and treatment challenges for our water treatment works.

Increased intensification of agriculture and tree felling, combined with more intense storms will lead to greater concentrations of pesticides, fertilisers, nutrients and pathogens in raw water and more turbid water reaching our water treatment works. This could necessitate the increased use of chlorine for treatment, leading to by-products that have been tentatively linked in some studies to asthma, dermatitis and bladder cancer (IPCS, 2000; Morris at al, 1992; World Health Organisation, 2003).

In parallel, between now and 2050 water quality regulations are likely to tighten regarding the presence of fertilisers and pesticides in drinking water.

Strategic response

We propose to address the risk to raw water quality by undertaking a programme of catchment management starting with high risk catchments. In each catchment, interventions will include:

- Creating an integrated programme at catchment scale, encompassing stakeholders, to co-ordinate and realise the full benefits of multiple catchment interventions;
- Influencing land management and land use practices through co-operative stakeholder engagement and regulatory interventions, including General Binding Rules (GBRs), as well as the creation of payment incentive mechanisms (for example, payment for ecosystems services);
- Controlling land management through targeted land purchase of priority or high risk land; and
- Recognise the uncertainly associated with a post-EU legislative environment around agriculture and the environment, and work flexibly within this new framework.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- Mitigation of the formation of taste and odour-causing compounds (for example, due to algal growth);
- Chemical free treatment processes, for example, through catalysis;
- Disinfection by-products and their removal;
- Innovative solutions for reducing the risk from cryptosporidium in a catchment;
- Emerging contaminants including micro-plastics and pharmaceuticals and their removal;
- Risk-mapping and early warning systems for raw water quality;
- Land management approaches including land ownership and land management techniques; and
- Catchment management partnership approaches, incentives and business models including efficient regulatory methods (GBRs), payment for ecosystems services approach, natural capital accounting, agricultural subsidies regime after Brexit.

Welsh Water will work with academic partners from Cardiff University and a wider consortium.

Co-operative approach

By emphasising the multiple benefits of a catchment approach, we will bring together multiple partners including public policy makers, landowners, third sector bodies and community groups at a catchment level to co-create and implement our plans. We will actively collaborate with the following identified partners:

- Natural Resources Wales and the Environment Agency;
- Other water utilities;
- Farmers Union of Wales, National Farmers Union and other farming bodies;
- Canal & River Trust;
- Welsh Government;
- Ofwat;
- Drinking Water Inspectorate;
- Public Health Boards;
- The National Trust;
- Wildlife Trusts; and
- Coed Cymru.

Figure 40 : Sheep in the Welsh hills. By Suzanne Glelis, Creative Commons License (CC BY-ND 2.0)

3. Strategic Responses

Strategic response 1. Safeguarding clean drinking water through catchment management

Customer promises

Clean, safe water for all

Controlling raw water quality will improve the ability of Welsh Water to provide clean, safe water to customers. Moreover, water retention in uplands, wetlands and flood plains can help to ensure security of supply during times of drought.

Safeguard our environment for future generations

Environmental stewardship in catchments will help improve biodiversity and the quality of the landscape. Research into chemical-free processes and the removal of disinfection by-products will help protect the environment for generations to come.

Fair bills for everyone

Improved catchment management may result in reduced operational expenditure and allow Welsh Water to keep bills low for customers into the future by avoiding expensive treatment.

A better future for all our communities

Working in partnership to tackle diffuse pollution at source would have multiple benefits for the environment, and enhance the provision of ecosystems services to our communities. These would include recreation opportunities, wider biodiversity and better health outcomes from cleaner air, soil and water.

Well-being goals

A resilient Wales

Catchment management will improve the resilience of the natural water cycle, and enable it to endure future shocks and stresses to water quality.

A prosperous Wales

Enhanced biodiversity, environmental stewardship, and the reduced need for treatment processes will contribute to a low carbon society and the efficient use of natural resources in Wales.

A globally responsible Wales

The enhancement of the natural environment will contribute to the well-being of ecosystems.

A healthier Wales

Catchment management will protect public health through safe drinking water and providing improved access to the countryside and leisure activities.

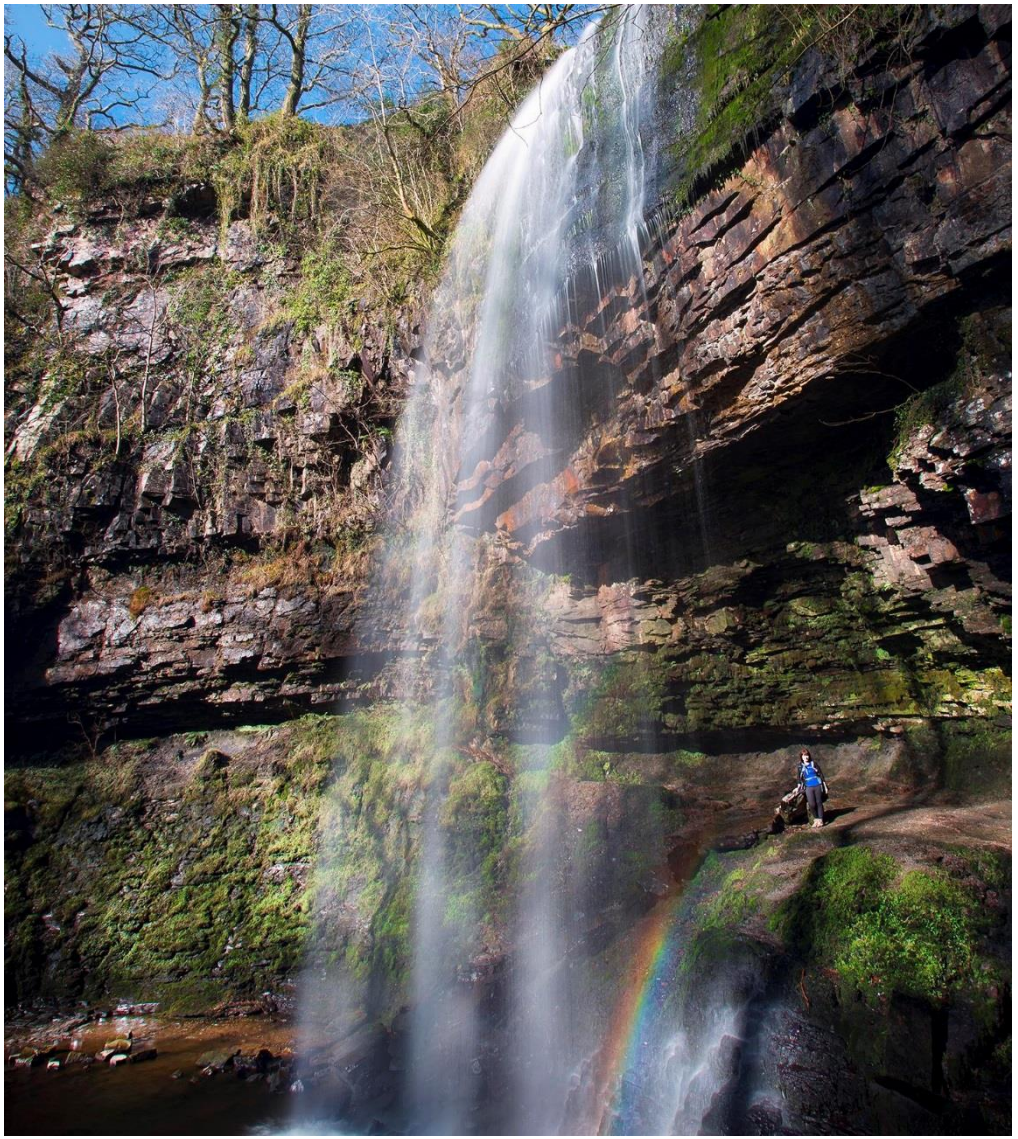


Figure 41 : Henrhrd Falls in the Brecon Beacons. By Dave Grubb, Creative Commons License (CC BY-SA 2.0)

3. Strategic Responses

Strategic response 1. Safeguarding clean drinking water through catchment management

Direction of travel

Improved Customer Outcomes

- Improved protection of raw water quality for between 1.1 million and 2.6 million customers;
- Increased control of the quality of our raw product in the face of increased turbidity and run-off due to extreme weather events caused by climate change; ensuring raw water entering our treatment works is of a consistent and manageable quality (including managing cryptosporidium, natural organic matter causing disinfection by products and algal growth causing taste and odour complaints);
- Spend to save: prevent or delay spend on additional/upgrades to water treatment works;
- Reduce the chemical and energy demand from water treatment works, due to reduced need for ultra-violet (UV) treatment, powder activated carbon (PAC) dosing and avoided chemical dosing, saving between £2m and £3m per annum;
- Generate wider benefits for communities and the environment including improved biodiversity, environmental stewardship and recreation opportunities; and
- Support Welsh Government's and Natural Resources Wales' payment for ecosystem services agenda.

Scope of work

We plan to implement water safeguard protection zones for all catchments which have a 'high risk' of poor water quality due to cryptosporidium, pesticides, high concentrations of natural organic matter and algal growth. This will benefit around 1.1 million of out customers across 30 catchments. We could also expand the programme further to include 'medium risk' catchments, benefitting a further 1.5 million customers over 80 catchments.

Each water safeguard protection zone will have a risk management plan, co-created in partnership with other catchment users and regulators. This co-operative approach is strongly supported by our consultees, and should protect and enhance the catchment through better stakeholder management and co-ordination, and improve raw water quality. If necessary, we could also explore regulatory interventions (for example, through General Binding Rules), the introduction of a payment for ecosystem services agenda and even targeted land purchase.

We believe that the 'catchments as a first line of defence' approach is crucial to the future safeguarding of drinking water quality. We plan to invest in catchment management and work collaboratively with stakeholders to protect raw water quality and to build resilience into our water supply service, depending on the number of catchments addressed. Whilst this will entail some investment cost for us, there will be some offsetting, long-term savings due to a reduced need for treatment, and the total net potential cost over 30 years is expected to be between £100m - £300m.

3. Strategic Responses

Strategic response 1. Safeguarding clean drinking water through catchment management

Case study: Weed Wiper Partnership

In 2015/16 Welsh Water successfully worked with Natural Resources Wales and the farming industry on an innovative campaign to tackle the rising levels of the grassland herbicide MCPA in water abstracted for drinking in two catchment areas, River Teifi and River Wye. Working together, best practice advice was provided and land managers were offered free hire of a weed wiper; an alternative application method that reduces the risk of herbicide loss into watercourses.

Issue

Concentrations of the herbicide MCPA in raw water (pre-treatment) were observed to often be greater than the prescribed concentration value of 0.1µg/l set down in the drinking water regulations. MCPA is costly and difficult to remove at water treatment works.

Action taken

As part of this campaign, actions included:

- Increased stakeholder engagement and working with farmers and land owners to help us tackle this problem, by managing rush infestations differently;
- Free hire of a weed wiper provided between April and October 2015 to farmers and land managers in River Teifi and Wye catchments;
- Best practice advice and information packs disseminated at numerous agricultural events, shows, workshops and in the media; and
- A dedicated area created on our website, featuring useful leaflets and a “how to” film.

Result

- 190 farmers received information packs;
- 63 participants hired a weed wiper;
- 618 hectares weed wiped;
- Significant reduction in MCPA detection in 2015, lower than previous two years;
- The use of around 1,800 litres of MCPA avoided in the two catchments;
- The outcomes of the Weed Wiper partnership have been shared with: Welsh Government; Natural Resources Wales; Farming Union Wales; Farming and Wildlife Advisory Group Wales; and many other relevant stakeholders.

Investment: £130,000

Next steps

The partnership has continued to build on the success in 2015/16, with the Weed Wiper trial ongoing in the original target areas, extending further into the Afon Teifi catchment during the 2017 season. Experience of the trial has been used to develop a ‘blue-print’ for delivery in other catchments with similar issues.

Figure 42 : Working with our farmers as part of the weed wiper partnership © Welsh Water

Figure 43 : Working with our farmers as part of the weed wiper partnership © Welsh Water

3. Strategic Responses

Strategic response 1. Safeguarding clean drinking water through catchment management

Case study: Brecon Beacons mega catchment

Around half of the water we abstract for drinking on a daily basis comes from the Brecon Beacons. There is a need to ensure that the raw water entering our treatment works is of a consistent and manageable quality. Robust catchment management will build resilience into our drinking water supply system, increasing our ability to react, respond and recover from events.

This initiative aligns with the Well-being of Future Generations Act (2015) and Environment (Wales) Act (2016). Both will provide a supportive policy framework for the long term viability of the approach in addition to encouraging the participation of many key stakeholders.

Issue

Current land use and activities present a risk to raw water quality. The projected impact of climate change is likely to increase the risks to raw water quality and quantity. Without control of the raw water quality entering water treatment works, the treatment process will require upgrades and more robust processes to deal with the deteriorating and more variable raw water quality.

Action taken or proposed

- Co-create a catchment enhancement strategy jointly with Brecon Beacons National Park and other land users;
- Following the December 2017 stakeholder meeting, a Steering Group has been created of key stakeholders including public bodies, NGOs, landowners, businesses and relevant experts. The Group will aim to secure external funding and develop the Brecon Beacons catchment management concept and future governance structure to help deliver on the ground actions;
- Create a landscape approach to safeguard raw water quality and quantity in the Brecon Beacons. This will involve developing new ways to work with farmers, community groups and customers to promote the adoption of 'water-sensitive' activities and behaviours; for example, the launch of a new WaterSource payment incentives scheme;
- Develop enabling tools that assist partners in deciding what land uses to change and where in the catchment to implement them. Possible land use changes could involve the use of runoff attenuation features, buffer and riparian management strips and seasonal livestock removal to slow and store surface water runoff;
- Build on stakeholder relationships made in AMP5 and AMP6 to pilot development of a payments incentives scheme; and
- Quantification of the environmental, social and economic benefits will need to be determined.

Expected Results

- Smoothing of annual fluvial flows;
- Increased control of raw water quality abstracted from the Brecon Beacons mega catchment;
- Reduction in future capital and operational water treatment requirements for half the water we extract for drinking;
- Generation of an array of social, economic, cultural and environmental benefits through partnership working, and
- Drive innovation in water sector, for example, through the development of incentivisation approaches including PES.

Next steps

We will

- Submit a proposal for the mega catchment approach as part of our PR19 investment case that reflects the collective aspirations and ambitions for the landscape.
- Raise awareness amongst stakeholders and partners of our catchment strategy progress to date and gain their support; and,
- Identify common areas of interest with stakeholders/partners to focus future collaboration.

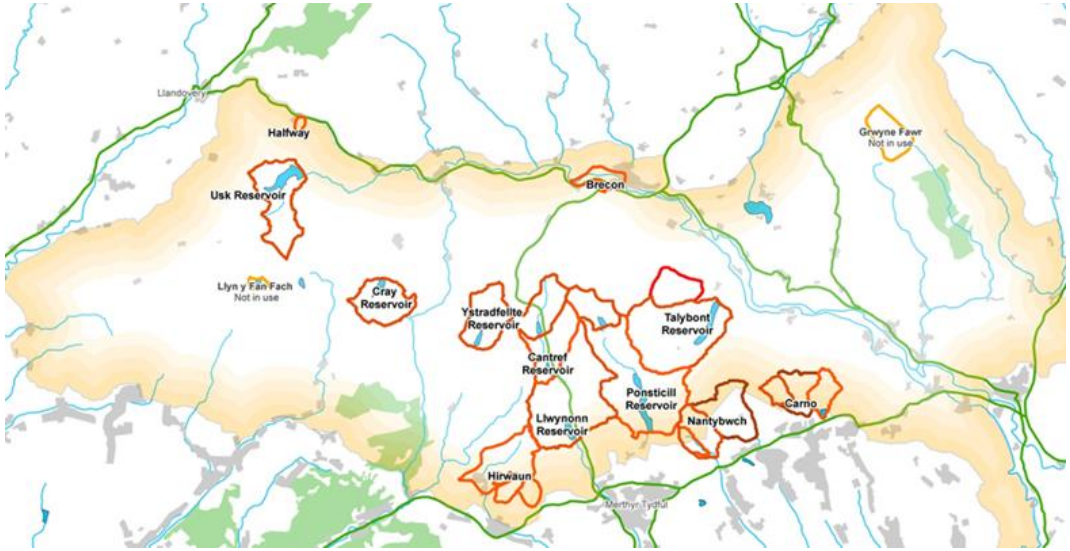


Figure 44 : A map of the Brecon Beacons catchment area. © Welsh Water.

3. Strategic Responses

Strategic response 2. Enough water for all

Confronted with an increasing water supply demand gap due to population growth and drier summers due to climate change, we will use our Water Resource Management Plan to ensure the water supply demand balance to 2050. We propose to implement water transfers, demand management measures and leakage reduction programmes to address any deficits, whilst recognising the possible need to support other parts of the UK

Importance for customers

Customers have made clear through research undertaken in 2014 (Welsh Water, 2014b) that a reliable source of water is of great importance to them and that we should be able to sustain water supply to customers in all but the most extreme of droughts. In addition, engagement with customers has informed us that a least cost approach is required when identifying solutions to address forecasted difficulties in supplying water to meet demand.

Responding to future trends

Water demand is expected to change in the future, due to:

- Population growth (particularly in the South Wales, Hereford and Wrexham areas);
- Changes to the structure of the economy, including industrial decline and growth in tourism;
- Land use change; and
- Changes in customer behaviour.

We extract just 3% of effective rainfall in Wales for public consumption, lower than other parts of the UK. However, supply could reduce in the future due to climate change, particularly as summers are projected to become drier.

Moreover, the European Habitats Directive 92/43/EEC requires a reduction in the amount of water abstracted from some of our water sources. By 2020, improvements will have been made at 20 of our sites to mitigate their environmental impact. In the future, other changes could reduce our ability to abstract water.

In addition, significant upgrades to spillways and internal pipework will be needed at many of our dams to meet new legislative requirements, ensure that they remain safe in light of an expected increase in extreme rainfall events, and remain flexible enough to respond to more frequent drought periods.

Strategic response

These challenges are considered in our draft Water Resources Management Plan 2019 (Welsh Water, 2018) which details what needs to be done from 2020 to 2050 to ensure a sustainable and affordable balance between water supply and water demand.

As part of looking at water demand, we developed demand forecasts for our zones, estimating usage levels in a hot dry year, and for the critical period of peak use. This gives us insight as to whether we can consistently supply water to all of our customers in the most arduous conditions, considering the risks and uncertainty associated with long term forecasting.

We have identified two Water Resource Zones that are anticipated to fall into deficit between 2020 and 2050;

- Tywyn Aberdyfi; and
- Pembrokeshire.

Our customers accept that it may be necessary to impose demand restrictions during periods of drought, as long as this does not happen too frequently (Welsh Water, 2017). Our current Level of Service (LoS) commitment states that we will:

- Not have a hosepipe ban more than once in every 20 years, (1-in-20) on average;
- Not restrict water for commercial use more than once in every 40 years (1-in-40), on average; and
- To never impose more extreme measures such as standpipes and rota cuts.

We have confidence that all but three of our water resource zones (Pembrokeshire, Tywyn Aberdyfi and Vowchurch) are resilient to an extreme (1 in 200 year) drought, without imposing ‘extreme’ drought management measures.

Options for mitigating supply-demand deficits include:

- Demand management– saving water through supporting customers to reduce their usage;
- Water reuse – encouraging the use of grey water reuse and rainwater harvesting;
- Water metering – to incentivise reduced water usage;
- Leakage – reducing the losses in our system through increased investment in leakage monitoring and repair, including beyond the domestic boundary;

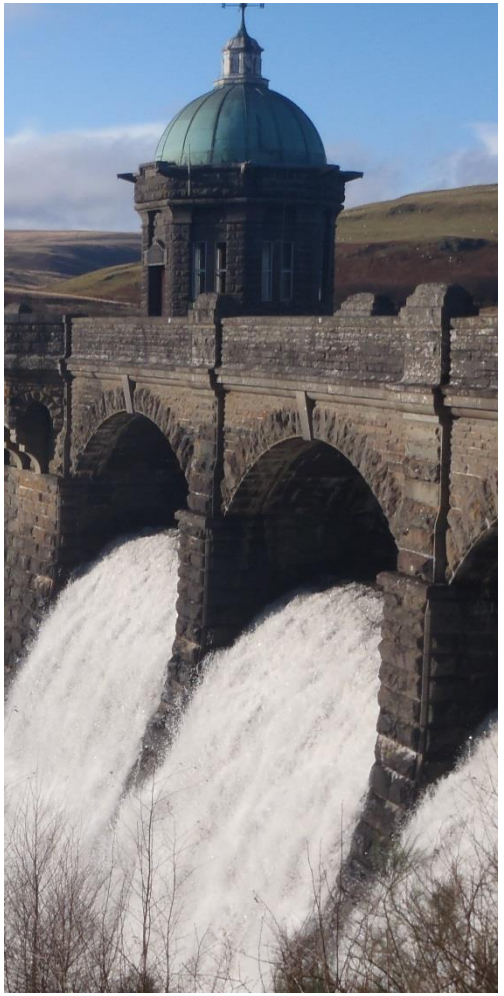


Figure 46 : Craig Goch reservoir spillway in operation © Arup

3. Strategic Responses

Strategic response 2. Enough water for all

- Water transfer and trading - across zonal or company boundaries, recognising the associated environmental risks, for example, the spread of non-native species;
- Catchment management and natural water retention - in uplands, wetlands and floodplains; and
- Water resource optimisation – utilising a new source of water or increasing the water we take from an existing source.

In order to identify the best measures to implement, we prioritise those solutions which provide the required volume of water savings with low social, environmental and economic costs – considering both catchment and demand management options as well as water transfer and reservoir upgrade solutions.

Details on options for addressing these deficits are given in the direction of travel and case study.

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Understand interventions that promote water conservation by consumers, businesses and community groups. This could include exploring the success of approaches such as reduced flushing, rainwater harvesting, greywater recycling, water labelling on appliances, smart metering and dynamic pricing;
- Assess the benefits of 'smart' metering, particularly for business customers;
- Assess the impacts of climate change on water abstractions, in terms of water availability, impact on the environment, and the use of catchment management to optimise water quantity and quality for ecosystems;
- Understand the possible role of local, community based water supply systems including local abstraction, treatment, and distribution methods;
- Understand and develop approaches to manage the uncertainty of climate change projections and water resources management planning;
- New market opportunities through trading water across company boundaries, taking advantage of new water trading incentives; and
- Low cost desalination opportunities, for example, graphene sieves.

Co-operative approach

The delivery of demand management measures in some of those zones in deficit will require us to focus on innovation with both our suppliers and customers. We will explore the opportunities to trade water across company boundaries, to the mutual benefit of customers. We will actively collaborate with:

- Customers and communities;
- The Customer Challenge Group;
- Academia;
- Waterwise and the Energy Savings Trust.;
- Regulators;
- Welsh Government, Natural Resources Wales and the Environment agency;
- Other water companies;
- Wildlife trusts and environmental groups; and
- Farmers.

Customer promises

Clean, safe water for everyone

Sustainable water resources is a cornerstone of clean, safe water for everyone. A sound approach to planning against future challenges, and then identifying and delivering the means of facing up to those challenges is critical.

Safeguard our environment for future generations

By working to manage and reduce the impact our water abstractions have on the environment we can ensure that water is abstracted in a way that is sustainable and safeguards the environment for future generations.

Put it right if things go wrong

Ensuring we have the plan in place to deliver the required amount of water to our customers in the face of many challenges improves our ability to respond to those future shocks and stresses on our system.

Fair bills for everyone

We have worked to ensure that the solutions identified to address forecast water resource deficits are those that provide the required volume of water savings or water supply at the least cost over the long term, or improving supply resilience where we have identified this as a benefit for customers.

Well-being goals

A resilient Wales

Enough water for all takes into account future shocks and stresses and makes Wales more resilient in the face of such events. We will also reduce the impact of abstractions on our ecosystems.

A healthier Wales

A safe drinking water supply, with enough water for all, helps enhance the good general health of our customers.

3. Strategic Responses

Strategic response 2. Enough water for all

Direction of travel

Improved Customer Outcomes

- Enable security of supply to our customers in all but the most extreme droughts (greater than 1 in 40 years);
- Ensure the environment is protected where we abstract water, and that we can release water from our reservoirs to safeguard the downstream environment; and
- In light of climate change and projection of more severe flooding events, upgrade our reservoirs and dams to ensure that their water storage can be optimally used for water supply and they meet the latest mandatory dams and reservoir safety standards.

Scope of work

We want to ensure that there is enough water for both people and wildlife across our operating area. We have followed the statutory process for producing a Water Resource Management Plan to meet current and future demand for water, which will plan the water supply-demand balance across our catchments to 2050. As part of this, we plan to implement water transfers, water efficiency measures and leakage reduction programmes.

The **Tywyn Aberdyfi Water Resource Zone** is expected to fall into deficit over the planning period from 2020 to 2050 during period of severe drought, accompanied by the risk of poor water quality during storm events. We are proposing the construction of a new abstraction point on Afon Dysynni, which has a greater supply capacity and is more resilient in drought conditions.

The **Pembrokeshire Water Resource Zone** is also predicted to fall into deficit over the planning period. It is proposed that Canaston pumping station, which abstracts from the Cleddau River, is upgraded with variable speed pumps, enabling more efficient river regulation and the preservation of storage at the Llysyfran Reservoir.

Moreover, whilst the **Vowchurch Water Resource Zone** is not predicted to fall into deficit, there is a risk that we could have to resort to severe demand management measures, such as rota cuts during extreme droughts (1 in 200 years). Therefore, we are proposing to lay a new trunk main between the Hereford and Vowchurch Water Resource Zones to mitigate this.

To reduce leakages across our network, we also aim to develop methods to regularly survey our 10,000 km of trunk mains using new technology, and to progress our ‘Toilet and tap’ initiative to get a better understanding of leakages beyond the customer boundary. We will undertake free repairs or replacements on a targeted proportion of customer supply pipe leaks, and invest in water efficiency messaging and education. Overall, we plan to meet Ofwat’s challenge of a 15% reduction in total leakage by the end of AMP7.

We will also discuss high level options for sustainable water trading with other water companies that would benefit the people of Wales according to the conditions set out in our Water Resources Management Plan (Welsh Water, 2017).

Across our operating areas, we will also plan to improve dam spillways and pipework to meet increasing standards of dam safety legislation associated with amendments to the Reservoirs Act in 2016, ensure that they remain safe in light of an expected increase in extreme rainfall events, and remain flexible enough to respond to more frequent drought periods.

We propose to invest in water transfers, water efficiency measures, leakage reduction and dam safety programmes to ensure there is enough water for all across our operating area. Due to improved efficiency in water use across our operating area we expect to be able to reduce abstraction from higher cost sources, and we expect that the total net cost could be in the region of £500m.

3. Strategic Responses

Strategic response 2. Enough water for all

Case study: water deficit zones

In our draft 2019 Water Resources Management Plan (Welsh Water, 2018) we identified two water resource zones that will potentially fall into deficit between 2020 and 2050, and an additional zone that may not be resilient in extreme drought conditions.

Tywyn Aberdyfi Water Resource Zone

The Tywyn zone is currently supplied from two small stream sources. New resilience analysis shows that the flow in these streams will not be able to meet demand during severe drought periods with a supply demand deficit. There is also a risk of poor stream water quality during storm events which is predicted to cause treatment issues.

The preferred option selected is to construct a new abstraction point on the Afon Dysynni. The Afon Dysynni is much larger than our existing sources and is more resilient to severe droughts. It is proposed to support this solution with a raw water bankside storage reservoir to enable short term shut down of the river source when necessary.

The scheme cost is around £7.5m.

The Pembrokeshire Water Resource Zone

The Pembrokeshire zone is primarily supplied from a river abstraction at Canaston, supported by regulation releases from the Llysyfran reservoir. The supply demand position in Pembrokeshire will reduce significantly in 2018 due to Habitats Directive driven abstraction licence reductions.

The Canaston pumping station has fixed speed pumps and operation within the abstraction licence means that we over regulate the Eastern Cleddau River every time the pumps are on, and release too much water from our Llysyfran reservoir. The installation of variable speed pumps will enable more efficient river regulation to preserve Llysyfran reservoir storage during critical dry years.

This scheme was by far the most cost effective of the options available at a cost of around £13m.

The Vowchurch Water Resource Zone

We have assessed the susceptibility of the Vowchurch zone to severe droughts using an ‘extreme value’ statistical analysis and this indicates that the zone is not likely to be resilient to a drought event that might be seen in 1 in 200 years. In such an event, we estimate that there is a possibility that we might need to resort to extreme demand management measures such as rota cuts.

Although the risk is low, the impact to our customers in the area is unacceptable.

There are limited options to resolve this issue in this area and demand management efforts such as leakage reduction would not on its own resolve the situation. Our plan is therefore, to lay a main between our Hereford and Vowchurch zones to improve the situation.

This would be at a cost of around £6m.

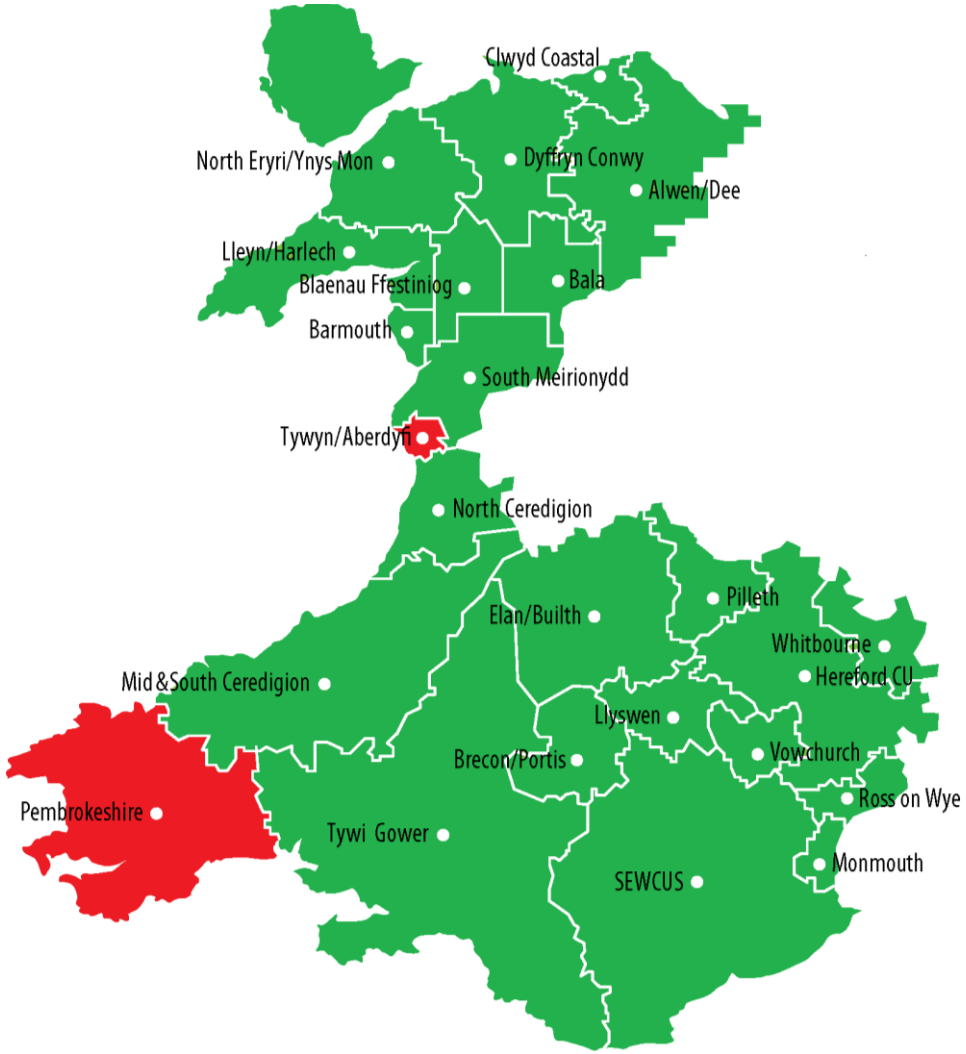


Figure 47 : Predicted water deficit zones (in **red**) in Wales between 2020 and 2050. © Welsh Water

3. Strategic Responses

Strategic response 3. Improving the reliability of drinking water supply systems

Faced with an increased risk of outages due to agricultural run-off, extreme weather events, terrorism, and cyber attacks, we will build more flexibility and integration into our water treatment and supply systems.

Customer impact

Water supply is the primary aspect that customers associate with our business. They expect a clean, safe and continuous supply (Welsh Water, 2016).

There is acceptance that some aspects of supply interruption are outside the control of Welsh Water. However, all customers highlighted the substantial impact that a loss of supply for more than 24 hours would have on them and, in particular, businesses' ability to stay open (Welsh Water, 2016).

Responding to future trends

Currently, Welsh Water does not have a grid supply system and there is very little connectivity between our areas of supply. For example, in many areas we typically have a single source (such as an impounding reservoir or river abstraction point), feeding a single water treatment works, which is fed by a single trunk main to the distribution system.

When any element of this supply system fails, whether due to raw water deterioration, treatment process failures, burst pipes or extreme weather events, there is no redundancy, and fixing the problem can be a major and urgent undertaking.

In the future, there is the potential for increased risk of failure of the water treatment system due to increased agricultural run-off, invasive species, extreme weather events, cyber attack and supply chain or critical asset failure.

Strategic response

We believe that we will need to invest to meet customers' growing expectations for the reliability of their drinking water supplies. The aim of this strategic response is to provide connectivity between our water resource supply zones and treatment works by moving from a traditional point to point distribution system to an automated grid system, that incorporates redundancy and strategic storage where necessary. The strategic response could ultimately:

- Reduce the number of water resource zones from 24 to 11 through connecting assets;
- Move from 63 to 39 water treatment works, which are more resilient to power outages, flooding and water quality contaminants;
- Aim to ensure that there is never just a single point of supply to groups of 5000 properties or more - the trigger level at which an alternative supply, in the event of an outage, cannot be provided by tankering;
- Build at least 24 hours' worth of treated water storage capacity at our treatment works;
- Transition from point to point distribution systems to grid and ring main supply systems in urban areas; and
- Secure the physical and cyber security of our assets to prevent supply disruption.

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Research lower cost treatment solutions to provide more resilient works such as ceramic membranes and efficient ultraviolet treatment;
- Development of new tunnelling techniques with our Alliance Partners to allow for optimal routing of trunk mains, to facilitate the construction of a grid supply system; and
- Research innovative resilient treatment and control systems, to enable protection against treatment related shocks, as well as deal with emerging cyber and security threats.

Welsh Water will work on this research with landowners particularly for site acquisition near new treatment works.

Co-operative approach

We need to work together to address at risk private water supplies in the most efficient manner. We will actively collaborate with the following identified partners:

- Drinking Water Inspectorate;
- Brecon Beacons National Park;
- Local Planning and Highways Authorities; and
- Capital Delivery Alliance Partners and wider supply chain.

Figure 48 : Wentwood reservoir © Arup

3. Strategic Responses

Strategic response 3. Improving the reliability of drinking water supply systems

Customer promises

Clean, safe water for all

A resilient supply system will improve the ability of Welsh Water to continue to provide a reliable source of clean, safe water to all its customers into the future.

Safeguard our environment for future generations

A grid system will allow Welsh Water to use more efficient and less environmentally sensitive water sources where available, and avoid unnecessary damage to ecosystems.

Put things right if they go wrong

A resilient grid supply system will dramatically improve the ability of Welsh Water to respond to shocks and stresses on the water supply network.

Fair bills for everyone

The more efficient distribution of water resources in a grid system will reduce long-term operational costs, and help deliver value for money for customers into the future.

A better future for all our communities

A resilient supply network will help reduce the negative effects associated with supply shocks on communities, especially in rural areas.

Well-being goals

A resilient Wales

The increased efficiency and resilience of water supply associated with a grid system will improve the capacity of the system to cope with change. Avoiding unnecessary damage to ecosystems.

A prosperous Wales

The more efficient use of water resources through a grid system, enhanced customer supply resilience and an ability to use cheaper sources of water will contribute to the creation of an innovative and productive society.

A Wales of cohesive communities

Resilient water supply and treatment systems are essential for the maintenance of strong communities, protecting them from shocks and stresses and enabling them to be viable and safe into the future.

Figure 49 : Water supply pipes on the A465. © Arup

3. Strategic Responses

Strategic response 3. Improving the reliability of drinking water supply systems

Direction of travel

Improved Customer Outcomes

By having a fully resilient water supply system, incorporating the key resilience elements we will;

- Create a resilience grid system that allows greater flexibility to supply 1.2 million customers, who are currently at risk if one of our major water treatment works (WTWs) failed;
- Reduce the number of customers that are reliant on a single source of supply by 2050. In the largest investment scenarios, we could further reduce the number of such customers from 340,000 to 22,000;
- Improve our customer service by reducing the outages that customers experience;
- Be more resilient to extreme weather events such as drought, storms and freeze thaws;
- Have greater flexibility to deal with things when they go wrong;
- Have the ability to use cheaper sources of water during periods when we have it;
- Save operational expenditure as we will require fewer maintenance teams and require fewer critical spare parts due to the modernisation of the WTWs; and
- Provide protection for changes in raw water quality and availability to manage the impacts of climate change and lifestyle changes.

Scope of work

We plan to rationalise the number of water treatment works from 63 to around 50, with the potential to reduce this number further to 40. Our remaining treatment works would be refurbished with new software and equipment, including specific measures for resilience against future shocks such as security upgrades (including cyber security), flood resilience, power resilience and treatment flexibility. This programme will include the completion of Merthyr Tydfil Water Treatment Works, which will consolidate five ageing assets with limited inter-operability into an integrated conjunctive system. Furthermore, we will also build at least 24 hours' worth of treated water storage capacity at our critical treatment works or in our networks.

Moreover, we will aim to connect trunk main systems to reduce the number of water resource zones from 24 to 11. If required, we could go further to reduce the number of zones to just nine and establish more grid systems within urban areas, or more widely, to maximise conjunctive use.

We plan significant investment to improve the reliability of our drinking water supply systems by rationalising and building resilience at our water treatment works and connecting trunk main systems to maximise conjunctive use. By reducing the total number of treatment works, reducing downtime and building a conjunctive system we will realise some offsetting efficiencies in our operations and expect the total net cost over 30 years, depending on the extent of rationalisation, to be between £350m and £950m.

3. Strategic Responses

Strategic response 3. Improving the reliability of drinking water supply systems

Case study: Dolbenmaen water treatment works

In 2015, Welsh Water commissioned a new water treatment works in North Wales, replacing two existing assets with a new resilient asset.

Issue

Cwmystradllyn and Garndolbenmaen water treatment works were both designed and constructed in the 1960s and were not designed to meet current water quality standards. Cwmystradllyn in particular had problems with cryptosporidium and the removal of organic matter from the water. This resulted in the formation of unwanted components after chlorine treatment, that could potentially be hazardous to health.

Action taken

A new water treatment works was constructed at Dolbenmaen with a capacity of 15 million litres per day, capable of providing clean water to 45,000 people.

The new water treatment works was designed to meet current and future water quality standards by treating the water with new chemical dosing, as well as removing particles and adding chlorine to remove bacteria. There is also additional treated water storage as well as new pipelines to distribute the clean water to homes and businesses.

A hydro turbine generator capable of producing electricity was also installed on the water main transporting water from Cwmystradllyn to the new water treatment works.

Result

As a result of this new water treatment works, the following impacts have been achieved:

- The new water treatment works is capable of supplying 45,000 people;
- The treatment processes involved are capable of reducing any previous risks associated with the two old treatment works;
- Cryptosporidium is now removed through advanced separation and filtration processes as well as inactivation through the use of ultra-violet light;
- The formation of unwanted hazardous chemicals has also been reduced through the installation of advanced chemical dosing and separation processes; and
- Improved treatment has led to improved taste for customers, and removed the need for costly re-chlorination of water in the distribution system.

Figure 50 : Photograph showing the new Dolbenmaen Water Treatment Works, Gwynydd, Wales. © Welsh Water

3. Strategic Responses

Strategic response 3. Improving the reliability of drinking water supply systems

Case study: Merthyr Tydfil water treatment works

A series of reservoirs and water treatment works in the Brecon Beacons that supply water to some of the major population centres of South Wales, particularly Cardiff, Merthyr Tydfil and the Rhymney Valley, are in need of replacement. A project is being considered to replace up to five of the existing treatment works with a new larger works in the Merthyr Tydfil area.

Issue

The existing water treatment works were originally built in the early part of the 20th century, and these ageing assets have difficulty in providing a good service in the face of deteriorating raw water quality. The sites have been altered many times over the years and now have limited space for the additional treatment capability required to manage the emerging problems. The current configuration also provides limited resilience to manage supply in the event of problems with poor raw water quality or drought.

Actions to be taken

This project would comprise:

- Construction of a new treatment works capable of supplying 350,000 households and businesses with water;
- The new water treatment works would consist of comprehensive and advanced treatment processes capable of treating water to current quality standards as well as being capable of meeting potential future regulatory changes and emerging new risks to drinking water quality; and
- The existing pipeline network would be reconfigured to feed the treatment works from existing reservoirs and ensure treated water is supplied to the areas currently served by the existing water treatment works.

Potential result

As a result of this project, we would hope to achieve:

- Higher and more consistent water quality;
- Improved flexibility with the existing and improved network ensuring continuous supply to customers;
- Lower operational costs;
- Ensuring a resilient water supply for South Wales for the future; and
- Supporting a wider South Wales network, which supplies water to close to one million people.

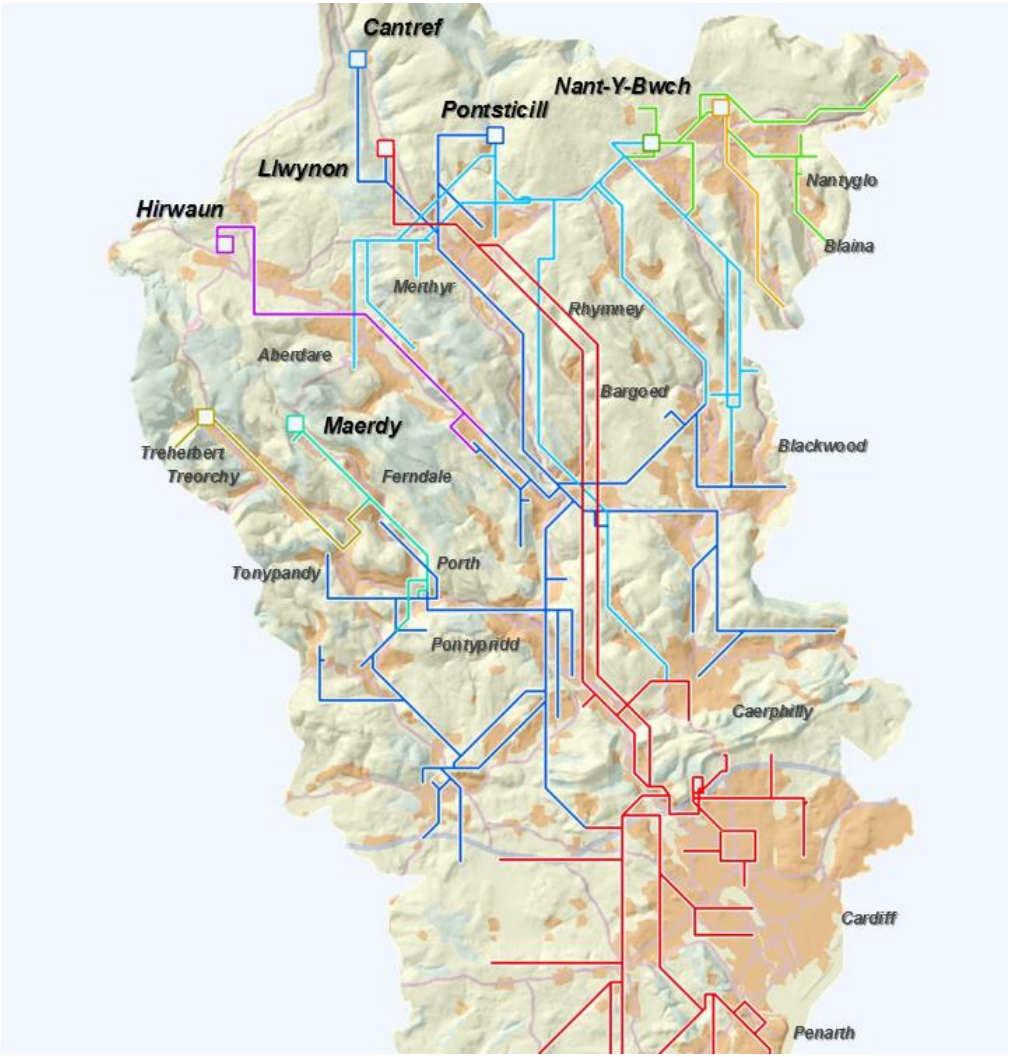
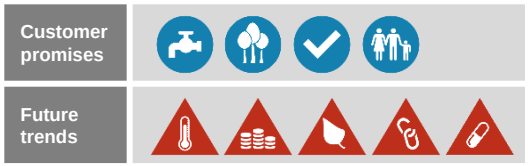


Figure 51 : Our supply system north of Cardiff. © Welsh Water

3. Strategic Responses

Strategic response 4. Protecting our critical water supply assets

With increasing risks of disruption (for example, from severe weather events resulting from climate change and increased reliance on technology) and limited customer tolerance of supply outages, we will improve the resilience of critical water assets which have high consequences of failure.



Customer impact

Customers have some tolerance for brief outages to supply. However, they become increasingly less accepting of outages the longer they last. Business customers, even those that are not water dependent, also view such a level of interruption as wholly unacceptable (Welsh Water, 2016).

Responding to future trends

Welsh Water has identified our most critical assets, where failure would lead to a significant customer service impact. The risk of failure of these assets due to events such as cyber attacks, flooding, coastal erosion, and contamination is likely to increase due to the trends previously identified, including climate change, land use change, increased use of technology and increased pressure on the supply chain.

Strategic response

This strategic response ensures a high degree of resilience for all those assets for which the consequence of failure is so great that it cannot be mitigated by an operational response, such as rezoning or tankering. It is unnecessary to achieve the same level of protection at all our other assets as their failure can continue to be mitigated through operational means. For these critical assets, Welsh Water has made an assessment of the resilience to the following threats: security, flooding, coastal erosion, catastrophic failure, contamination, loss of power and cyber threat. We propose a risk-based approach, targeting assets with a high consequence of failure first. We have identified the following measures to improve resilience:

- Complete security upgrades;
- Installation of flood resilience measures around critical assets;
- Improvements to power resilience and onsite power generation;
- Upgrades to treatment works control systems;
- Improvements to treatment flexibility to deal with varying raw water conditions;
- Improvements to maintain access;
- Develop, test and refine business continuity plans for key assets; and
- Twinning of strategic mains crossing under rivers, roads and railways.

Dams and dam pipework are considered in strategic response 2, “enough water for all”. We have also recognised the need to develop ‘best practice’ resilience design and operation standards.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- Commission research to assess flood risk to critical sites, using a wider historical evidence base than studies to date;
- Develop new pipe repair technologies with our Alliance and other suitable partners, including self-repair technologies;
- Research different post-event recovery approaches to inform continuity plans; and,
- Research interdependencies between infrastructure sectors including energy, transport and the supply chain. This research may be a collaboration with energy and transport agencies as well as the supply chain.

We will collaborate with Category 1 and 2 responders on these topics.

Co-operative approach

This strategic response will focus on innovation and working with suppliers to ensure continued reliable service provision. We will actively collaborate with the following identified partners:

- Scottish and Southern Energy Power Distribution ;
- Western Power Distribution;
- Critical supply chain partners;
- Network Rail;
- Natural Resources Wales and the Environment Agency; and
- Local Authorities (particularly Highways and Flooding teams).

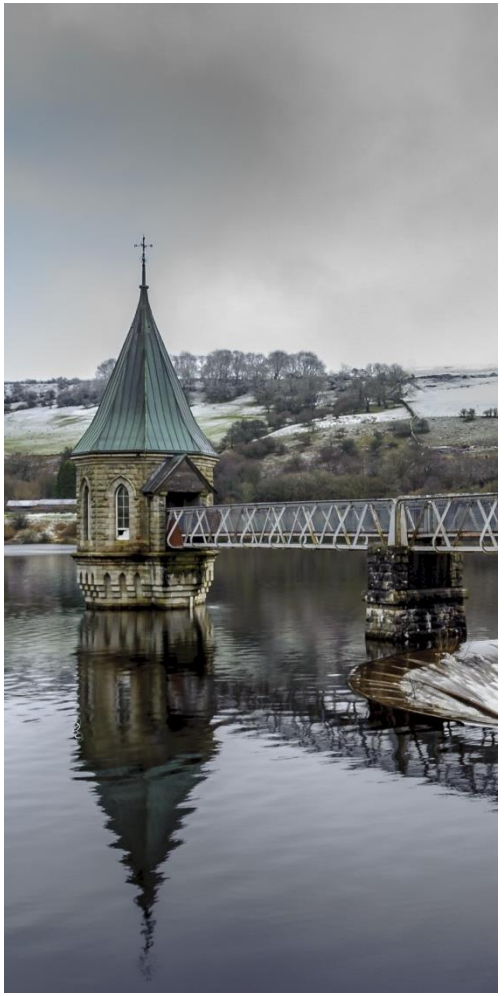


Figure 52 : Pontsticill Reservoir. © Welsh Water

3. Strategic Responses

Strategic response 4. Protecting our critical water supply assets

Customer promises

Clean, safe water for all

Resilient assets will improve the ability of Welsh Water to continue to provide clean, safe water to all its customers into the future.

Safeguard our environment for future generations

More resilient assets will reduce the risk of environmental pollution incidents.

Put things right if they go wrong

More resilient assets will improve the ability of Welsh Water to respond to shocks and stresses on the water supply network.

A better future for all our communities

A resilient supply network will help reduce the negative effects associated with supply shocks on communities.

Well-being goals

A resilient Wales

Full resilience of assets will improve the capacity of our systems to adapt to change.

A prosperous Wales

Full resilience of assets, and associated reliability, will contribute to an innovative and productive society, and the wealth of Welsh Water's customers.

A healthier Wales

A safe and reliable drinking water supply will help to ensure good general health and support the treatment of poor health amongst the people of Wales.

Figure 53 : A small Welsh Water UV treatment plant in Herefordshire. © Arup

3. Strategic Responses

Strategic response 4. Protecting our critical water supply assets

Direction of travel

Improved Customer Outcomes

By having resilient water service assets protected against security risks, flooding, coastal erosion, catastrophic failure, pollution, loss of power and cyber threats, we will:

- Meet customer expectations that our service provision resists and recovers from ‘shocks or stresses’, i.e. drought, storms and severe winters;
- Reduce the risk of major water supply interruptions;
- Reduce the risk of travel disruption resulting from failure of water mains;
- Reduce outages of water treatment works and breaches in public health standards; and
- Reduce the risk of terrorist or cyber disruption of key national infrastructure.

Scope of work

This is a risk based approach focusing on protecting the most strategic and critical water assets, which have a high consequence of failure and cannot be met with operational mitigation. We plan to protect around 50 (of 79) impounding reservoirs, 10 (of 680) pumping stations, 15 (of 491) service reservoirs, and 20 (of 63) water treatment works. Other assets do not require such a high level of protection as their failure can be mitigated through operational means, for example, tankering and re-routing water supplies through the water supply network.

To improve the resilience of these vulnerable assets, we will make a number of specific upgrades. To improve cyber security, we will aim to complete security upgrades in our asset control systems, and upgrade our treatment works control systems. To protect against other physical risks, we will aim to also install flood resilience in and around our critical assets, improve power resilience and install onsite power generation where possible. We will also make improvements to access arrangements for our assets for people and vehicles. Moreover, to protect our critical supply network, we will also twin strategic mains crossings under rivers, roads and railways.

To deal with shocks in water quality, we will aim to improve the flexibility of our treatment works and hence their ability to deal with more variable input conditions. Finally, we will develop, test and refine business continuity plans for key assets and develop resilience design and operations standards for retrofit at current assets and the design of future assets.

We will invest in resilience upgrades at our critical water assets to protect them against physical risks such as vandalism, flooding, power outage and poor raw water quality as well as cyber attacks. The total cost is expected to be around £300m.

3. Strategic Responses

Strategic response 4. Protecting our critical water supply assets

Case study: Pontsticill water treatment works

In 2009 Welsh Water identified a risk of flooding at Pontsticill water treatment works, which supplies approximately 100,000 properties in South Wales. Investment has been made to protect the works in the instance of flooding and ensure a continued supply of safe drinking water.

Issue

Detailed flood modelling identified that the site was at risk of flooding from a 1 in 100 year storm from the river which flows through the site. The operators reported occasions of near misses in recent history. This level of flooding would damage some interstage pumping and the second stage filters, meaning that it would not be possible to provide safe water from the site for some time after the flooding subsided.

Action taken

As part of this project, the following interventions were made:

- New flood proof doors were installed on critical buildings;
- Ducts to critical buildings were sealed;
- The pipe bridge was raised to ensure it does not create a blockage in the event of raised water levels; and
- Works were carried out to divert the watercourse using redundant lagoons and provide a bypass in the event of high water levels.

Result

As a result of this project, the site flood risk has been reduced to safe levels.

Figure 54: Raised pipe bridge at Pontsticill. © Welsh Water

3. Strategic Responses

Strategic response 4. Protecting our critical water supply assets

Case study: Felindre Main Strengthening

The Felindre trunk main is a major link between South East and South West Wales, allowing for the transfer of treated water to support a number of communities.

Issue

The 65 km long main is largely a single pipe, travelling close to a major railway, a motorway and crossing several major rivers. In total, 34 risk points have been identified along its length. This means that if it is damaged or bursts then any repair would be difficult and take some considerable time, due to the close proximity to other infrastructure and difficulties with access.

Actions to be taken

The improvements to the resilience of the main are expected to be undertaken in phases over a number of years. An initial detailed study and site investigation is required to identify options and prioritise projects to progress. The majority of the work is likely to be providing parallel pipes at critical points, so that water can be switched over in the event of a problem and customers' supply can continue. This will also allow pipes to be maintained and the condition monitored, spotting the warning signs of problems before catastrophic failure.

Expected result

Improved flexibility ensuring a continuous supply to customers.

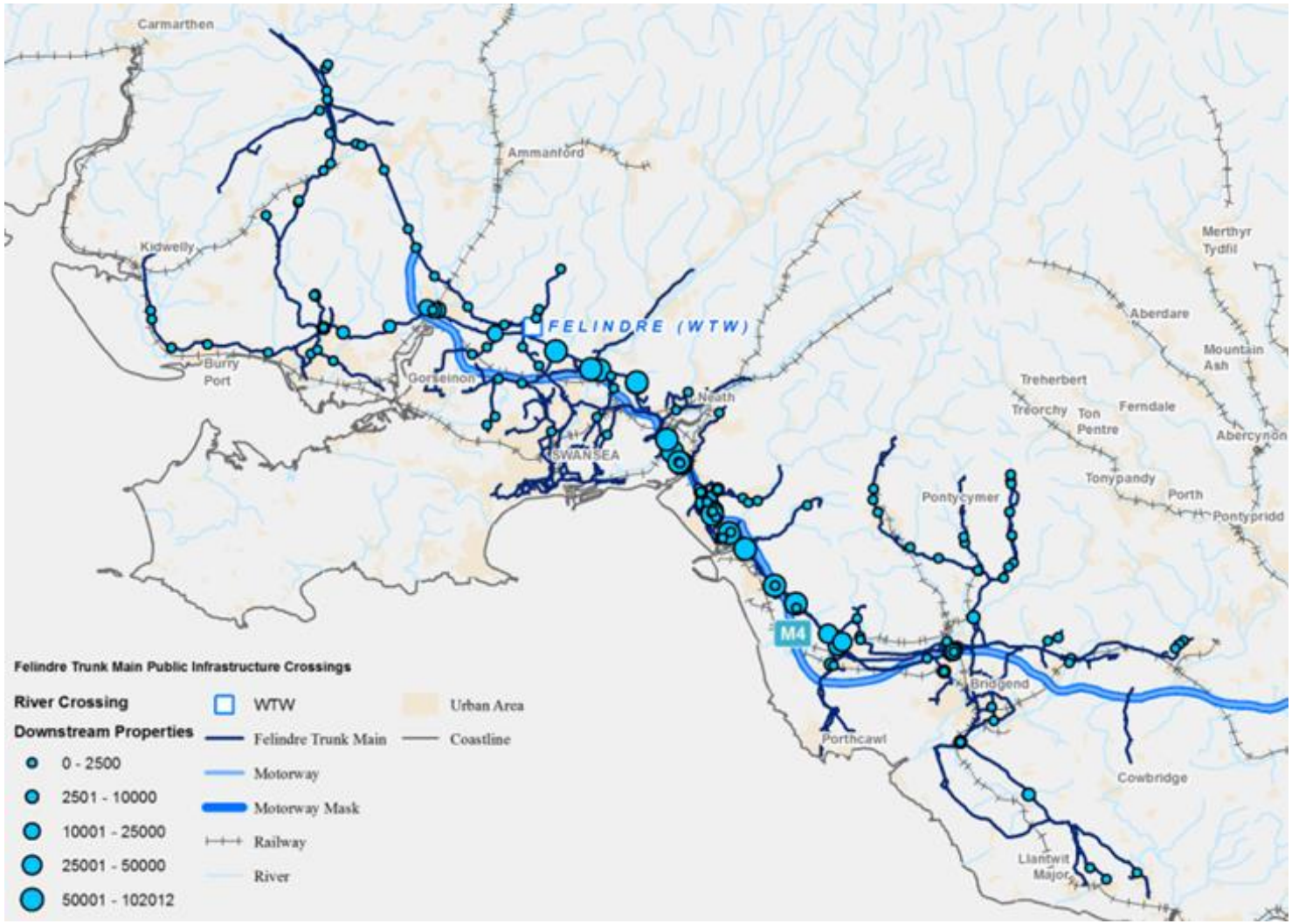


Figure 55 : Schematic of Felindre Trunk mains and surrounding infrastructure. © Welsh Water

3. Strategic Responses

Strategic response 5. Achieving acceptable water quality for all customers

Ageing water mains and more extreme weather events increase the risk of supplying water which is discoloured or has a poor taste. This will be addressed through a targeted replacement of iron mains.

Customer impact

Acceptability of water (including colour, taste and odour) is a high cause of customer contacts. We had approximately 7,800 customer contacts in relation to discoloured water in 2016, an increase from approximately 7,000 contacts in 2015. 80% of these contacts were from customers in just 24% of water supply zones, indicating a concentration of issues in poorly served areas. Customer complaints in relation to discoloured water are the one area of our performance which is behind that of other UK water companies, partly due to ageing iron mains and partly due to the nature of raw water from our upland catchments.

In initial PR14 research, customers noted the need for pipes to be repaired as and when required but also the need to ensure these are replaced with new materials to ensure supply is future proofed (Accent, 2013).

Responding to future trends

Some 40% of Welsh Water's water mains (11,000km of the 27,500km) are cast iron. These pipes currently present significant reliability issues, and on average experience 30 bursts per 1,000km of pipe (compared to 6 per 1,000km for plastic pipes).

Climate change is predicted to cause more extreme temperatures, and these extreme temperatures, combined with ground movements and changes in water pressures, are likely to increase the likelihood of burst pipes in the future.

Cast iron pipes can also have issues with discoloured water, contributing to customer complaints.

Strategic response

Improving the acceptability of water quality for customers is a current priority for us. This strategic response will involve the targeted replacement of up to 11,000km of cast iron water mains with more reliable plastic pipes, creating a more secure supply for our customers with improved water quality and reducing leakage, supporting strategic response 2, "Enough water for all".

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Undertake holistic zonal studies to prioritise pipe replacement and maximise the positive impact on customer service;
- Chemical free treatment processes, for example, through catalysis;
- Develop more cost effective methods of pipe replacement including new reinstatement technologies (including 'no dig' techniques), new more efficient materials, ecological assessments, and jointing methods; and
- Research new pipe cleaning techniques (including self cleaning).

We will work with our supply chain to achieve cost effective and less disruptive pipe replacement.

Co-operative approach

This strategic response will involve working closely with other utilities and highways to reduce disruption to supply network. We will also actively collaborate with the following identified partners:

- Customers and communities;
- Customer Challenge Group;
- Zonal Study experts; and
- Drinking Water Inspectorate.

Figure 56 : Some of our younger stakeholders. We want all of our customers to have access to good quality water. © Welsh Water

3. Strategic Responses

Strategic response 5. Achieving acceptable water quality for all customers

Customer promises

Clean, safe water for all

Replacement of water mains with appropriate materials will improve the ability of Welsh Water to continue providing clean, safe drinking water that customers can rely on in to the future.

Put things right when they go wrong

Replacement of water mains will reduce the need for reactive maintenance, and help to reduce the problems of supply outages, water discolouration and low pressure.

A better future for all our communities

Increased resilience of supply will help reduce the negative effects associated with supply outages on communities, especially those which are disproportionately affected by outages at present.

Well-being goals

A resilient Wales

The improved resilience associated with appropriate materials will increase the ability of the network to cope with climate change.

A more equal Wales

Providing a more resilient water supply to communities, who experience repeated supply outages, such as those with the oldest supply pipes often in the most deprived regions, to ensure a resilient water supply is enjoyed equally by our customers.

A Wales of cohesive communities

Reducing repeat supply outages will ensure some communities do not perceive themselves as less important to Welsh Water.

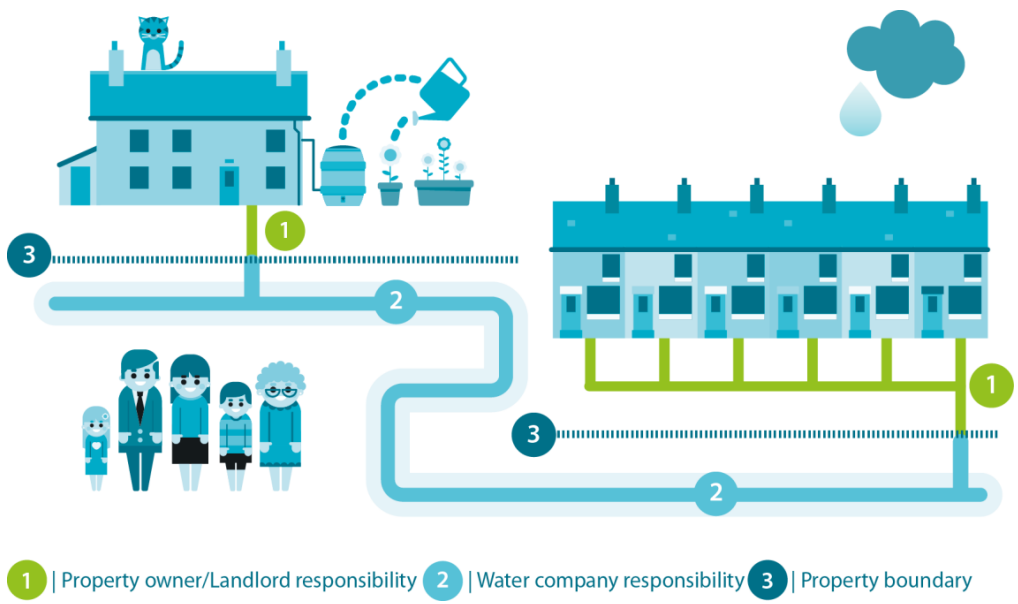


Figure 57 : An illustration of the ownership structure of water supply pipes. © Welsh Water.

3. Strategic Responses

Strategic response 5. Achieving acceptable water quality for all customers

Direction of travel

Improved Customer Outcomes

By targeted replacement of iron mains with modern, plastic mains across these zones, we will aim to:

- Reduce customer contacts from 2.9 acceptability contacts per 1,000 population to 0.8-1.3 acceptability contacts per 1,000 population. We could go further with additional iron mains replacement and seek to reduce the number of customer contacts to 0.5-1.0 acceptability contacts per 1,000 population by 2050;
- Reduce Customer Minutes Lost to supply below seven minutes (average per customer per year) from around 15 minutes at present, or potentially to below 3 minutes in the most extensive pipe replacement scenarios;
- Reduce leakage by between 7% and 30% through reduced pipe bursts;
- Improve water quality for between 5,000 and 8,000 customers;
- Improve reliability of supply and reduce bursts by 50%;
- Support our strategy to achieve ‘Calm Networks’;
- Remove iron failures and improve the quality of drinking water;
- Reduce operational costs through reduced pipe bursts, call outs and leak repairs.

Scope of work

During AMP6 we will plan to complete the implementation of the recommendations of zonal studies for around 25% of zones where 80% of customer contacts come from, which will include the replacement of around 500km of water mains. In AMP 7, we will aim to complete zonal studies for around a third of the remaining zones.

Moreover, using the outputs of these zonal studies we may replace 500km of iron mains per Asset Management Period (AMP) from AMP8 (2025-2030) to AMP12 (2045-2050), comprising 2,500km in total, with the possibility of upgrading a further 8,000km of iron mains serving smaller populations to improve water quality and reduce Customer Minutes Lost for our customers, should that prove necessary and cost effective.

Based on recommendations from our zonal studies, we plan to invest in targeted replacement of cast iron water mains with modern, plastic mains to improve water quality for our customers. Whilst this investment programme will be very expensive, the response is expected to lead to a significant reduction in maintenance expenditure, and hence the total net cost over 30 years will be around £450m - £1.80bn, depending on the total length of iron mains replaced.

3. Strategic Responses

Strategic response 5. Achieving acceptable water quality for all customers

Case study: Zonal Studies

Zonal Studies are analytical reviews of water quality, hydraulic and customer performance data to determine investment options within an individual water quality zone, of which we have 83 across our supply network. To achieve our performance commitments across a variety of network measures, we must intervene and replace some of our old pipework. Replacing this old pipework improves our customer service in a number of ways: quality of drinking water, customer minutes lost and acceptability of water.

Issue

Welsh Water have a number of iron mains that are corroded and at risk of failure. Their failure would cause significant disruption to supply and/or discoloured water complaints.

Action taken

Welsh Water have:

- Prioritised poor performing water supply zones and pipework covering 14 zones and a population of approximately 860,000 people;
- Completed 203km of pipeline renewals – This is a process of removing the old pipework from the supply system and replacing it with modern materials such as plastic;
- Undertaken 200 surveys, prioritising what pipes should be surveyed to ensure we assess and catalogue the condition of our pipes:
- Cleansed 703km of network cleansed; and
- Completed approximately 30 schemes for network contingency and pressure management.

Our customers will notice major improvements in the water supply reliability and quality.

Result

There has been an annual reduction of:

- approximately 130 unplanned interruptions to supply;
- 1,800 customer contacts for discoloured water; and
- 7 drinking water quality failures.

Next steps

Following on from the success of the AMP6 investment in zonal studies in the poorest performing areas, we are proposing continued investing in this initiative. Our vision is to ensure that our customers will be able to trust that the water they drink meets high standards of quality all the time, and always looks and tastes good.

Figure 58 : Iron pipe corrosion. © Welsh Water

3. Strategic Responses

Strategic response 6. Towards a lead free Wales

We have the opportunity to help improve public health, and propose a targeted replacement of lead communication and supply pipes, as part of a wider societal effort to address lead in drinking water.

Customer impact

Welsh Water has a good record on compliance with water quality standards, including those relating to lead (Glas Cymru, 2016).

There are known adverse health effects of excessive, long term lead exposure. Lead is a cumulative toxin that affects multiple body systems, and prolonged exposure can, in extreme cases, have serious consequences such as a reduced IQ and behavioural problems. Children and expectant mothers are particularly vulnerable.

Most customers experience no issues with drinking water quality, and we comply with World Health Organisation drinking water standards 99.71% of the time in 2016. However, customers who are aware of the risks following a lead failure or the detection of lead solder at their property, can become anxious about potential health effects, particularly when children live in the property. It is also possible that there could be tightened health standards for lead toxins in the future.

Responding to future trends

Water utilities are the utility provider which does not own assets to point of use. This can cause confusion amongst customers, and a rise in complaints.

It is estimated that 25% of homes (380,000) in Wales have lead pipes, most of which are owned by the customer. The Water Strategy for Wales recognises that transferring a portion of privately owned pipes to water companies could be part of the solution to the problems associated with lead (Welsh Government, 2015a).

It is estimated that 25% of Welsh Water's leakage is from lead supply pipes. They are at increased risks of bursts due to freeze thaw, an issue that will be exacerbated by climate change and increased cold weather events. Customers are responsible for maintenance of these pipes, and replacement typically costs several hundred pounds.

Lead in drinking water is a societal issue in which we are planning to play our part. Currently Welsh Water does not have responsibility for customer owned supply pipes nor, therefore, the ability to require them to be changed. We are, however, willing to be an active participant in exploring wider lead pipe replacement with Welsh Government, as part of a wide societal effort to address lead in drinking water.

Strategic response

Given the benefit to public health, we believe that we have a role to play in addressing the issue of lead supply pipes. However, we do not propose to replace all lead pipes as we are not legally responsible for customers' supply pipes. This strategic response will involve four programmes to mitigate the risks of lead pipes replacement:

- Replacement of all communication and lead supply pipes by Welsh Water where higher than normal lead sample readings have been identified (even though these will typically still meet all the required health standards);
- Replacement of lead supply pipes amongst vulnerable customer groups, through the Welsh Governments 'Arbed' and 'Nest' schemes for households with expectant mothers and children under 6;
- Replacement of lead supply pipes by Welsh Water when found during meter installations; and
- Offering grants to all customers who approach Welsh Water if they find lead pipes.

If Welsh Government placed a requirement on Welsh Water to replace of all lead supply pipes, it would require a change in legislation and would cost an estimated £650m.

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Research and quantify the impact of lead in drinking water to public health through the Water Health Partnership;
- Research new techniques and technologies for pipe replacement or remediation technology;
- Research the impact of supply pipe adoption; and
- Research alternatives to chlorine in combatting the plumbo-solvency of lead in water.

We will collaborate with the Drinking Water Inspectorate to undertake this research.

Co-operative approach

We will actively collaborate with the following identified partners:

- Welsh Government;
- Warm Homes – Arbed;
- Water Health Partnership;
- Plumbing Standards Body (WaterSafe); and
- Landlords and Home owners, with a focus on local authorities and Registered Social Landlords.

3. Strategic Responses

Strategic response 6. Towards a lead free Wales

Customer promises

Clean, safe water for all

Safe and resilient customer supply pipes will help Welsh Water supply clean, safe water into the future.

Fair bills for everyone

Working with stakeholders to help vulnerable customers with lead supply pipes to replace them with safe, modern alternatives.

A better future for all our communities

Reducing the health effects associated with lead piping will help to improve the health of Welsh Water's customers and create a better future for communities.

Well-being goals

A resilient Wales

More robust non-lead supply pipes will increase the ability of these assets to cope with climate change.

A more equal Wales

The phased replacement of lead piping, initially targeting the most vulnerable and those with the least ability to pay will help to promote health amongst all customers, equally.

A healthier Wales

Reducing the health effects associated with lead piping will help to improve the health of Welsh Water's customers.

Figure 59 : Pipe replacement. © Welsh Water

3. Strategic Responses

Strategic response 6. Towards a lead free Wales

Direction of travel

Improved Customer Outcomes

Over time, this will reduce the background levels of lead in drinking water, leading to improved public health, particularly for children and expectant mothers. It will improve water fittings compliance and quality through direct contact and engagement with WaterSafe accredited plumbers and will also provide the added benefit of reducing supply pipe leakage.

Scope of work

Whilst customer supply pipes are not Welsh Water's legal responsibility, we do have responsibility for water quality at customers' taps. We have proposed four programmes involving the targeted replacement of lead supply pipes, where there would be a benefit to public health.

Firstly, we could replace all communication and supply lead pipes (estimated at 140 pipes a year) when we have a sample reading of more than 5 micrograms Pb/litre, which is half the prescribed health standard.

Secondly, we could focus on replacing lead supply pipes for vulnerable customer groups identified through Welsh Government's Arbed project (approximately 6,600 properties over 15 years) and Nest (approximately 16,000 over 15 years) schemes.

Thirdly, we could replace lead when found during meter installations (approximately 1,500 per annum), including supply and communication pipe replacement.

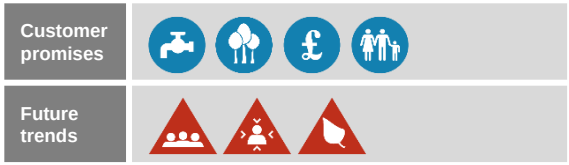
Finally, we could reduce complexity by offering grants for lead pipe replacement to customers who approach Welsh Water if they find lead pipes (approximately £750 per grant).

We propose to undertake targeted replacement of lead supply and communication pipes, where sample readings are abnormal, for vulnerable customers through Welsh Government's Arbed and Nest schemes, or when they are found during meter installations. We also propose to offer grants to customers to replace their lead supply and communications pipes. The potential investment required for this strategic response over 30 years would be in the order of £50m.

3. Strategic Responses

Strategic response 7. Working with customers and communities

We will work with customers and communities to co-create solutions, share knowledge, and support initiatives which reduce water use, prevent sewer abuse, and provide wider benefits for communities and the environment.



Importance for customers

The benefits of working with customers to co-create and shape what and how that service is delivered include more community buy-in and ownership of projects, community-facilitated maintenance, reduced water use and improved public perception of the water company. We will engage in communities we serve through co-creation, community-led projects, our supply chain, and aim to maximise the benefits in the communities we serve including improving bio-diversity and the environment, recreation, and the socio-economic impact of our work.

Many consider the water industry to be very complex, and so education could serve to help customers understand both their own impact on the water environment, and the importance and complexities of the work that we do to provide clean running water, and remove wastewater from homes. During our 'Have Your Say' Consultation, many consultees believed that Welsh Water should be implementing schemes to encourage efficient water use. We see this as an integral part of what we can work on with our customers to improve our services.

Responding to future trends

Demand management is an important part of the solution for some of the challenges we face in the future trends identified in this report. Welsh Water acting alone to manage water supply can only solve one half of the equation.

Welsh Water can also work with communities to respond to pressures on the environment and biodiversity through community-led projects such as RainScape. These also have additional benefits of improving health and well-being.

Strategic response

Following the consultation, we believe our approach should go beyond statutory requirements and identify where working with customers can help address water supply challenges. There is an opportunity to engage households on demand management and behavioural change as part of this strategic response, delivered through effective customer communication, education and stewardship.

Demand management:

- We will work with customers to help them understand the value of water and reduce their demand, helping them save money too, through initiatives and advice on water-saving devices, water harvesting and recycling grey water. Energy costs associated with heating water are significant for both households and businesses and also can be addressed through demand management.

Behaviour change:

- Develop an improved understanding of customers in Wales and opportunities to change behaviour and enhance their participation in water cycle management.
- Investigate new behavioural techniques help customers to avoid introducing inappropriate solids into the sewer network.
- Adopt smart metering and the Internet of Things in relation to our services to help customers manage their water use.
- Raise awareness about impacts that our systems and misuse of sewers have on the environment, and work with customers to reduce these.
- Examining incentives for customers to drive behavioural change, such as wastewater metering to reduce discharge volumes.

Communication and education:

- Improving education and awareness of water issues of both general public (on demand management and stewardship) and landowners (on pollutants).
- Educate about the process of delivering safe, clean drinking water. Lead the way in educating households. From our consultation, members want to know about how they can help to alleviate some of the stress on the water system.
- Increase awareness and understanding of blue infrastructure: RainScape provides us with opportunities to raise awareness of the link between urban water quality, sensible use and our water sources in upland catchments.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- Understand the behavioural economics behind water use, encouraging customers to pay bills, accepting help, blockage reductions, willingness to go on a meter;
- Understand how to influence customers to use appropriate channels for contact, for example, using the website and chat bot for frequently asked questions;
- Work with the Consumer Council for Water to harness the findings of their 'triangulation project' to build a better customer evidence base (ICF, 2017);
- Horizon scanning on customer communication technologies; and
- Understanding smart technologies that could help customers and business users reduce their water use.

Co-operative approach

This strategic response will take an approach which will include education, community engagement, co-creation, and working with community groups. We will actively collaborate with the following identified partners:

- The Consumer Council for Water;
- Waterwise;
- Energy Savings Trust;
- Local Health Boards;
- Local charities;
- Local Authorities;
- NRW;
- Officer of the Future Generations Commissioner; and
- Housing Associations.

3. Strategic Responses

Strategic response 7. Working with customers and communities

Customer promises

Personal service that's right for you

Working more closely with customers and wider sections of society will be beneficial to achieve collective outcomes.

Safeguard our environment for future generations

Water stewardship in all areas of the water cycle in Wales will help improve biodiversity and the quality of the landscape. We will continue our role in educating future generations about the importance of the water environment, including its flora and fauna, and the damage that sewer misuse can cause on the environment.

Fair bills for everyone

Supporting households and citizens to manage their demands, with initiatives including improved smart metering.

A better future for all our communities

Working in partnership with other organisations and individuals will be beneficial to achieve collective outcomes and wider benefits for communities. We will adopt a community-centred approach, which will target one community at a time to provide holistic services including upgrades to infrastructure, RainScape, dealing with blockages, advising on social tariffs and more.

Well-being goals

A resilient Wales

Demand management will improve the resilience of the natural water cycle, and support other initiatives we pursue to improve resilience of supply.

A prosperous Wales

Improving awareness, understanding and action on water stewardship will contribute to the efficient use of natural resources in Wales.

A healthier Wales

Children and adults alike can explore the great outdoors and find out more about the water cycle at our Discovery and Visitor Centres. We'll look for opportunities to improve health, support nature and engage the public with the natural environment.

A Wales of cohesive communities

Empowering communities to take stewardship of their water environment will improve their recreation opportunities and the natural environment, and reduce their water demand.

Figure 60 : Working with our customers and all the communities that we serve

3. Strategic Responses

Strategic response 7. Working with customers and communities

Case study: Rhondda Fach Water Resilient Communities

Issue

In the Rhondda Fach area, one of the most economically disadvantaged communities we serve, only 96 of 10,000 households are on social tariffs, but many more are likely to be eligible. Similarly only 17 of 10,000 are on our priority services register.

Action taken

As part of our Customer-led Success (CLS) approach, we're increasing the amount of customer involvement in our business planning and on day-to-day decisions as well as supporting customers in vulnerable circumstances through a range of initiatives.

The Rhondda Fach Water Resilient Communities project will allow us to work with and involve customers in a way that we haven't done before, by "working with customers to co-create and co-deliver more resilient services" (Resilience in the Round, Ofwat) as well as focusing on a targeted area that faces numerous challenges both from a Welsh Water asset point of view, and from a community point of view. The project will look at direct involvement and collaboration with the community for long-term benefit, building a more Water Resilient Community.

The project will work alongside the £23million investment in our drinking water network as well as aligning to the objectives of the Cwm Taf Well-being Plan – health, wealth and asset. It will also work in-line with the Future Generations Act's five ways of working (Long term; Integration; Involvement; Collaboration; Prevention).

We are collaborating with key stakeholders from the local area including Cwm Taf Public Service Board, Cwm Taf Health Board, Interlink, Local Authority, Natural Resources Wales, Office of the Future Generations Commissioner and Trivallis to understand the local challenges and data available for the area which was layered with Welsh Water performance data.

We are working with the local community and stakeholders to develop objectives and targets for the project and adopting an holistic view to maximise the benefit to customers. Therefore as part of the overall programme other initiatives being explored include RainScape, lead pipe replacement, assisting in the governance of community groups, apprenticeships, and milk teeth campaigns.

Result

The project will result in collaboration with the local communities to develop our social tariff and Priority Service Register strategy, including the sign-up process. This is expected to effect a significant increase in social tariff uptake and lead to 1,500 demand management home audits.

A bespoke education outreach will increase engagement and awareness whilst tackling some of the local challenges, and where possible, alignment of investment plans across the business will create least disruption to customers and maximise the benefits of work in the area.

Figure 61 : Working with the community of Rhondda Fach

3. Strategic Responses

Strategic response 7. Working with customers and communities

Direction of travel

Improved Customer Outcomes

- Our customers will play an increased role in shaping our work and we will encourage our customers to take part in collaborating and co-creating our strategies and projects;
- Our customers will develop a sense of stewardship for their own water use and behaviours, and have a better appreciation for how this relates to the wider water environment; and
- Our Discovery Centres can educate and engage customers on the water environment. Our work with communities can respond to pressures on the environment and biodiversity through community-led projects such as RainScape. These initiatives will provide the additional benefits of improving health and well-being by improving green infrastructure and access to natural spaces in our communities.

Scope of work

We will work with customers to help them understand the full value of potable water and the impact of sewage. Specific activities could include raising awareness about water consumption, water-saving devices, smart metering, water harvesting and recycling grey water. We could also raise awareness about the impacts that misuse of sewers have on the environment and our systems, and investigating new behavioural techniques to help customers to avoid introducing inappropriate solids into the network (for example, ‘Stop The Block’ campaign).

In addition, we aim to improve the awareness of water issues amongst both the general public and landowners through our education programmes, and work directly with community groups to promote a sense of stewardship of the water environment.

Moreover, we will work internally to help our colleagues have a better understanding of our customers, and the opportunities and incentives to change behaviour around water use and enhance their participation in water cycle management.

We plan to engage with customers and communities to raise awareness of demand management through water-saving devices, smart metering, water harvesting and recycling grey water as well as the impacts that misuse of sewers has on the environment and our systems. The costs associated with implementing these programmes will be relatively small over the 30 years of the Welsh Water 2050 programme.

3. Strategic Responses

Strategic response 8. Ensuring affordability of services delivered to customers

With inequality, debt, and poverty on the rise we aim to ensure that our services remain affordable for all customers: both in terms of average bills and for those on social tariffs. We will ensure that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our customers.

Importance for customers

The majority of our customers do not feel that their bills are too high (Blue Marble, 2017). Water bills as a proportion of average household income have stayed fairly static over the long-term. This is reflected in customer surveys where 82% of our customers believe that Welsh Water's bills represents good value for money (Consumer Council for Water, 2016).

This affordability can be measured by comparing average household disposable income in Wales, which rose by 1% more than Consumer Price Index (CPI) inflation, with Welsh Water's average household bill, which rose by 1% a year more than CPI inflation between 2001 and 2017 (ONS, May 2016).

In our 2017 'Have your say' consultation generally our customers agreed that those in a good financial situation should be paying extra on their bills in order to help those who are less able to pay.

Responding to future trends

It is estimated that some 300,000 (23%) households in Wales are currently living in poverty (defined as in receipt of less than 60% of median household income) (ONS, 2016). Income inequality has risen over the past few decades and could rise even further in the future.

This affects how the costs of water and sewerage services are recovered from customers. If society as a whole decides that it wants improved outcomes and is prepared to pay more in bills for them, then it becomes increasingly important to protect those that already struggle to pay. This is identified as a priority for the Welsh Government in its Water Strategy for Wales (WG, Water Strategy for Wales, 2015).

Welsh Water's charges to customers are set every five years by the industry regulator, Ofwat. This process, known as a "Price Review" takes into account priorities identified by customers for the next five years, in the context of governments' policies. The next Price Review is in 2019 which will set charges for the five years 2020- 2025. This takes account of customers' circumstances such as general price inflation, expected growth in average household incomes, and customer feedback.

Strategic response

Overall we anticipate that the investment required will result in a total cost in the region of £4.5-9 billion. We recognise that we deliver an essential public service, and our customers expect us to continue to provide this service for future generations in the face of the future trends that we experience. This strategic response reflects our aim to ensure bills remain affordable for all customers.

Welsh Water has, and will continue to, engage with customers to assess their priorities and the level of bills which customers regard as value for money. This means that over the longer-term, we will adopt a flexible position on the pace of delivery of Welsh Water 2050, reassessing customers' views every five years. Our aim is to be an innovative and efficient business to provide an affordable service for all our customers. To ensure that everyone can afford our bill this includes providing support for those who struggle to pay.

Welsh Water is the industry leader in providing support to customers with difficulty in paying their bills. Our range of affordability tariffs currently helps some 100,000 customers. The cost of lower tariffs for these customers is met by charging other customers a little more and by direct subsidy by Welsh Water itself. This approach was formulated in conjunction with Welsh Government's Social Tariff Guidance (WG 2014) and underpinned by customer research which demonstrated strong customer willingness to support disadvantaged customers (Accent, 2014).

It is our intention that Welsh Water, will, over the long-term continue to help a growing proportion of those customers who struggle to pay their bills by setting appropriate charges for those in need.

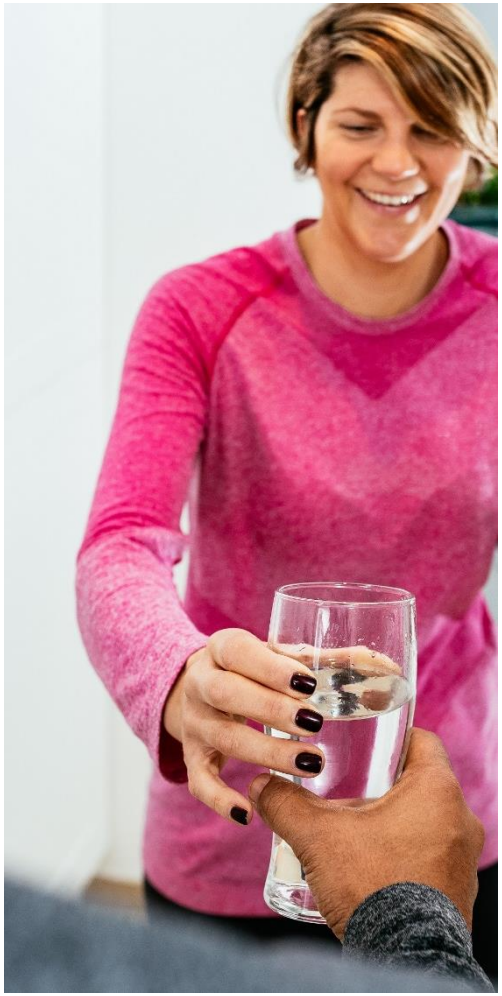


Figure 62 : One of our customers enjoying a glass of water. © Welsh Water

3. Strategic Responses

Strategic response 8. Ensuring affordability of services delivered to customers

We will ensure that our services are affordable in the long-term, provide value for money, and are accessible for those struggling to pay.

This will need the continuing support both of government and our customers, as well as continued direct funding from the company. In particular, with access to necessary governmental information, we could aim to ensure that every customer pays the lowest charge applicable in their circumstances, helping to ensure that everyone's bill is fair and affordable.

We will seek innovative and dramatically more efficient ways to deliver improvements to our ongoing service. We will aim to deliver good value for money for our customers and are committed to drive down costs by:

- Seeking innovative new technologies to deliver lower investment costs.
- Working in partnership with others to take advantage of better ways of working together that will deliver improved outcomes for society more efficiently.
- Minimising our running costs by looking at new ways of working and exploiting opportunities for savings resulting from our asset investments.
- Transparency of tariffs and sharing with our customers the process of deciding social tariffs.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- Alternative approaches to social tariffs to improve their sustainability and encourage uptake by customers in vulnerable circumstances; and
- Alternative flexible tariff models, which allow customers to pay more for environmental and social programmes.

To complete this research we will collaborate with other utilities.

Co-operative approach

Through the Digital Economy Act, we will share information with the UK Government to enable us to ensure that every customer pays the lowest charge applicable in their circumstances, helping to ensure that everyone's bill is fair and affordable. We will actively collaborate with the following identified partners:

- Citizens Advice Bureau;
- Local Authorities;
- Social housing providers;
- Money advice charities; and
- Food banks.

We already work with around 150 such organisations in promoting our social tariffs.

Customer promises

Clean, safe water for all

We will ensure that all customers are able to afford clean and safe water.

Safeguard our environment for future generations

Welsh Water will consider the suitability for tariffs where customers are able to donate extra amounts for water related causes at home or abroad, these causes may include environmental projects.

A personal service that is right for you

We could give customers the choice to donate to affordability, environmental and water-related causes.

Fair bills for everyone

We could work to ensure that our customers bills are suitable for their situation, and will work to make our tariffs transparent.

A better future for all our communities

We will work to reduce social inequality by ensuring that those who are struggling to pay are supported, and that every customer pays the lowest charge applicable to their circumstances.

Well-being goals

A resilient Wales

We aim to support the social and economic resilience of our customers by ensuring that their tariffs are suitable to their circumstances.

A more equal Wales

We aim to reduce inequality in Wales through ensuring we seek innovative ways to reduce running costs and identify struggling customers.

Figure 63 : Working for all our customers. © Welsh Water

3. Strategic Responses

Strategic response 8. Ensuring affordability of services delivered to customers

Direction of travel

Improved Customer Outcomes

- Continue to deliver water services to customers that are affordable for households;
- Ensure our services are on track to deliver value for money, engaging customers to allow them to shape our future strategies and plans; and
- Delivering quality services for lower costs by improving efficiency and seizing innovation opportunities.

Scope of work

We will continue to engage with customers to assess the level of bills which customers regard as value for money and will review and amend suitable targets for tariffs up to 2050. We will continue to provide support to customers with difficulty paying their bills and aim to increase the uptake of our social tariffs.

Improving cost efficiencies across our business will be a major contributor to ensuring affordability for all our customers. This will mean that over the longer-term, we will adopt a flexible position on the pace of delivery of Welsh Water 2050, reassessing customers' views every five years.

We aim to continue to provide a service that all our customers consider to be value for money and affordable by improving our cost efficiencies across our business and increasing the uptake of social tariffs. The direct costs required to enable these initiatives will be relatively small over the 30 years of the Welsh Water 2050 programme.

3. Strategic Responses

Strategic response 8. Ensuring affordability of services delivered to customers

Case study: Welsh Water's social tariffs

Issue

Welsh Water have a number of social tariffs to help those customers, who are unable to pay their bills.

Action taken

These tariffs include:

- The HelpU tariff, which provides support to households earning less than £15,000 with their water and sewerage charges;
- Water Direct, which allows those customers who receive certain benefits and are currently in arrears to pay the lowest tariff directly through their benefits;
- WaterSure Wales, which caps the bills for low income households with a meter who receive a qualifying benefit or tax credit and have either a large family or a family member with a certain medical condition that requires the extra use of water;
- Customer Assistance Fund, which pays off half of the arrears of customers who pay their current charges for six months.

We provide "bill assistance" training to third party organisations which means that they can act as verifiers for us. Therefore, when speaking to customers they can recognise those who would benefit from a scheme or tariff. They can also support customers through potential issues such as completing the required forms.

We have provided this training to 141 organisations, of which 74 have been this year. Examples of organisations who receive this training are Registered social landlords, Age Cymru, Shelter Cymru and the Energy Saving Trust.

We also offer an awareness session to organisations so they can sign post our schemes and tariffs, we have held 88 awareness sessions this year, to organisations such as Job Centres, Alzheimer's, Housing Association and Doctors Surgeries.

Result

Through these programmes, Welsh Water wants to ensure that bills are affordable for all their customers.

As of December 2017 we are supporting 50,000 customers on our HelpU tariffs. There are an overall total of 95,000 customers across all of tariffs and schemes which include HelpU, Watersure Wales (including the old Welsh Water Assist), Customer Assistance fund and DWP (third party deductions).

Figure 64: Welsh Water HelpU programme

3. Strategic Response

Strategic response 9. Supporting customers in vulnerable circumstances

We need to use data effectively, provide personalised customer service and work in partnership with other service providers to give appropriate and effective support to customers in vulnerable circumstances.

Importance for customers

At Welsh Water, we are acutely aware that the areas of Wales and England that we serve include communities that are amongst the poorest in the UK. Beyond financial vulnerability, we have been recognised as an exemplar company by both Ofwat at the launch of their focus report on customer vulnerability and this year by the National Mental Capacity Forum for the work we are doing to support customers.

Responding to future trends

We believe Welsh Water services for customers in vulnerable circumstances are at the forefront of our sector, however we need to further develop our people, systems and policies to ensure that we enhance the scope and resilience of these services in the future.

Vulnerability is a state that many people will experience at some point in their lives. Vulnerability may be experienced through a combination of factors, including physical or mental health, financial circumstances or a change in life circumstances (such as a bereavement or a job loss).

Vulnerability and the characteristics of vulnerable people in Wales are acute and changeable. The number of people living with dementia in the UK is expected to double in the next 40 years (FCA Occasional Paper 8, 2015). Currently, it is estimated that almost half of adults do not have enough savings to cover an unexpected bill of £300 (www.moneysavingadvice.org.uk). In Wales, 107,000 adults have sight loss and 575,000 have hearing loss (http://gov.wales/docs/statistics/2016/160622-welsh-health-survey-2015-health-status-illnesses-other-conditions-en.pdf), and 13% reported themselves as being treated for a mental health condition in 2016.

Strategic response

We will improve our internal processes and work with partner organisations to deliver a portfolio of initiatives to support customers in vulnerable circumstances. We will:

- Work with social housing providers to include water-saving devices in new properties or during refurbishment.
- Adopt a community-centred approach, targeting one community at a time to complete upgrades (new water mains, green infrastructure), tackle blockages, promote social tariffs, etc.
- Use our data and systems and work with the UK Government and other utilities under the Digital Economy Act to identify customers in vulnerable circumstances. We will innovate to tailor communications and services for customers and to help our employees to make better decisions and identify the best course of action for our customers.
- Reduce the impact of operational incidents (for example interruptions to supply, water quality incidents and flooding) and tailor our communications and service for customers who have a specific need or dependence on our service by increasing the numbers of customers registered for Priority Services and improving the support we offer.
- Address financial vulnerability and affordability by having schemes in place to support customers to have a reduced bill. As well as affordability schemes this includes promoting meters where they would reduce a customer's bill and providing demand management/money saving advice that might help customers to lower their bills.
- Be flexible with vulnerable customers on items such as when bills are paid, use different formats of bills to be understandable and encourage payment, where meters are located.
- Be more flexible on capped bills for health conditions.
- Put focus onto understanding transient factors that may put customers into vulnerable circumstances and develop ways of addressing them.
- Train and support employees so that they understand factors that make our customers vulnerable and provide them with the knowledge and skills to respond or refer the customer on to a specialist team or external source of support.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- Explore the opportunities to identify customers in vulnerable circumstance through new data sharing programmes including the Swansea University's SAIL Databank. This facility provides the ability to take Welsh Water datasets and compare to other datasets from a wide range of contributing partners. A good case in point would be area-based comparisons of Welsh Water customers on social tariffs with those in receipt of particular benefits.
- Understand patterns of consumption for vulnerable customers, using smart meter data, and flagging if there are unusual usage patterns; for example, they've left a tap running.

We will work with other utilities for this research such as Wales and West Utilities and WPD, within the Digital Economy Act: sharing data monthly to identify customers in vulnerable circumstances.

Co-operative approach

We will actively collaborate with the following identified partners:

- Customers and communities;
- Other utility companies and public services;
- Waterwise;
- Energy Savings trust;
- Warm Wales (Arbed);
- Citizens Advice Bureau; and
- Food banks.

3. Strategic Response

Strategic response 9. Supporting customers in vulnerable circumstances

Customer promises

Clean, safe water for all

We will provide peace of mind that vulnerable customers will receive their water service 24/7.

Personal service that's right for you

We will provide training for our colleagues on how to identify and deal with vulnerable customers, and improved collaborative working with other organisations and service providers.

Put things right if they go wrong

We will be flexible with vulnerable customers where we can help, such as when bills are paid, and using different formats of bills to be understandable and encourage payment.

Fair bills for everyone

We will improve our approaches to identify vulnerable customers, how we communicate with them and provide flexible and practical solutions to support their needs. This will include practical help for dementia sufferers and flexibility on capped bills for health conditions.

A better future for all our communities

Working in partnership with other service providers will be beneficial to achieve collective outcomes and wider benefits for communities, such as working with social housing providers to include water-saving devices in new properties or refurbishment.

Well-being goals

A prosperous Wales

Developing services and initiatives which support a productive economy, efficient use of resources, and fair opportunities in Wales.

A healthier Wales

Providing peace of mind and reducing stress that our customers could experience will increase happiness and well-being.

A more equal Wales

Addressing vulnerability through the services we offer will contribute to reducing inequality.

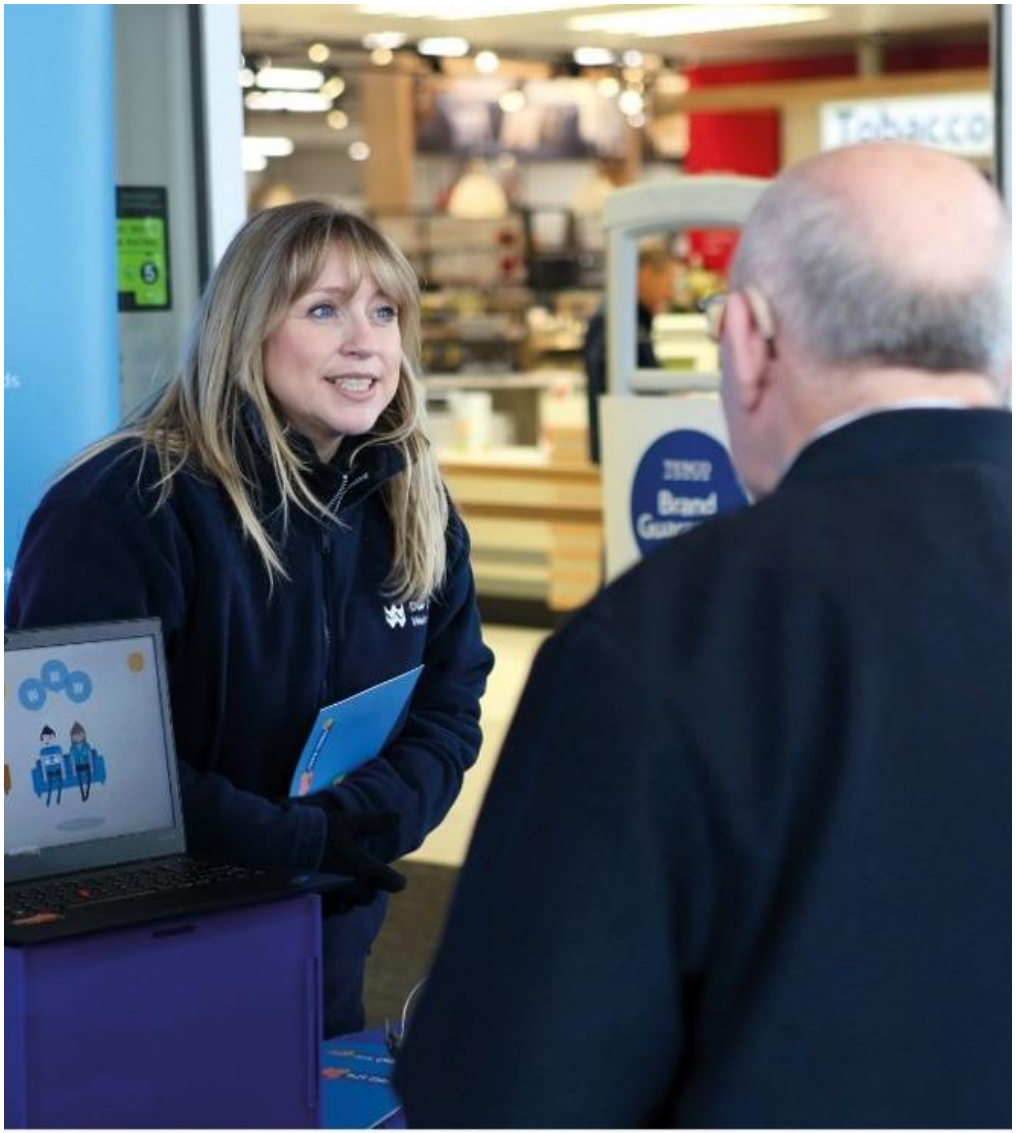


Figure 65 : Working with all our customers. © Welsh Water.

3. Strategic Responses

Strategic response 9. Supporting customers in vulnerable circumstances

Case studies: Supporting Vulnerable Customers

Issue

Welsh Water offer several support services to their customers in vulnerable circumstances. These include:

- The HelpU tariff, which provides support to households earning less than £15,000 with their water and sewerage charges;
- Water Direct, which allows those customers who receive certain benefits and are currently in arrears to pay the lowest tariff directly through their benefits;
- WaterSure Wales, which caps the bills for low income households with a meter who receive a qualifying benefit or tax credit and either a large family or a family member with a certain medical condition that requires the extra use of water;
- Customer Assistance Fund, which pays off half of the arrears of customers who pay their current charges for six months.
- Priority service areas, which can offer practical help and extra services if customers are visually impaired, speech impaired, hard of hearing, elderly or have medical conditions, physical or learning disabilities. These include providing emergency water in the event of service disruptions for those with medical conditions that require the use of water, for example, home dialysis. We plan to work with Mind Cymru to carry forward this programme.
- We aim to work with Wales and West and Western Power Distribution to share data and provide a more effective service.

In order to encourage more customers in vulnerable circumstance to make the most of these services, Welsh Water have partnered with a number of charities to promote them directly to eligible customers. These charities include the Cardiff food bank and the Citizen's Advice Bureau.

Action taken

Welsh Water regularly attends Cardiff food banks to sign customers up immediately onto our affordability tariffs, and promote other support services. To further support the work of the Cardiff food bank, we also maintain their two delivery vans and provide a pool vehicle if one of theirs is off the road.

Welsh Water employees also support the Cardiff food bank through collecting food and financial donations.

Welsh Water have funded a utilities debt advisor for the Pontypridd Citizens Advice Bureau. The advisor helps clients in debt and promotes our support schemes and priority services as well as provide further citizens advice support. Through this partnership Welsh Water are gaining an understanding about the needs of Citizens Advice Bureau clients.

Result

Through these partnerships, Welsh Water is able to directly work with their customers to provide support during vulnerable circumstances through their social tariffs and priority services.

Figure 66 : Welsh Water provided funding for utilities debt advisor for the Pontypridd Citizens Advice Bureau

3. Strategic Responses

Strategic response 9. Supporting customers in vulnerable circumstances

Direction of travel

Improved Customer Outcomes

- Continue to deliver water services to customers in vulnerable circumstances that are appropriate to their needs and resilient to future changes;
- Ensure customers in vulnerable circumstances are identified and engaged with in a comprehensive and appropriate way; and
- Improve our response to more transient vulnerable circumstances.

Scope of work

By making better use of our data systems, and by working with the UK Government and other utilities under the Digital Economy Act, we can better identify customers in vulnerable circumstances and provide them with appropriate levels of support.

At present, we have 27,000 customers registered with us for Priority Services, around 2% of our total customer base, which is relatively high for a water company. However, this is smaller than similar registrations for energy companies, who typically have around 8% of their customers registered. This could indicate that we aren't fully identifying our vulnerable customer base, and therefore we will set targets for customer registration which will be reviewed and amended up to 2050.

We plan to expand our Priority Services scheme by promoting it through third parties and through a targeted data-driven campaign. We already have links with over 150 organisations who we have trained in our affordability tariffs, and will use our existing connections to maximise the exposure of the Priority Services scheme. If necessary, we could also broaden the scheme based on customer feedback of what would most help them, and seek to offer support for those experiencing transient vulnerability.

Moreover, we will train and support our colleagues so that they recognise factors that make our customers vulnerable and provide them with the knowledge and skills to respond or refer the customer on to a specialist team or external source of support. In order to tackle problems at source, we may also work with social housing providers to include water-saving devices in new properties or during refurbishment. We will adopt a community-centred approach, targeting one community at a time to deliver infrastructure upgrades (new water mains, green infrastructure), install meters where they will reduce bills, and advertise social tariffs and Priority Services.

We plan to make better use of our data systems and work with partners to better identify customers in vulnerable circumstances. We will also improve the support they receive through our Priority Services scheme and the training of our people to ensure that we are providing the best possible service, tailored to our customers' individual needs. These costs will be relatively small over the 30 years of the Welsh Water 2050 programme.

3. Strategic Responses

Strategic response 10. Addressing our 'worst served' customers

Faced with increasing customer expectations for a good service at all times, we will address the longstanding service complaints of 'worst served customers' to ensure that everyone receives an acceptable level of service.

Customer impact

Welsh Water Return of Value research showed that there is strong customer support for investment to improve the service they receive from Welsh Water, particularly for those who suffer repeat incidents of poor service. Targeted service improvements for those customers suffering from repeat service failure ranked third in priority out of the six options given (Return of Value research, Fresh Minds, 2016).

'Worst served' customers are currently defined as those who:

- Experience interruptions to supply –an average of 2 or more failures per year, initially recorded over a 3 year window; or
- Experience persistent low pressure – recorded on the DG2 register; or
- Experience sewer flooding, specifically:
    - Properties recorded as being at active risk of flooding internally due to hydraulic overload in the 2:10 risk category; or
    - Properties recorded as being at active risk of serious external flooding due to hydraulic overload in the 2:10 risk category; or
    - Properties which have flooded internally more than once in the last ten years due to 'other causes'; or
    - Properties which have suffered, on average, more than one serious external flooding due to 'other causes' in the last three years.

Responding to future trends

Currently Welsh Water have 1500 households who suffer frequent problems- 'Worst Served'.

In part, these issues arise because we prioritise investment that has the potential to benefit a significant number of customers. This cost-benefit approach means that high cost solutions for individual, often rural, customers are not undertaken. Changing customer and societal expectations may make this cost-benefit approach unacceptable, as all customers are entitled to a minimum universal service standard.

Strategic response

We believe that we need to recognise that a small number of our customers do not receive an acceptable level of service. To do this, we will not charge customers when their service does not meet our service standards. We will aim to address these poor standards by considering the following:

- The development of a suite of minimum service standards for all customers irrespective of cost-benefit constraints;
- A commitment to automatically suspend water or sewerage charges in the event of service quality failures;
- A step-change in the way we communicate with those experiencing problems;
- Prevent low pressure;
- Eliminate sewer flooding; and
- Resolve issues of interruption to supply.

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Develop, through our innovation process and with Alliance partners, innovative 'small' capital solutions such as low cost 'package pumping stations' to resolve issues for our 'worst served' customers; and
- Continue to contribute to Water UK's 21st Century Drainage Programme and implement drainage and wastewater management plans to inform our decisions for our worst-served customers.

We will work with our university partners and our supply chain to develop low cost capital solutions, and continue involvement with aligned research programmes such as UKWIR, Cardiff University Water Institute, Pennine Water Group / Sheffield University.

Co-operative approach

We will actively collaborate with:

- Academic partners;
- Local authorities; and
- Customers and communities.

Figure 67 : Flooding in Llechryd. By Morien Jones, Creative Commons License (CC BY 2.0)

3. Strategic Responses

Strategic response 10. Addressing our ‘worst served’ customers

Customer promises

Clean, safe water for all

Tackling low pressure and interruptions to supply will ensure all customers receive a clean, safe water supply that they can rely on.

Put things right if things go wrong

Replacing pipes, addressing low pipe pressure, interruptions to supply and preventing sewer flooding will all help to create resilient water and wastewater systems that are less prone to failure.

Personal service that’s right for you

Ensuring the needs of all customers are met will help to create an effective service for all customers into the future.

Fair bills for everyone

Customers won’t be charged if they are not receiving the prescribed minimum acceptable service standard.

Well-being goals

A more equal Wales

Addressing the needs of all our customers will contribute to a society where all communities can fulfil their potential.

A prosperous Wales

Proactively tackling issues and ensuring there are no worst served customers, including businesses, will contribute to creating an innovative and productive society.

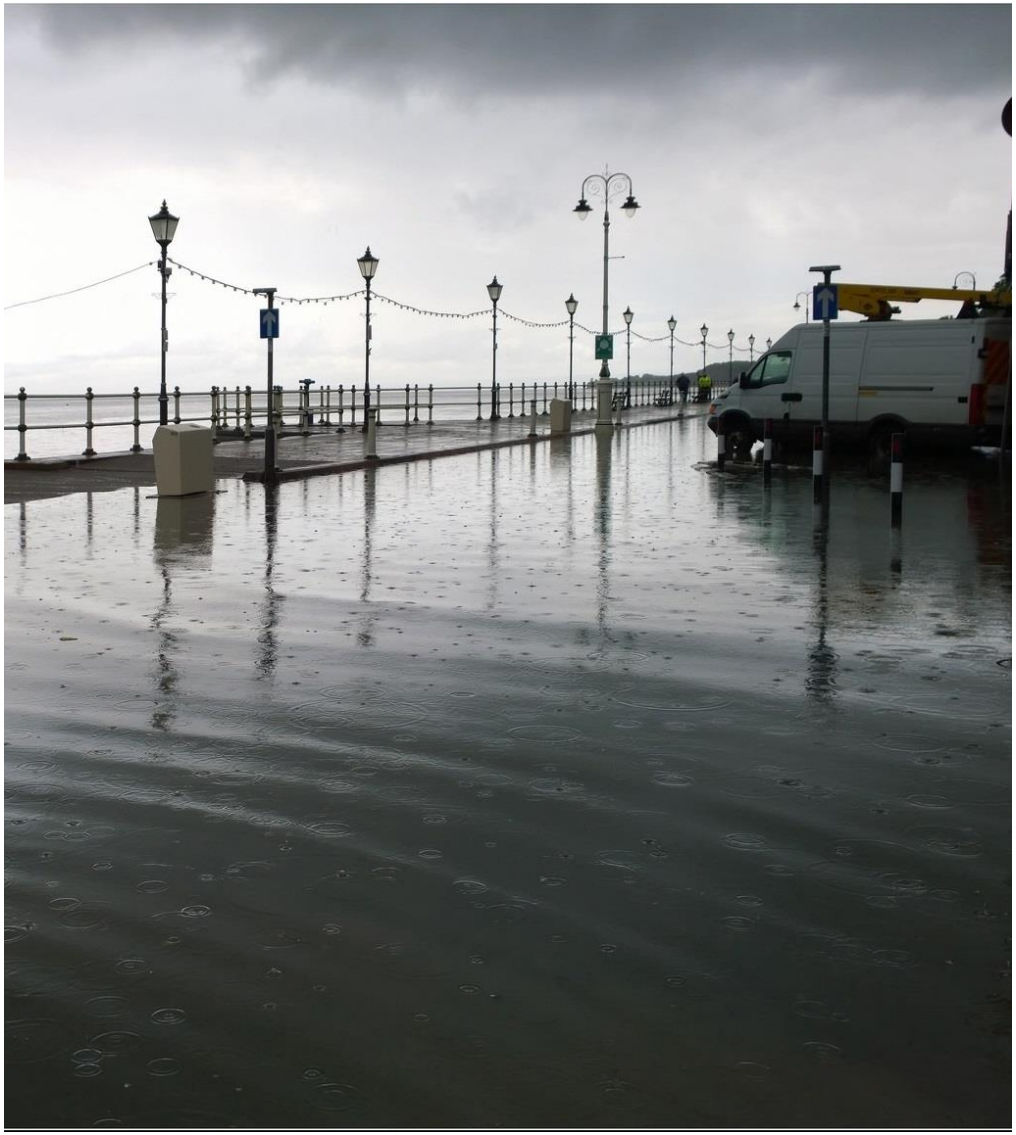


Figure 68 : Flooding in Penarth. By Ben Salter, Creative Commons License (CC BY 2.0)

3. Strategic Responses

Strategic response 10. Addressing our ‘worst served’ customers

Direction of travel

Improved Customer Outcomes

- Improved communication with customers experiencing repeated poor service;
- Whilst customers are waiting to have instances of repeated poor service is addressed (for example, risk of sewer flooding or low water pressure that do not present a health and safety risk to our customers) they will not be charged for the relevant service until an acceptable level of service is provided; and
- We will proactively tackle issues for customers who often have long standing instances of poor service by giving their problems increased priority, helping us to improve our standing with customers and consumer groups. Operating costs will also be reduced by lower reactive repairs and call outs.

Scope of work

We believe that we need to recognise that a small number of our customers do not receive an acceptable service. As an initial response, we will not charge our 1500 ‘Worst Served Customers’ who have been identified as experiencing a repetitively poor service, until an acceptable level of service is provided.

Over time, we will work to improve the service provided to these customers. We will address repeated low water pressure complaints affecting 131 of our customers, sewer flooding affecting 368 of our customers and disruption to supply affecting 1000 of our customers.

We will also improve communication with those customers experiencing repeated poor service through a dedicated Welsh Water customer contact.

We plan to improve the service we provide our ‘worst served’ customers and not charge for our service until it is at an acceptable level. Because the cost of tackling each of these long-standing service problems is generally very large, the cost of providing an acceptable level of service to these customers could be up to £250m.

3. Strategic Responses

Strategic response 10. Addressing our ‘worst served’ customers

Case study: Carway Street flood alleviation scheme, Burry Port

Need

The Carway Street scheme was primarily developed to mitigate flooding of eight properties in three different locations in Burry Port; Carway Street, Gors Road and Pemberton Avenue. The properties had flooded up to three times and were assessed to have more than a 10% chance of flooding in any one year.

The flooding was caused by surcharging of the sewer network. This was due to the age of the sewers and growth in the catchment which had resulted in flows that were greater than those originally designed for, particularly during storm conditions.

As well as reducing the risk of flooding, the scheme also addressed the following needs:

- Reduced the number of spills at the Burry Port sewage pumping station;
- Provided capacity to enable future economic development; and
- Provided resilience against climate change.

Solution description

An extensive survey of the sewage system and catchment in Burry Port was undertaken to identify the causes of flooding. This included CCTV, manhole, topographic and connectivity surveys of the sewage systems. These investigations identified lengths of sewer, including two sewer siphons under the local railway line, which had insufficient capacity to pass storm flows.

The traditional approach to addressing sewer flooding is to upsize sewers and sewage pumping stations. However this approach is expensive and, particularly where increased pumping is required, not considered to be sustainable. Our flood alleviation scheme philosophy is therefore based on our RainScape initiative, which is to disconnect surface storm water flows from the existing combined sewage systems and convey these flows to a suitable outfall discharge point.

The approach was adopted to reduce the risk of flooding at Burry Port as the upsizing of the existing sewers could not be justified on cost grounds. The proposed solution therefore incorporated the removal of storm water flows discharging to the existing combined sewer network and conveying these via 400m of new storm sewer to a suitable outfall discharge point at Burry Port Docks. This work included the installation of 72m of 1,200mm diameter tunnel to act as a storm water siphon beneath the existing railway line.

As a result of the scheme, the eight properties are protected against flooding for rainfall events up to and including the 1 in 30 year return period.

The total cost of the scheme was **£2.6m**, or an average cost of **£325,000** per customer who directly benefitted from the scheme.

Figure 69 : Flooding on Carway Street. © Welsh Water

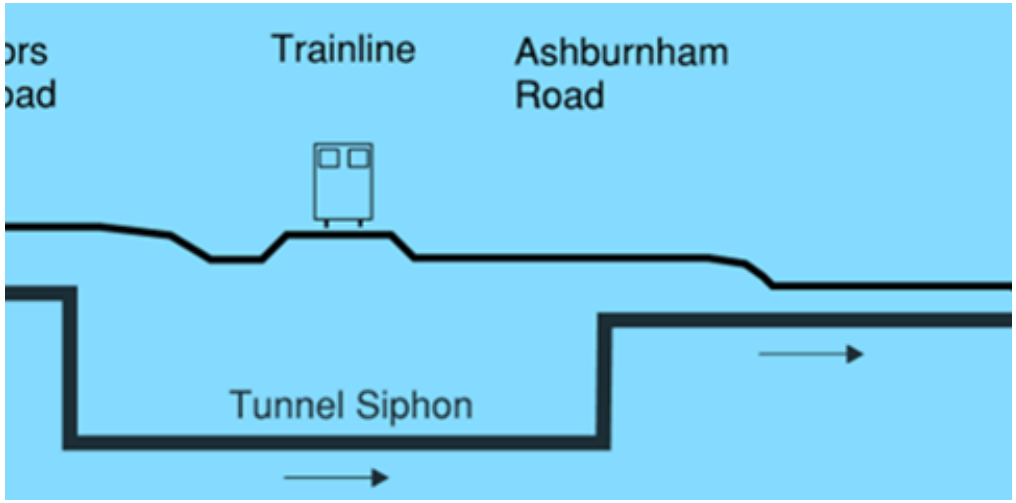


Figure 70 : Carway Street flood alleviation scheme. © Welsh Water

3. Strategic Responses

Strategic response 11. Employer of choice

With an ageing population, an increasing shortage of technically skilled employees and increasing demand for more flexible approaches to working, we will need to continue to be an employer of choice; attracting, developing and inspiring people from a diverse range of backgrounds, to deliver an excellent service for our customers.

Customer impact

Employee behaviours and attitudes, especially the ability to deal with problems and complaints, were key differentiators for the top performing organisations in a recent Institute of Customer Service report. There is compelling evidence of the link between good customer satisfaction and high levels of trust, and increased employee engagement (Institute of Customer Service, 2016).

Our best practice visits to 'best in class' customer service institutions have highlighted the link between employee engagement and customer satisfaction, and 93% of our employees now say we put customers first.

Responding to future trends

Large long term investment projects (including Hinkley Point, Wylfa Newydd, Tidal Lagoon Swansea Bay) could increase the mobility of labour and competition for key skills.

Welsh Water relies heavily on Science, Technology, Engineering and Mathematics (STEM) roles. The UK annual shortfall of STEM skilled employees is estimated at 40,000 workers, thus requiring significant investment in graduates and apprentices and proactive retention strategies by STEM reliant businesses.

Changing customer expectations and a move to a digital economy means that our people need to possess a flexible customer focused attitude and be able to learn new skills, and embrace new digital technology with increasing speed.

The UK and Wales' ageing population is reflected in our people. Addressing the challenges and opportunities this presents, and effectively planning for succession, will continue to be key elements of our recruitment and well-being strategies.

The water industry has historically been male dominated and although we have made progress by uplifting from 21% in 2012 to 28% females in 2017, we need to take further action if we are to achieve the business benefits of a diverse workforce, especially in STEM roles.

Some historical working patterns and practices create particular challenges when meeting customers' demand for 24/7 service.

Strategic response

The strategic response will include:

- Health, safety and well-being strategy – demanding safe behaviour and ways of working, becoming a smoke free business, well-being champions supporting employees with both temporary and permanent mental health illness, achieving and maintaining the Welsh Government Platinum Corporate Health Standard;
- Talent and Resource Plan – embedding the responsibility for managers to develop their teams and succession plans at every level in the business;
- Lean and Service Excellence – embedding a culture where employees continually seek out increasingly efficient and innovative ways of working; and
- Employer of Choice - utilising new technology and latest recruiting methods to attract diverse new talent with a passion for delivering a great customer experience. Investing in the continuous development of all employees, promoting innovation and securing retention of key knowledge and skills;
- Improved internal communication – building a shared understanding of our objectives, plans, policies and the needs of our customers, enabling integrated working across teams and better planning for succession;
- Leadership development - we will continue to equip our leaders and aspiring leaders with contemporary coaching, mentoring and people management skills via our Welsh Water Leadership Programme;
- Customer focused employees – We will develop, coach and continually assess our colleagues on both a team and individual basis to enhance our customers' experience when they interact with us, irrespective of which media they choose to use;

Figure 71 : Two of our employees examining one of our assets. © Welsh Water

3. Strategic Responses
Strategic response 11. Employer of choice

- Strong employee relations – Welsh Water's 'Working Together Agreement' forms the basis of our partnership approach with our Trade Unions. In place for 25 years, this joint problem solving approach provides a strong foundation for employee relations. Our mutual aims to provide a high quality working environment with good terms and conditions and opportunities for development, have provided a solid platform for progressive levels of flexibility and service to our customers.
- Creating an inclusive environment and promoting diversity - changing behaviours to create a fully inclusive, engaging Welsh Water. Our leaders will be role models of inclusive behaviour to ensure all employees feel safe and able to be themselves at work. We also will facilitate diversity and inclusivity training for all our people, giving them the tools they need to mitigate the effect of unconscious bias. We will nominate inspiring leaders to champion inclusivity activities and promote the benefits of a diverse workplace ~~force~~ and inclusive culture.
- Welsh Water aims to be an employer of choice at all stages of career. Improvements to succession planning and operational flexibility will be implemented to meet the needs of a changing demographic.
- Promote community work – we will encourage our people ~~staff~~ to get involved in community roles.
- Zero tolerance of discrimination – we will ensure that all our people are aware of our zero-tolerance approach to any form or harassment or discrimination through educations films, e-learning and workshops;
- Promoting diversity – We will promote and support activities to ensure we retain existing talent and continue to attract new talent from all minority groups. Our recruitment campaigns will celebrate our commitment to creating an inclusive culture;
- Engaging young people –our STEM team will engage with young people across our operating area. We will also continue to support workshops that provide young people with key skills that are relevant to our business, through our Welsh Baccalaureate resource. We will encourage our leaders and aspiring leaders to mentor disadvantaged young people to encourage them to pursue a career with us;
- Employability – we will expand the number of internships and work experience placements we offer every year and promote them through our schools, colleges and university contacts. Moreover, we will continue to offer our employability skills programme both internally and externally, with a particular emphasis on equipping women with the skills to secure employment and promotion in STEM roles;
- Apprenticeships – we will expand our apprenticeship programme to reflect the skills we need for the future, for example, data science and cyber security and promote opportunities widely to schools and higher education institutions. Our education and talent development teams will actively support Welsh Government's STEM delivery plan for Wales;
- Graduates – we will continue to invest in graduate schemes for STEM and other core skills we rely on, such as data science and IT; and
- Welsh Water technical academy – develop a Welsh Water Technical Academy to ensure sufficient and well-trained technicians to operate the increasingly sophisticated control processes of the future.

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Understand future ways of working and how Welsh Water can develop its work environments and cultures to encourage collaborative and efficient working and healthy and happy colleagues;
- Understand future gaps in skills and knowledge in our people and work with colleges, universities and industry institutions to encourage uptake of those skills.

We will work with Government, charities and other interest groups to develop a more inclusive workplace with greater diversity, particularly in STEM roles.

Co-operative approach

We will actively collaborate with and learn from the following identified partners:

- Those such as the Equality and Human Rights Commission, Chawarae Teg, Stonewall, WISE, Time to Change Wales to develop a diverse and inclusive environments;
- In partnership with STEM Cymru and the Engineering Education Scheme Wales, we will continue to offer experience days.
- Schools, universities and training providers to develop the Welsh Water Technical Academy programme;
- Those that have shared challenges, including technical skills gaps, such as the Canals and Rivers Trust Wales and our supply chain, particularly Alliance Partners; and
- Industry bodies, such as WRAS, to spread good practice and improve service to the public.

3. Strategic Responses

Strategic response 11. Employer of choice

Customer promises

Clean, safe water for everyone

Increasing operator knowledge, skills and competency will ensure a high quality service.

Safeguard our environment for future generations

Increasing operator knowledge, skills and competency will contribute to protecting the environment.

Put it right if things go wrong

Developing and enhancing employee skills and ability to use the latest technological solutions will lead to faster resolution of issues.

Personal service that's right for you

Developing and empowering customer teams to problem solve at the earliest point of contact will enhance customer satisfaction.

Well-being goals

A more equal Wales

Promoting equal opportunities to join Welsh Water, and development of all individuals, regardless of age, gender, race, religion, disability, sexual orientation or other protected characteristics, contributing to a more equal Wales.

A healthier Wales

Supporting employees to improve their health and well-being will improve health within the workplace and local communities.

A prosperous Wales

Supporting high quality jobs in our organisation and our supply chain, that allow our employees to develop and flourish, will support an innovative and productive society

A Wales of vibrant culture and thriving Welsh language

Supporting high quality jobs in our organisation and our supply chain will help to make employment available to a diverse range of communities, including bilingual ones.

Figure 72 : One of our employees at one of our assets. © Welsh Water

3. Strategic Responses

Strategic response 11. Employer of choice

Direction of travel

Improved customer outcomes

- Healthy, engaged employees with low absence rates and low turnover;
- The knowledge and skills, to provide excellent customer service;
- The ability to attract the best possible people from all parts of the community by being inclusive and allowing everyone to be themselves at work;
- An increasing proportion of applicants and new employees who are women and from non-traditional and deprived backgrounds; and
- A diverse workplace, which helps us to access diverse skills and make better decisions.

Scope of work

Young people are the future of our organisation and so it's vital that we engage them in what we do as early as possible. We hope to do this through our STEM ambassadors, experience days, workshops, our Welsh Baccalaureate resource and the Engineering Education Scheme. Moreover, we will encourage our leaders and aspiring leaders to mentor disadvantaged young people to encourage them to pursue a career with us, and expand our work experience and internship programme.

As we expand or renew our teams, we will attract highly skilled and motivated employees by utilising new technology and the latest recruiting methods, and through competitive remuneration packages and best in class graduate development and apprenticeship programmes. We will also expand our apprenticeship programme to ensure we have the skills we need for the future, including skills in data science, IT and cyber security.

Ensuring Welsh Water is a fantastic place to work into the future will require a number of specific and carefully considered activities. We will create a health, safety and well-being strategy to encompass all our activities in this area. In addition, we will create the Welsh Water Technical Academy - a suite of training programmes designed to continually up-skill our people and improve retention and promote career development. Moreover, we will continue to equip our leaders and aspiring leaders with contemporary coaching, mentoring and people management skills.

As part of our diversity agenda, we will implement new initiatives to mitigate the effects of unconscious bias, and continue to identify new opportunities for improving our gender balance. This will include nominating inspiring leaders to champion inclusivity activities and promote the benefits of a diverse workforce and inclusive culture. We will encourage networking across communities, learn from partnering with Chwarae Teg, WISE, Stonewall and Time to Change Wales and celebrate events such as International Women's Day, Pride Cymru and Time to Talk. We will implement a zero tolerance approach to harassment and discrimination.

We aim to attract and retain highly skilled and motivated employees to join our company by encouraging young people to pursue a career with us through our outreach programmes; providing competitive remuneration packages; providing best-in-class professional development programmes; creating a safe, healthy and happy place to work and ensuring we have an inclusive culture with a diverse workforce. The potential cost of these activities over 30 years could be up to £50m.

3. Strategic Responses

Strategic response 12. Leading edge customer service

Changing customer expectations, the digital revolution and demographic and lifestyle change are all leading Welsh Water to further develop our customer service culture. We will harness technological change to provide a personalised service for customers through their preferred contact channel.

Importance for customers

Our research indicates that our customers want a say in how Welsh Water is run, given that we provide a vital public service. It also shows that trust amongst our customers rests on three key factors:

- Perceived value for money;
- Perception of customer service; and
- Familiarity with the company, its purpose, and the work that we do.

Responding to future trends

Customers' expectations are driven by the digital revolution, demographic and lifestyle change and a profound shift in their relationship with organisations and collective institutions.

Due to an increase in available customer information our customers will expect us to automatically understand their needs and offer them a service personalised for their individual circumstances. It will be vital that we build a better understanding of our different customer groups, to ensure that we can tailor our services to meet all of their needs, when it is convenient to each customer and in the way that they want it.

With the increasing ease of access to information, customers are becoming better informed, more critical and demanding, resulting in decreasing loyalty towards organisations. There is an opportunity for us to embrace emerging collaborative systems for common goals including open data, crowdsourcing, and co-creation. These initiatives could harness our customer base and allow them to be part of a process that shapes our future as an organisation.

Customers will expect significant changes to the way they communicate with companies and the speed with which problems are resolved. The challenge for Welsh Water is not only to keep up with the wide variety of emerging communications channels, but also the expanding ranges of devices that are connected to intelligent technologies (the internet of things) including smart meters and other sensors.

We serve a diverse range of customer groups, including vulnerable customers and business customers. Business customers will increasingly expect better usage data, demand management support and flexible billing. It is vital that we have the right information to meet their specific needs through appropriate access to information and tailored methods of communicating and engaging with them.

Figure 73 : One of our employees. We want to make sure they are fully equipped to meet the needs of our customers. © Welsh Water

3. Strategic Responses

Strategic response 12. Leading edge customer service

Strategic response

Welsh Water's vision is to "earn the trust of customers every day" and we believe that it will be essential to keep up with customers' rapidly growing expectations for service and value for money. Given the very rapid pace of technological change, we will need to demonstrate great flexibility in how we respond to this challenge and opportunity in the longer term, drawing on 'best practice' from all sectors of the economy. To achieve this requires embracing a customer-led approach by:

- Continuing to consult customers on the delivery of investment projects;
- Coaching and regularly assessing and developing all customer-facing teams to enhance our customers' experience;
- Becoming a customer-centric culture that delivers a consistent, sector-leading and personalised service at every interaction, across a widening range of technological and physical platforms;
- Becoming a joined-up, integrated business where everyone is focused on customer service;
- Listening and reacting to customers' views and priorities both on a day-to-day basis and in terms of longer term planning. For example, through the use of online customer communities to test and support our plans;
- Improving the use of data analytics, artificial intelligence, customer insight and engagement to better target and personalise our customer services;
- Realise a significant reduction in response times and the time taken to resolve issues;
- Ensuring the company is recognised by customers, stakeholders and regulators for the significant positive contribution it makes to our communities; and
- Ensuring that we use data and implement appropriate segmentation to fully meet the diverse needs of business customers.

Welsh Water will:

- Give customers a strong voice in day-to-day and long-term business planning by using innovative engagement tools and communities to inform our decisions, whilst taking full advantage of open data and big data analytics;
- Provide a personalised service for customers through their preferred communication channel, and in the language of their choice.
- Ensure our business customers are given access to usage data, demand management support and flexible billing in a manner tailored to their business needs;
- Develop a mature and integrated customer data, research and engagement function that is central to the company's decision-making and business planning processes;
- Embrace artificial intelligence to improve the efficiency of the service and use predictive analytics to identify potential service failures before any impact on customers;
- Use new smart technology to give customers greater control over the services they receive and increase the transparency of the cost to them (for example, building on the smart metering programme in the energy sector); and
- Ensure that customers will automatically be placed on the lowest tariff for their personal circumstance, helping to keep bills affordable for all. This will require appropriate access to government data.

Research and innovation

Welsh Water will do further research into:

- Develop emerging customer contact technology systems in order to meet customer expectations, improve service and reduce cost;
- Automation and use of artificial intelligence to improve the accuracy and consistency of the service it provides customers (for example, the potential future use of chatbots);
- Open data and big data analytics to tailor our approach to customer engagement, based on their individual needs and aspirations;
- Identifying innovative communication and co-creation channels (for example, gamification) to ensure customers' views are fully reflected in decision making and business planning;
- Using emerging smart technologies (for example, 360º cameras and virtual and augmented reality) to respond and check customer issues on first contact before a physical visit;
- The link between employee engagement and customer service to better understand the impact of the company culture and management on the service it provides;
- The development of automated, instantaneous translation capabilities; and
- Using behavioural economics to inform our behavioural change campaigns such Let's Stop the Block and demand management.

We will undertake this research in collaboration with government departments and other utilities to share essential data that allows us to tailor our services for vulnerable customers.

Co-operative approach

We will actively collaborate with the following identified partners:

- We will partner with other organisations to support our aims, including working with other agencies and charities to help our customers who are in need
- We will partner with local authorities, Natural Resources Wales, the Environment Agency, Public Service Boards and Health Boards.
- We will seek to learn from best practice across all sectors and invite our customers to join an 'online community' to have a regular say on our day-to-day decision making and longer term business planning.

3. Strategic Responses

Strategic response 12. Leading edge customer service

Customer promises

Put things right if things go wrong

We will provide a swift resolution of customer issues that is consistent across the services we provide.

Personal service that's right for you

Welsh Water will provide personalised digital account management and issues tracking. We will use available data to segment our customer services and offerings in order to provide the most relevant and personalised service, particularly for vulnerable, disadvantaged and business customers. Customers will be able to contact us in the language and through the channel of their choice.

Fair bills for everyone

By using emerging digital technologies and artificial intelligence, we will reduce our costs by becoming more efficient in how we deal with customers and resolving their issues. Customers will automatically be put on the lowest tariff for their circumstances.

Well-being goals

A more equal Wales

Welsh Water will support the most vulnerable customers who are struggling to pay their water bills by offering and promoting social tariffs and financial assistance.

A Wales of vibrant culture and thriving Welsh Language

Welsh Water will promote the provision of customer services in Welsh and bilingually – giving real choice to customers to use their preferred language of contact.

A globally responsible Wales

Welsh Water will continue to educate its customers through the promotion of demand management, environmental protection and personal behavioural change campaigns.

Figure 74 : Our customers at an engagement event. We're committed to providing the very best customer service, for all of our customers. © Welsh Water

3. Strategic Responses

Strategic response 12. Leading edge customer service

Direction of travel

Improved Customer Outcomes

- Significant improvement in the rate of resolution of customers' issues on first contact;
- Reduced customer complaints and better engagement with our diverse range of customer groups;
- Sector leading customer trust, satisfaction levels and perception of value for money, amongst both household and business customers;
- All business customers will have equal access to added value services as other business customers do in the UK and competitive value for money;
- Strong customer engagement and involvement;
- Customers will have greater control over the services they receive and increased transparency of the cost to them;
- Customers will have a strong voice in day-to-day and long-term business planning by using innovative engagement tools and communities to inform our decisions.
- Customers will have greater control over the services they receive and increased transparency of the costs of them through the use of smart technologies (for example, building on the smart metering programme in the energy sector);
- Customers will have a strong voice in day-to-day and long-term business planning by using innovative co-creation tools and online communities to inform decisions, whilst taking full advantage of open data and big data analytics; and
- A strong customer-centric culture at Welsh Water.

Scope of work

We aim to transition to providing a personalised service for customers through their preferred communication channel, whilst ensuring that business customers have equal access to added value services, such as demand management advice, that meets their individual needs.

To allow us to do this, we could develop a mature and integrated customer data, research and engagement function. We could also embrace artificial intelligence to improve the consistency of the service we provide, and use predictive analytics to identify potential service failures before any impact on customers.

To improve efficiency and develop trust in our customer base, we may appropriately adopt new smart technology to give customers greater control over the services they receive and increase the transparency of the cost to them (for example, linking with the smart metering programme in the energy sector). We hope to also combine this with innovative engagement tools to give our customers opportunities to inform day-to-day and long-term business planning.

To further support our more vulnerable customers, we will aim to place customers on the lowest tariff for their personal circumstance, helping to deliver affordability for those struggling to pay their water bill. This will require appropriate sharing between our customer data and government data in order to understand our customers' circumstances.

We aim to provide a personalised service for our household and business customers through the adoption of technologies such as artificial intelligence and predictive analytics and the development of an integrated customer data, research and engagement function. We also propose to adopt innovative engagement tools to give our customers opportunities to inform day-to-day and long-term business planning. The potential total cost over 30 years of these schemes could be around £150m to keep up with customers' growing expectations for service.

3. Strategic Responses

Strategic response 12. Leading edge customer service

Case study: “Have your say” customer consultation, summer 2016

Need

As a not-for-profit company without shareholders, all Welsh Water’s financial surpluses are reinvested in the business for the benefit of customers. A key part of the company’s customer-led success is to increase the use of customer insight into its day-to-day decision making and business planning, including customers having a say in how any surpluses are used in future. The high profile customer consultation and engagement campaign in 2016 was also intended to raise awareness of the role of the company and to build customer trust.

Solution description

The “Have your say” consultation took the form of an online survey where customers were asked to allocate £30m between six options.

The consultation was supported by an advertising campaign across TV, radio and digital channels which encouraged customers to go to the website to ‘have their say’. In addition to the advertising campaign, engagement events were held across the length and breadth of our operating area, including the Royal Welsh Show, Eisteddfod, pop-up events and ‘customer of the future’ college events.

The online consultation was completed by over 12,000 people from across the operating area. Over 2,000 customers expressed an interest in participating in further research. In general, there was a good spread of allocation of the £30m across the six options, with strong support for community, education and recreation projects and additional help for those who struggle to pay. Some 49% of consultees did not want any reductions to their bills but would prefer to support the other five options, including additional investments to improve the service, resilience and efficiency of the business, to help keep down bills in the long term.

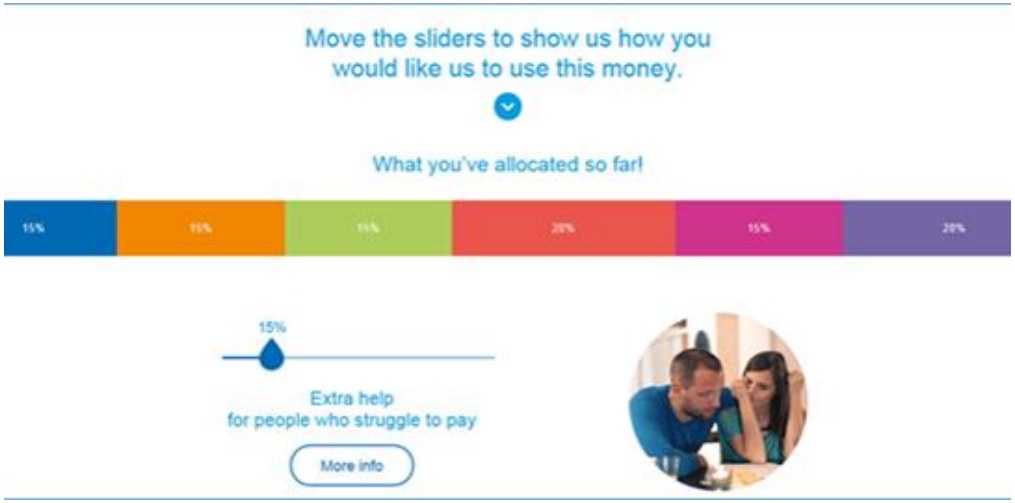


Figure 75 : ‘Have Your Say’ website snapshot. © Welsh Water

3. Strategic Responses

Strategic response 13. Smart water system management

With the opportunity to capitalise on technological advances, we will improve the service performance and resilience of our assets through remote sensing, data analysis and automation; solving problems before they impact on our business or the environment.

Customer impact

The Institute of Customer Service notes in its '2016 Customer of the Future Report' that increased use of sensors will enable organisations to extract greater value from physical assets, improve individuals' quality of life and "allow for better, more immediate and even proactive customer service". Digital technology can provide an opportunity to co-create solutions with customers.

Responding to future trends

The provision of a safe and reliable water and wastewater service is essential for our customers, and it is expected that they will be less tolerant of outages by all utilities in the future. Climate change may increase the frequency and severity of outages.

The growth of the digital economy will provide opportunities to improve system efficiency and customer service, whilst reducing operational costs through artificial intelligence, automation and increased availability of data.

Training will be needed to develop our colleagues to allow them to work alongside automated systems. However, changing demographics will represent opportunities for new skills in a changing workforce.

Moreover, the updated connected digital equipment increases our susceptibility to cyber attacks – and increasingly interconnected systems make institutions highly vulnerable to disruption (Williams, 2014).

Strategic response

Welsh Water recognises smart technologies and data will play a key role in supporting the 2050 strategy and that leveraging these opportunities will help improve performance, improve decision-making, improve resilience and improve interactions with customers and stakeholders. These technologies are rapidly developing so our smart plan will need to be flexible to take advantage of this progress.

Welsh Water's Smart Hub aims to optimise asset performance through local automation and remote intervention, with on-site intervention only required in exceptional circumstances. The capability to collect and analyse large volumes of data will help currently unforeseen events become more predictable. We will use machine learning, artificial intelligence and other advanced technologies to further enhance decision-making within our own networks and assets, and across the water cycle, working with stakeholders and communities. Interventions will include the following actions.

- Sensing and control - We will drive innovation in sensor development, increasing coverage and enhanced visibility. We will also use intelligent automation on our assets wherever possible to achieve optimised networks. In the coming years this will include raw water quality sensing, real time quality monitoring, leaking monitoring and customer connection monitoring. This may also include technology like 3D and 4D printing in the future.
- Collection and communication - We will drive towards continuous collection of asset data and effective communications of data to our mobile workforce. This will include improved data communications, extension of water control groups and motherships and hopes to include Internet of Things (IoT) platform, fully connected workforce, managed Machine to Machine (M2M) services, adoption of 5G, intelligent water control, digital twin (which is a digital representation of a physical object) and programmable matter.
- Data management and visualisations - We will create a data governance strategy. This will aim to provide accurate, near real time data with spatially representation via flexible user friendly mediums for our operators. This will also include opening up appropriate datasets for use by third parties, and developing an internal data platform to share data on everything from customer sentiment to asset conditions seamlessly across the business. In the next few years this will include situation awareness, open data pilot, operational intelligence, data management tools and data governance. This hopes to includes IT Asset Management (ITAM) governance in the future.
- Fusion and analytics - We will use innovative technologies to provide predictive and real time modelling of actual and potential failures. This will include enhanced water network performance, development of a robotics, and AI strategy, implementation of robotics pilots, secure data sharing, and further work on production optimisation. This aims to also include adoption of robotic process automation, adoption of AI and Quantum computing in the future.
- People and process; We will ensure that we have the technology and skills to implement these plans and ensure the security of our business and network. This will include a more detailed cyber security programme. This aims to include integrated catchment management, organisational strategy to prevent siloed working, advanced interaction with customers, personalised customer service, and optimised utility bills.

3. Strategic Responses

Strategic response 13. Smart water system management

Research and innovation

We will undertake the following research and innovation activities to support the strategic responses.

- Continue working with the International Smart Water Networks research and best practice group to accelerate the adoption of data-driven technologies in our water and wastewater networks.
- Develop real-time monitoring systems of water quality and quantity from sources to sea using new sensing technologies and use advanced analytics and prediction technologies to improve decision making and move customer service and operations into predictive mode.
- Leverage more data sets (Big Data) to gain insights into operations and customer service, resulting in improved reliability and performance.
- Use the new Welsh Water Technical Academy to ensure sufficient and well-trained technicians are available to operate the increasingly sophisticated control processes of the future.
- Develop research projects on the application of robotics, drones, internet of things and artificial intelligence to improve our business.
- Pilot the role of innovative engagement techniques, such as ‘gamification’, in customer engagement and colleague training.
- Continually improving cyber security to prevent cyber attacks on our assets and data.
- Develop a dynamic procurement platform to enable a more responsive and resilient supply chain.

We will work with partners like Western Power Distribution and Wales and West utilities on this research.

Co-operative approach

We will actively collaborate with the following identified partners:

- International partner water and wastewater companies (currently in the Netherlands and Denmark);
- Small and larger companies;
- Ofwat;
- Academia ;
- Natural Resources Wales and the Environment Agency;
- Third sector organisations like Surfers Against Sewage;
- Water companies and suppliers to develop innovative customer-orientated solutions; and
- Customers, to engage them in data collection, and use technology as a tool to enable co-creation.

We will develop a new platform to engage with our supply chain in a new and adaptive way.

Customer promises

Clean, safe water for everyone

Improved performance, sensing and control of the network, reduced rates of failure, and improved data analysis will ensure Welsh Water can continue to provide clean, safe water into the future.

Safeguard our environment for future generations

Enhanced data and monitoring of services and assets as well as catchment management will help us to improve environmental management and prevent pollution.

Put things right if things go wrong

Advanced control systems, analytics, and automation will ensure Welsh Water is able to respond to change in a timely and effective manner, with minimum impact on service.

Personal service that’s right for you

Technology can provide better customer service. We can also improve data collection, analytics and predicative capacity to provide a more reliable service.

Fair bills for everyone

Reduced costs through better analysis of asset performance and reduced reactive maintenance will help to keep costs and bills low.

Create a better future for all our communities

The open availability of data sources will help us to work better with stakeholders and local communities to co-create a better future for themselves.

Well-being goals

A resilient Wales

Utilising big data sets and analytics will help Welsh Water to understand and control its impact on the environment, creating healthy and resilient ecosystems.

A prosperous Wales

Smart information sharing will enable water to be used more efficiently, contributing to an innovative, productive and low carbon society.

Figure 74 : Augmented reality. We will take advantage of new technology where it helps to meet our vision for 2050.

3. Strategic Responses

Strategic response 13. Smart water system management

Direction of travel

Improved Customer Outcomes

- Improved customer service through predictive capability avoiding asset service failures that impact on customer service;
- Reduced flooding and water service outages through better remote monitoring of our services and assets, along with utilisation of big datasets for more effective intervention;
- Better analysis of asset performance through the Smart Hub to help reduce costs;
- Reduce the reactive field maintenance required, through better problem analysis and information to the field teams, reducing costs through avoiding failure;
- Better resilience to cyber attacks through improved cyber security;
- A highly automated network to increase efficiency and reduce the likelihood of failure;
- Open data availability allows for the co-creation of solutions with communities;
- Better relationships with customers, suppliers and stakeholders; and
- Enabling dynamic consenting, which will result in efficiencies and no harm to the natural environment.

Scope of work

As part of our overall smart management approach, we plan to improve how we manage, collect and analyse our data, and communicate and control our networks and assets. We will be flexible in our approach and will look for opportunities to implement new technologies as they mature.

This will include implementing innovative sensing and control technology across our networks. For example, we could implement raw water quality sensing, real time quality monitoring, leakage detection and customer connection monitoring. Moreover, we will look to extend our water control groups and motherships. We also hope to implement an Internet of Things platform, a fully connected workforce, managed machine to machine services, the adoption of 5G, intelligent water control, digital twin and programmable matter. To improve cross-sector resilience we will look at publishing data on an open platform.

We will also create a data governance strategy and use near real-time data in our operations. We aim to start modelling using real time data to highlight potential failures and enhance our real world network performance. To further improve the efficiency of our operations, we will look to implement artificial intelligence and robotics in our control systems, along with production optimisation.

We will ensure that we have suitable people and skills to deliver these plans and to ensure the security of our systems.

We aim to improve our data collection and analysis, communication, and management and control of our networks using the latest technologies. The total cost over 30 years is estimated to be £500m, which comprises the up-front investment in technology and the ongoing operational, communications and support costs.

3. Strategic Responses

Strategic response 13. Smart water system management

Case study: flood warnings in Copenhagen

Issues

Extreme rainfall events in 2010 and 2011 caused significant economic, social and environmental damage to the city of Copenhagen. In particular, in July 2011, 80,000 homes were flooded and the damage was valued at approximately €1bn.

Future weather projections for Copenhagen point to an increase in extreme rainfall events in summer, an increase in precipitation in winter, more days of high wind, and rising sea levels. While experts generally agree on the extent to which sea levels are expected to rise, it is difficult to project where and when extreme rainfall events will occur.

Action taken

In order to help protect people and property against the risks of intense rainfall, a flood warning tool, SURFF (Surface Flood Forecast) was developed. SURFF uses:

- Local weather prognosis data;
- Measurements of seawater level; and
- A model of the city (both surface terrain and the below-ground pipe system)

to predict resulting water flows and flood stages, along with sewerage pipe flows, for the next six hours. If the rainfall event is predicted to create 10cm or more of standing water over a significant area, a warning is issued to the relevant person on duty by SMS. They can then use a web-based viewer to gain a better understanding of the location and extent of the predicted flooding, and can decide whether utilities, emergency response units, or the wider public should be alerted.

The predictive nature of the tool allows authorities and utilities to temporarily increase their treatment capacity to meet the predicted demand, or implement relevant public safety measures if necessary whilst avoiding costly and disruptive false alarms.

Result

The project has been very successful at ensuring the existing sewerage network is used more efficiently, avoiding the need for costly upgrades. It was led to a reduction in energy used for treatment, and a significant improvement in the water environment.

90%

Reduction in number of wastewater overflows between 2013 and 2014

10-15%

Less energy used for wastewater treatment

⅓

Less pollution in the industrial port

Figure 77 : Swimming in the harbour area. Creative Commons License (CC-BY-2.0). By Thomas Rousing.

Figure 78 : Flooding in 2011, Copenhagen. Creative Commons License (CC-BY-2.0). By Lisa Risager.

3. Strategic Responses

Strategic response 13. Smart water system management

Case study: AMP6 coastal studies programme

Issue

We identified the need to gain a full quantitative understanding of the impact of our assets on bathing and shellfish waters around our coastline. It was recognised that more complete and useful datasets would be essential to provide a solid evidence base for future plans, and mitigate expensive future investments in our assets. It could also bring value by promoting high quality bathing waters, and meeting new guidelines shellfish standards, providing value to the Welsh economy.

Actions taken

The study consisted of a two year programme reviewing in detail the water quality risks at 49 bathing and shellfish waters around Wales.

This investigation included marine surveys and the processing of samples over 10 years, a large scale review of our asset telemetry and the development and use of water quality models to identify how our assets impact on such designated waters.

It was the largest single innovation project we have ever undertaken in Wales, and included the identification of multiple pollution sources (including our sources, private sources and sources of diffuse pollution) and a quantification of their impact on receiving water bodies.

Outcomes

The study identified gaps in our existing datasets, validated our existing sewerage network models and led to the creation of one regional and five local coastal models, spanning 2,700km of coastline.

The marine models developed will be used for an asset by asset cost benefit analysis to assess whether we should make any waste water investments at these coastal sites. This will help us to maintain affordable customer bills and support resilient sewerage designs for the future by ensuring we make the most effective and efficient interventions, whilst advising third parties of interventions that they can make in order to promote environmental improvements.

The models allow us to understand and apportion the causes of impacts, including sources that are not our responsibility, to help us contribute our fair share towards protecting the environment and public health.

The new modelling resources are available to regulators, developers and academia – maximising the benefit of our investment to the Welsh and wider UK economy.

The study has created a robust water quality prediction and forecasting tool, which allows us to warn bathers of short term pollution events.

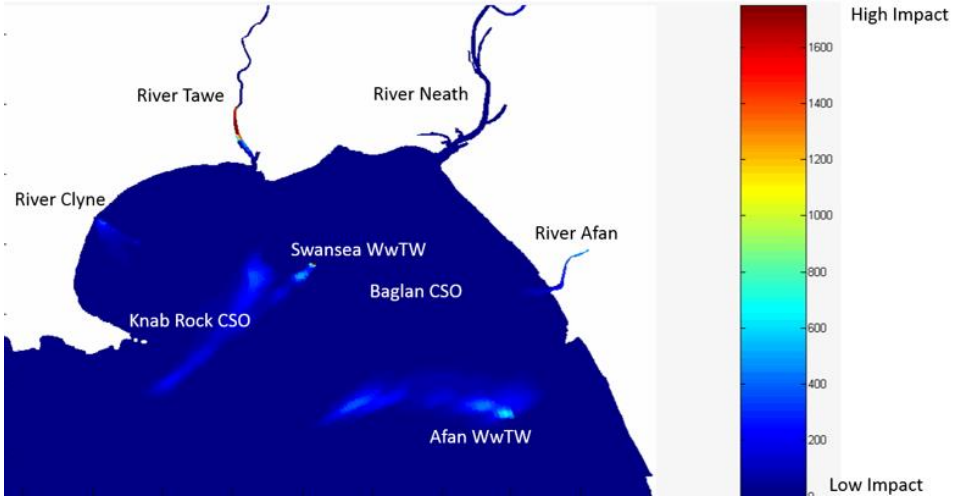


Figure 79 : An example of water quality impact mapping in Swansea Bay, showing the impact of our sewer outfalls. © Welsh Water

£8 million

Total cost of the study

2,700 km

Of coastline included in the new models

27,000

Hours of oceanographic survey data processed

3. Strategic Responses

Strategic response 14. Supporting ecosystems and biodiversity

Biodiversity faces threats including habitat loss, fragmentation and over-exploitation. In the longer term, temperature and changed rainfall patterns will also impact biodiversity. We will look for ways to help nature, enhance biodiversity and promote ecosystem resilience while we carry out our water and sewerage activities. Welsh Water has a duty under the Environment (Wales) Act (2016) to enhance biodiversity and promote the resilience of ecosystems in the exercise of our functions.

Importance for customers

Our stakeholders consider protecting the environment and biodiversity is vital to the work we do. We agree that supporting nature aligns with our mission of being a sustainable water service. Encouraging a wider public engagement with nature can increase public health and social well-being, through reducing stress, and supporting social cohesion. An environment that supports thriving, biodiverse wildlife is likely to be high quality and unpolluted.

Responding to future trends

Climate change is causing more frequent and severe droughts, extreme rainfall events and extreme temperature fluctuations, which in turn impacts species distribution and abundance, habitat use and the timing of seasonal events. This will likely change the composition of plant and animal communities and change the character of habitats and ecosystems as well as causing biodiversity loss.

An increase in the population in Wales may, for example, lead to more habitat loss and fragmentation. It may also lead to increased demand for abstraction from rivers. This increase coupled with changing rainfall patterns may alter river flows, impacting migration of species like salmon, reducing the protection from pollution events and decreasing oxygen supplies to flora and fauna.

We may be subject to new, more stringent environmental standards and legislation.

Strategic response

We aim to protect the landscape, rivers and coasts we operate in and the 40,000 hectares of land which we manage directly aligning with our biodiversity duty under the Environment (Wales) Act 2016. We will:

- Report on progress in delivering our statutory biodiversity plan, “Making Time for Nature” and keep it under review.
- Raise awareness of biodiversity within the business and look for opportunities to harness the enthusiasm of our colleagues for helping nature.
- Ensure that we take account of potential impacts on nature in our Water Resources Management Plan.
- Where appropriate, provide potential habitats for nature at our sites, while not impacting our operations.
- Plant trees in suitable areas within some of our drinking water catchments in order to secure land from erosion and landslip. In selecting the species to plant, we will consider how to maximise biodiversity gain.
- Continue to explore the potential role of natural and social capital accounting for improving our decision making processes.
- Work in partnership with others to play our part in wider campaigns to help biodiversity, e.g. through helping to reduce the spread of invasive non-native species or by increasing habitat connectivity.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- We will work with our regulators to improve our understanding of the potential for our practices to spread invasive non-native species and the potential cost implications.
- Look for ways to improve the management of protected sites in our stewardship, such as Sites of Special Scientific Interest.
- Within regulatory constraints, investigate opportunities to harness nature based approaches to water and wastewater treatment, as well as surface water management.
- Improve our understanding of the potential contribution our sites could make to wider habitat connectivity particularly focussing on species and habitats of principal importance for the purpose of maintaining and enhancing biodiversity.

We will work with the Welsh Government, Ofwat, Natural Resources Wales, the Environment Agency and Local Authorities to undertake this research.

Co-operative approach

This strategic response aims to encourage collaboration on biodiversity enhancement where there are shared interests in particular catchments.

- We will work with charities such as Afonydd Cymru, Canals and Rivers Trust in Wales, RSPB Cymru, Wildlife Trust Wales and community groups
- We will work with National Park Authorities on all catchment-scale environmental interventions, including the Brecon Beacons.
- ‘WaterSource’ will continue to explore collaborating with the third sector, where there are opportunities to support biodiversity while protecting our water supply sources.
- We will invite applications from non-profit organisations for funding for projects that will deliver positive outcomes for biodiversity; improve compliance with the Water Framework Directive and/or help to reduce the risk of non-native species where there is some link to Welsh Water’s operations.
- Subject to adequate insurance and licensing arrangements, we would like to explore the role of “Friends of” and other community groups who might adopt and help us to manage some of our sites.

Figure 80: Grebe. © Welsh Water

3. Strategic Responses

Strategic response 14. Supporting ecosystems and biodiversity

Customer promises

Safeguard our environment for future generations

Improving biodiversity, improves the quality of the landscape and the environment for the future,

A better future for all our communities

The wider benefits of biodiversity and environmental stewardship could help to provide a better future for Welsh Water's communities, including by encouraging public access to the countryside.

Well-being goals

A prosperous Wales

Enhanced biodiversity and environmental stewardship, will contribute to a low carbon society and the efficient, sustainable use of natural resources in Wales.

A resilient Wales

Enhancing a biodiverse natural environment and healthy functioning ecosystems are the key outcomes of this strategic response.

A healthier Wales

Encouraging wider public engagement with nature can increase public health and social well-being, through reducing stress.

A Wales of cohesive communities

Working with communities to improve and manage the biodiversity strengthens community groups, supporting social cohesion.

A globally responsible Wales

The enhancement of the natural environment will contribute to the well-being of ecosystems; support the principles of the UN's Convention on Biological Diversity; and respect the importance of the pan-European network of protected nature conservation sites.

Figure 81 : Salmon. By Melissa Doroquez. Creative Commons License (CC BY-SA 2.0)

3. Strategic Responses

Strategic response 14. Supporting ecosystems and biodiversity

Direction of travel

Improved Customer Outcomes

- Increase resilience of nature for future generations to harness and enjoy;
- Wider engagement with nature through encouragement and education as well as by setting an example;
- Resilient water supplies while respecting the nature that also relies on the water environment;
- Protection of public health through further reductions in pollutant exposure and reduced flood risk;
- Strengthen community groups through collaborative working and environmental ownership; and
- Preservation and enhancement of protected sites.

Scope of work

Our Biodiversity Plan reflects the value that our customers and stakeholders place on the natural environment, and explains how we will embed the importance of biodiversity in our people and amongst our customers.

As a first step, we plan to take account of biodiversity and ecosystem resilience when reviewing our Water Resources Management Plans. We will also look to protect water supplies and benefit wildlife by working with landowners to remove contaminants from run off, reduce pesticides in the environment and secure land from erosion and landslip through a programme of tree planting. We will also improve our understanding of the potential role of our activities on the spread of invasive non-native species, and respond to this as appropriate.

We are also planning to investigate the impact of our operations on 76 inland water bodies, and where a water body is not achieving Good Ecological Status under the Water Framework Directive. Where we are the confirmed cause, we will agree a programme of improvements for 2020–2025. As part of this, we could also support not for profit organisations that work in this area and “Friends of” groups that are already enriching biodiversity in their local communities through, for example, collecting ecological data, planting pollinating flowers and litter picking. More widely, we also plan to increase renewable energy generation capacity and improve existing energy efficiency.

As part of a programme of engagement with our customers and stakeholders, we hope to educate future generations about the importance of the water environment and inform customers about the impacts of sewer misuse on the environment, including on marine wildlife.

As part of a wider programme of cultural change within Welsh Water, we also want to promote legal conservation obligations to all of our colleagues. We also plan to encourage the promotion of biodiversity through contract arrangements and procurement processes. Internally, we will trial the role of catchment Biodiversity Champions to support nature and showcase how it is possible to achieve a balance of operational purpose, health and safety and support for nature using Case Studies .

We propose to work with partners to improve the biodiversity and ecosystem resilience of the environment in which we operate. This may include investing in catchment management and invasive non-native species removal programmes. We will also engage with our customers to inform them about the importance of the water environment and how they can contribute to its protection, and engage with our colleagues to promote our legal conservation obligations and showcase how it is possible to support biodiversity and ecosystems. These costs will be relatively small over the 30 years of the Welsh Water 2050 programme.

3. Strategic Responses

Strategic response 14. Supporting ecosystems and biodiversity

Case study: Elan Nature & Wildlife

Owned by Welsh Water, our Elan estate covers about 180 square kilometres. Its moorland, bog, woodland, river and reservoir habitats are of national importance, each supporting their own ecosystems. It is leased by the Elan Valley Trust, which was established by Welsh Water in 1989 as a charitable trust to promote conservation, appropriate public access and disseminate information about the estate.

Issue

Most of the Elan Estate is covered by 12 separate Sites of Special Scientific Interest. Within the Estate is the Claerwen National Nature Reserve, 800 hectares of upland plateaux with gently rolling hills covered with acid grassland and in parts, blanket bog on a mantle of peat.

Action taken

The estate is managed by the Trust in a way that is sympathetic to nature so, for example, grazing has been reduced on the reserve to protect species like bog mosses, bog rosemary, cotton grasses and heather.

It is one of the most important areas for land birds in Wales and the majority of the estate has been designated as a Special Protection Area under the EC Directive on Wild Birds.

Result

Of the 110 species “Amber Listed” (declining, some now uncommon) by the Royal Society for the Protection of Birds and British Trust for Ornithology, 21 breed regularly here and a further 47 have been seen on the Estate. The estate’s importance extends beyond birds: for example, 27 species of butterflies and over 200 species of moth have been seen on the Elan Estate as well as 17 kinds of dragonfly and damselfly.

Next steps

During the year a series of events takes place at Elan designed to educate and engage visitors of all ages about the natural environment, such as wildlife tracking; birdwatching safaris; pond dipping; managing wildflower meadows; moth and bee identification.

Figure 82 : Garreg-ddu reservoir, Elan alley (CC BY-ND 2.0) by Andrew Hill

Figure 83 : Male Red Grouse (CC BY 2.0) by Peterichman

3. Strategic Responses

Strategic response 15. Using nature to reduce flood risk and pollution

RainScaping our communities: confronted with urban creep due to demographic change and increased intensity of rainfall due to climate change, Welsh Water is proposing to reduce the risk of sewer flooding and pollution through sustainable urban drainage systems.

Customer impact

Sewer flooding is considered the worst service failure customers can experience, and is noted as a highly emotive issue amongst our customers. They consider us responsible for preventing such events. (Welsh Water, 2016).

Responding to future trends

Climate change is causing an increase in winter rainfall and increase in intensity of summer storms. This will cause increases in the scale and frequency of sewer flooding. Urban creep, caused by population growth, and an expansion in the impermeable area within our towns and cities is steadily increasing the amount of rainfall which is collected into our combined (foul sewage and surface water) sewage systems. This increases the risk of sewer flooding and pollution due to hydraulic overload and blockages and increases the pressure on our weakened ageing infrastructure. In addition, with increased pressure on councils to reduce their budgets, the spending on maintenance of surface water sewers and highway drains may be reduced, further increasing the risks of sewer flooding at a time when capacity requirements could rise to meet future demographic growth and climatic changes. In addition, the incidence of sewer flooding caused by internal blockages remains high.

The cost of energy may increase making it more efficient to reduce the amount of rainwater being pumped around our sewage network. Increasing environmental pollution through emerging contaminants poses risks to the natural environment.

Strategic response

This strategic response includes:

- Implementing sustainable drainage systems across our region, co-creating local solutions with communities;
- Mitigating flood risks for all properties at a high risk of internal flooding and resolve new ‘high-risk’ flooding issues as they arise;
- Communicating and engaging with customers to avoid introducing inappropriate solids into the sewerage network;
- Undertaking a study to explore the costs, risks and benefits of the adoption of surface water and highway drainage by Welsh Water, something that is not currently our responsibility; and
- Rainscape will be one of a toolbox of measures across the business which will be used in conjunction with other inventive measures and the development of networks.

Research and innovation

The following research and innovation will support this strategic response:

- Research pipe repair techniques (including self-repairing pipes) as well as incentives to reduce urban creep to help tackle inflow and infiltration into the sewer network affordably;
- Develop our understanding of the performance of sustainable urban drainage systems including their benefits for amenity, biodiversity and water quality, their long-term performance and their performance during drought and floods in rural and urban settings;
- Develop standard approaches for implementing SuDS including standard designs and the use of statutory powers for SuDS implementation;
- Formulation and development of drainage and wastewater management plans, in line with Water UK’s 21st Century Drainage Programme, to inform decision-making on sewerage and surface water drainage.
- Research to understand and apply climate change to sewage and urban drainage design with consultants HR Wallingford;
- Research customer behaviours around sewerage use and how to influence these behaviours, including the economic incentives for the installation of greywater reuse systems and the labelling of products that should not be flushed;
- Research to understand the nature and fate of pollutants entering our sewage systems and how best to control such substances; and
- Research to understand how long our drainage assets will last and how best to maintain and rehabilitate them.

We will work with Natural Resources Wales and the Environment Agency to undertake this research.

Co-operative approach

We will work in partnership with Local Authorities, landowners and local communities to co-create sustainable urban drainage systems. This will include design, implementation and maintenance to ensure the schemes operate sustainably and effectively, and bring the widest possible benefits for the local community. We will encourage local communities to adopt sustainable urban drainage systems, and we will work closely with the Welsh Government to ensure legal frameworks are in place for adoption. We will also work with customers to find the best interventions to protect our sewerage network against inappropriate solids (such as wet wipes).

3. Strategic Responses

Strategic response 15. Using nature to reduce flood risk and pollution

Customer promises

Safeguard our environment for future generations

Long term sustainable drainage and researching the fate of pollutants will help to improve the environment and support biodiversity across Wales.

Putting things right if they go wrong

Reducing surface water and sewage flooding will protect communities and reduce the need for reactive interventions. The adoption of all surface water sewers and highway drains could allow for a more co-ordinated approach to asset management, and a more effective response when things go wrong.

Create a better future for all our communities

Improved water quality, effective control of the sewage system, and a greener urban environment will create a healthier and better future for communities and encourage biodiversity.

Well-being goals

A prosperous Wales

The adoption of all surface water sewers and highway drains could allow Welsh Water to manage flows more efficiently and effectively, and contribute to a more innovative and productive society.

A resilient Wales

Sustainable drainage will help to reduce pollution and flooding in the face of climate change and urban creep and provide opportunities for natural habitats in urban environments.

A healthier Wales

Improved water quality and a greener urban environment will enable healthier livelihoods and communities.

A more equal Wales

Many communities most at risk of flooding are also amongst Wales' poorest, and thus taking ownership of key assets and reducing flood risks will help to create a society where everyone can fulfil their potential.

A Wales of cohesive communities

Improve the built environment through sustainable drainage reducing the incidence of sewerage flooding will help to create more attractive and viable communities.

A globally responsible Wales

The enhancement of the natural environment will contribute to the well-being of ecosystems.

Figure 84 : Rainscape Community Fund winners. © Welsh Water

3. Strategic Responses

Strategic response 15. Using nature to reduce flood risk and pollution

Direction of travel

Improved Customer Outcomes

By delivering sustainable drainage systems in the major conurbations we will virtually eliminate flooding in all but extreme events for our high risk customers. The customer outcomes will include:

- Increasing the resilience of our assets and customers to future risks including climate change;
- Mitigating flood risks for individual properties experiencing a high risk of internal flooding (flooding during a 1 in 10 year event) currently and in the future;
- Greening the urban environment (as per Welsh Government Water Strategy) and helping to meet the requirements of the Well-being and Future Generations (Wales) Act 2015;
- Providing wider benefits to our customers, such as biodiversity and greener communities; and
- Mitigating local risk of external flooding, in particular for areas where it has an impact on communications, transport and access to properties.

Scope of work

We believe that the RainScape approach will be crucial to protect our communities and the environment from the growing risks of flooding and pollution. We aim to install sustainable drainage systems in cities and major conurbations (Swansea, Cardiff, Newport, Wrexham, Chester) facing the highest risk of sewer flooding and pollution. We will consider the feasibility of extending this to all urban communities at risk (broadly those with a population of 2,000 people or more), in order to virtually eliminate urban flooding and pollution, which represents 90% of the population which we serve.

We propose to deliver sustainable drainage systems in cities and major conurbations to tackle flooding and pollution. We could extent this further to all urban communities at risk (broadly those with a population of 2,000 people or more). There will be some offsetting savings associated with reduced costs of sewer flooding and responding to incidents. Depending on the geographical extent of the roll-out of RainScape across our communities, we estimate that the total net cost over 30 years could be around £600m - £2.1bn.

3. Strategic Responses

Strategic response 15. Using nature to reduce flood risk and pollution

Case study: RainScape Llanelli

Llanelli was particularly prioritised due to the impact of flooding on customers and preventing economic development. The total costs of the RainScape in Llanelli is £55 million.

Issue

Large volumes of rainwater are entering the sewers during periods of heavy rainfall. This has led to some sewer flooding in residential areas, frequent spills of storm sewage into the sea, and restrictions to economic development. We cannot resolve this problem solely using traditional methods such as building additional storage tanks, as they would be difficult to operate and would not tackle the fundamental problem of too much rainwater getting into the sewers during storms.

Action taken

A variety of RainScape solutions have been installed in Llanelli to collect and store rainwater. These include:

Queen Mary's Walk – construction of a swale on a playing field;

Stebonheath School - the transformed playground includes a pond, a swale, planters, permeable paving, water butts and an outdoor educational area; and

Glevering Street / Swansea Road - installation of new drainage kerbs, grass channels and planters.

In addition, the Welsh Water communications team have opened a RainScape information station in Llanelli town centre, liaised with more than 3,500 customers, issued in excess of 11,500 letters, hosted public exhibitions and surgeries and answered all questions openly and honestly.

Result

To date, Welsh Water have removed 30,000m^3 of surface water from the sewer, reducing spills of storm sewage into the sea, freeing capacity for new development, and addressing the risk of flooding at six Llanelli properties.

Next Steps

Welsh Water will continue the Loughor RainScape programme to reduce network flows and spills, including:

- Further work with communities, including the Station Road tunnel and implementation of RainScape at Emma Street and Asda (Phase 2);
- Increase pass forward flows at Northumberland Sewage Pumping Station (SPS) to achieve 10 spills per year; and
- Peak flow equivalent secondary treatment at Llanelli and Gowerton wastewater treatment works.

Figure 85 : A rain garden at Queen Mary's Walk, Llanelli. © Arup

Figure 86 : A bioswale at Queen Mary's Walk, Llanelli. © Arup

3. Strategic Responses

Strategic response 15. Using nature to reduce flood risk and pollution

Case study: Highways drainage - assessing the impact of adoption

We are currently undertaking research to input into the Welsh Government Water Strategy consultation on sewage and drainage ownership.

Issue

Drainage systems have developed over time and this has led to a range of individuals and organisations having ownership and responsibility for surface water and highway drains. This often means that we have no control over the root cause of problems, such as sewer flooding caused by surface water surcharge.

In built-up areas, local authorities and the sewage undertaker each have certain responsibilities. In rural areas, drainage is often the responsibility of Natural Resources Wales.

Highways drainage is the responsibility of highways authorities. The relationship between highways drains and the public sewage network is complex, with some highways drains carrying surface water from public systems and some highways drainage discharging into public sewers.

An estimated 7% of properties in Wales depend on independent privately owned and operated systems such as septic tanks, cess pools and package treatment plants.

Understanding the role each plays in drainage is vital for development of sustainable integrated drainage.

For our customers it can prove confusing and create difficulties in understanding who to go to when problems arise. Whilst this issue of urban flooding is outside our responsibility, we want to play our part in promoting solutions that provide the best service for our customers in the most efficient way.

Actions

Five task and finish groups have been set up to review the practical challenges that would be faced through any addition to our roles and responsibilities as a sewage undertaker:

- Work Area 1 – Technical
- Work Area 2 – Resource, Cost and Service
- Work Area 3 – Risk
- Work Area 4 – Legal
- Work Area 5 – Welsh Government Proposal

The first two work areas consider the practicalities and impact of any transfer of privately owned drainage assets to Welsh Water. The second two work areas consider the risk and legal implications for the transfer of privately owned drainage assets to Welsh Water. Work Area 5 co-ordinates the opinions of the full project group into a series of recommendations which will be made to the Welsh Government in support of their recent consultation.

Expected Result

It is too early to predict the outputs of the internal project and the impact of any transfer of assets on customers or Welsh Water.

However, the project is expected to provide evidence to the Welsh Government that it can use to inform future policy decisions or further studies into various transfer options.

Next Steps

We are not proposing that Welsh Water should take overall ownership of sewage and drainage, as this is outside of our current legislative duties. We propose to explore the scope of any change through the following activities:

- Establish a framework to identify any evidence, data or regulatory gaps and consider how these might be addressed;
- Assess the costs, benefits and risks of adoption;
- Assess requirements for highway drainage and private un-adopted surface water sewer maintenance;
- Target rehabilitation of any adopted assets in poor condition; and
- Assess requirements for the operation of additional urban drainage.

Figure 87 : Drainage © Welsh Water

3. Strategic Responses

Strategic response 16. Cleaner rivers and beaches

With increasing pressure on the natural environment from increased population, changing land use, climate change and new sources of pollution, we will improve our wastewater assets to do our part to help achieve 'good' environmental status for our rivers, lakes and coastal waters.

Customer impact

Our customers are disappointed by poor river water quality statistics, and see clean rivers and beaches as a key priority. They also place a high value on coastal bathing water quality, and note the importance of coastal waters for supporting a high quality of life and the tourism industry (Accent, 2013). Our customers continue to place value on the protection of the environment and recognise the importance of everyone playing their part to protect it.

Responding to future trends

The European Water Framework Directive requires all waterbodies to achieve 'Good' environmental status. Waterbodies can be impacted by multiple activities including agriculture, urban run-off, wastewater discharges (continuous and intermittent), abstraction, physical modifications (dams, bridges, weirs) and industry (such as mines).

Increased winter rainfall, increased agricultural run-off and increased run-off due to urbanisation are likely to have a detrimental impact on the ecological status of waterbodies. Reduced summer rainfall will lead to more periods of low flows in rivers, exacerbating these impacts.

The cost of resources required to treat wastewater may increase in the future. There is also potential for tightening standards in the future which could be difficult and expensive to achieve.

Although the nature of the regulatory environment after Brexit is uncertain, there could be an opportunity to take advantage of new national regulation that improves environmental outcomes and social efficiency, for example, through alignment of consenting with the Water Framework Directive, and through seasonal permitting.

There are opportunities for Welsh Water to respond to the desire of the Welsh people to do more outdoor recreation.

Strategic response

The Water Framework Directive places legal obligations on Welsh Water through new and changed permits for abstractions and discharges. Welsh Water will investigate the impact of our operations on waterbodies, where we are the confirmed, probable (or suspected) cause of water quality failure.

Natural Resources Wales and the Environment Agency may impose new permits on us to meet the Water Framework Directive. We will work with Natural Resources Wales, the Environment Agency and other stakeholders to understand the impact of our operations and those of others on waterbodies where we are the confirmed, probable (or suspected) cause of water quality failure. We aim to develop solutions that are appropriate for the catchment to achieve 'good' environmental status. There is likely to be significant investment to reduce the impact of operations on the environment, in such instances, for example to reduce nutrient levels entering waterbodies from our assets.

As part of the 21st Century Drainage Programme, we will work with Ofwat and Water UK to effectively plan for the longer-term challenges in our sector. As part of this response, we will be improving monitoring and performance of our sewer overflows, addressing sewer misuse, and reducing groundwater infiltration.

Research and innovation

Welsh Water will explore the following research topics to support this initiative:

- Work with our regulators on alternative catchment wide permitting approaches (including seasonal and load-based consenting) and develop flow and load monitors to understand the impact of spills;
- Research the use of natural capital accounting or ecosystem services approaches to value the impacts of spills and the benefits of our interventions;
- Understand the effects of climate change on river flows and ecology to anticipate future environmental needs in 30 years time;
- Understand how best to address emerging contaminants, including the fate of antibiotics, other pharmaceuticals, microplastics and microbeads in the wastewater treatment process, and their impact on the environment;
- Explore new ways to treat storm water including the addition of bacteria, additives and phosphorus into sewers and reedbeds;
- Explore localised wastewater treatment including off-grid and community wastewater treatment works; and
- Explore the models of drainage asset ownership, including the practicalities, legal framework, costs and risks.

We will work with Natural Resources Wales and the Environment agency to undertake this research.

Co-operative approach

Achieving good ecological status involves a range of partners. We will actively collaborate with the following identified partners:

- Local authorities
- Land users including agriculture
- Natural Resources Wales and the Environment Agency
- Community groups and third sector bodies

3. Strategic Responses

Strategic response 16. Cleaner rivers and beaches

Customer promises

Safeguard our environment for future generations

Welsh Water will use a catchment-wide approach to water management to reduce the impact of our operations on the environment, benefitting watercourses, lakes, estuaries, coasts and aquifers across Wales.

Fair bills for everyone

Working together with stakeholders across catchments and harnessing new technological solutions will keep down the costs of environmental improvements into the future.

Create a better future for all our communities

Reduced sewage discharges, through projects such as RainScape, will improve the natural environment for people, and help communities create a better future for themselves.

Well-being goals

A resilient Wales

A catchment-wide approach to water management will help to maintain a resilient, biodiverse, natural environment into the future.

A prosperous Wales

Improving our water environment will contribute to an innovative and productive society, where natural resources are used efficiently and proportionately, and will promote leisure, tourism and the well-being of our communities.

A globally responsible Wales

The enhancement of the natural environment will contribute to the well-being of ecosystems.

Figure 88 : Three Cliffs Bay, The Gower. Maintaining high quality rivers and beaches can help to promote tourism, as well as support the well-being of the people of Wales. By William Pearce, Creative Commons License (CC-BY-2.0).

3. Strategic Responses

Strategic response 16. Cleaner rivers and beaches

Investing towards 'Good' status for rivers: Cumulative capital investment (Capex) required to achieve 'good' status, and relative attribution of cause of failure to the water industry

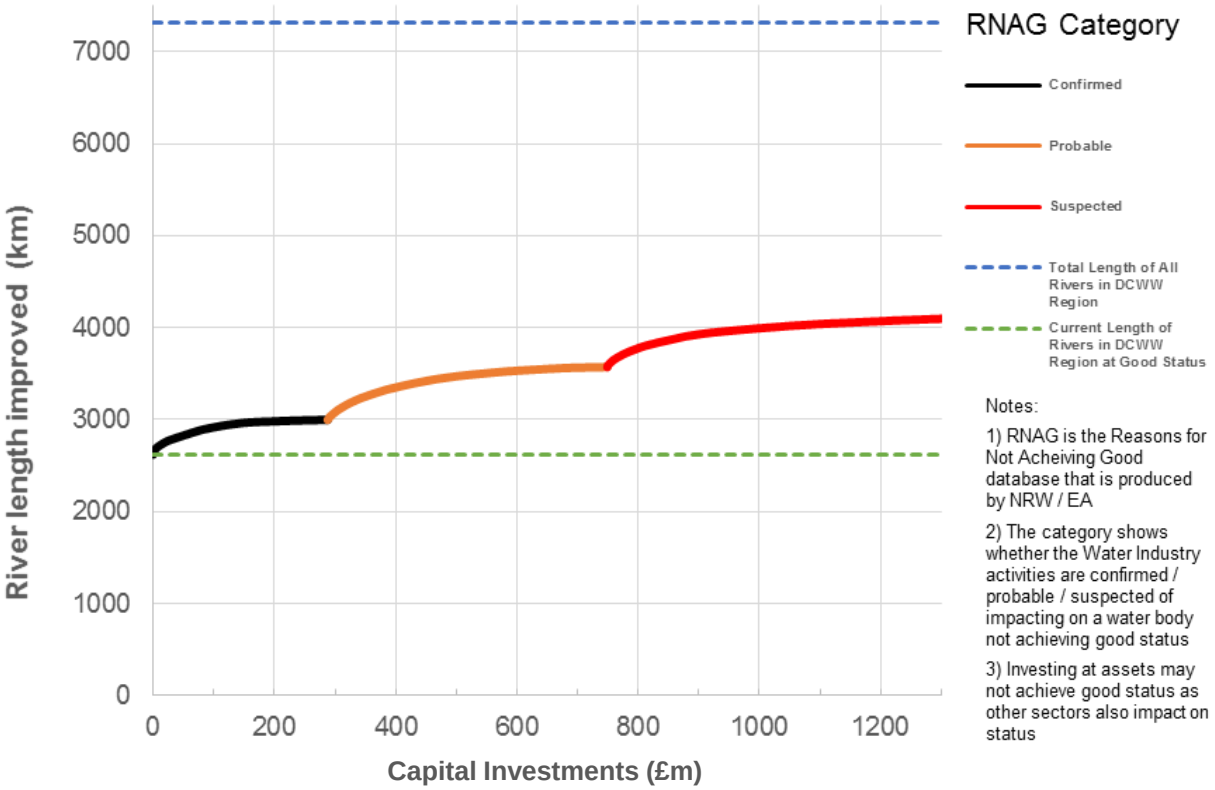


Figure 89 : Capital investments required to achieve 'good' status (Welsh Water)

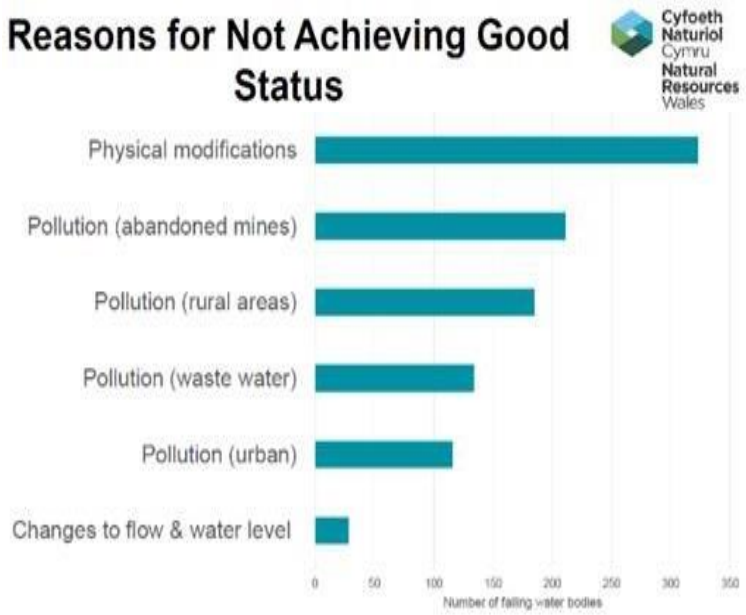


Figure 90 : Reasons for not achieving 'good status' © Natural Resources Wales

3. Strategic Responses

Strategic response 16. Cleaner rivers and beaches

Direction of travel

Improved Customer Outcomes

- We will aim to make our contribution to a wider societal programme to achieve ‘good’ status amongst all the rivers where we are the confirmed or suspected cause of water quality issues, constituting between 1,000 km and 1,500 km of rivers in Wales;
- We will reflect the desires of our customers, who value the environment;
- We will enhance our approach to wider catchment management and put in place resilient solutions for the future;
- We will use sound science and investigations to target our investment, and help to identify partnering opportunities with contributing sectors who can also play their part; and
- This approach will deliver economic benefits, particularly for the tourism industry.

Scope of work

We believe that we have an important part to play in achieving cleaner rivers and beaches. We plan to work with Natural Resources Wales, the Environment Agency and other stakeholders to identify the root causes of pollution, understand the impact of our operations, and those of others, on waterbodies where we are the confirmed or suspected cause of water quality issues, constituting between 1,000 km and 1,500 km of rivers in Wales. We will mitigate the impact where we are the confirmed or suspected cause of water quality issues, as part of an integrated catchment plan involving all the necessary parties.

We plan to work with partners to identify and mitigate for water quality issues where we are the confirmed or suspected cause to contribute to achieving ‘good’ status for all rivers and beaches in Wales. The total cost is expected to be around £800m – £1.5bn over 30 years, depending on the scale of works proved to be necessary and cost effective.

3. Strategic Responses

Strategic response 16. Cleaner rivers and beaches

Case study: Swansea Bay bathing water

Issue

The Swansea Bay bathing water had experienced varied compliance with the original Bathing Water Directive (cBWD) and had been identified by Environment Agency Wales, now Natural Resources Wales, as being at risk of not meeting 'sufficient' class under the revised Bathing Water Directive (rBWD). Investigations identified investment as being required for improvement of the direct discharges and larger local indirect discharges to enable 'sufficient' class to be achieved.

Action taken

- We have undertaken investigations to identify impact of our assets on Swansea Bathing Water; and
- We implemented of sustainable drainage (RainScape) approach over AMP5 and AMP6 to meet Natural Resources Wales required spill frequencies at identified assets.

Result

- Welsh Water is playing its part in helping the bathing water reliably meet its statutory water quality standard under the rBWD. Bathing water status has improved from 'Poor' and is currently classed as 'Good'; and
- The improvements will reduce the overall volumes of water entering our network during storms, reducing pumping at Langdon Road pumping station and Swansea Bay wastewater treatment works.

Next Steps

We will complete of RainScape schemes to achieve three spills design solutions at the following combined sewer overflows: Dunns Lane; Sketty Green and Derwen Fawr.

The total cost of the scheme is £5.2 million.

Figure 91 : Swansea Bay. By Palickap - Own work, CC BY-SA 3.0,

3. Strategic Responses

Strategic response 16. Cleaner rivers and beaches

Case study: Wye Catchment phosphorus removal investigations

Phosphate levels in some locations within the Wye catchment are above current target levels. Phosphate loads to the catchment need to be reduced by Welsh Water and other parties. By undertaking investigations in AMP6, investment in AMP7 will be based on sound evidence.

Issue

The River Wye and River Lugg are areas of special importance for nature conservation, with both rivers being designated as Sites of Specific Scientific Interest (SSSIs). The lower stretches of the River Lugg, along with the River Wye, are also a part of the River Wye Special Area of Conservation (SAC) designated under the Habitats Directive. The SAC includes reaches where the levels of phosphate exceed the target level currently set by Natural England, meaning that waterbodies are not at 'Good' status.

Actions to be taken

We will undertake:

- Source apportionment investigation to identify which of our activities and those of other land users are impacting and where;
- Stakeholder and partnership working, supporting the Nutrient Management Plan; and
- Identification of solutions including phosphorus removal at WWTWs and, catchment based solutions.

Expected result

The expected results are:

- Good status achieved for waterbodies in the Wye and Lugg river catchments;
- Allowance for forecast population growth in catchments; and
- Improved cost effectiveness by taking a catchment wide approach.

Next steps

The next steps are:

- Participation at Wye Nutrient Management Plan Board and Technical Advisory Group;
- Updating of Source Apportionment Geographical Information Systems (SAGIS) modelling for source apportionment in partnership with Environment Agency; and
- Scheme development for onsite and offsite, catchment solutions to achieve phosphorus removal.

Figure 92 : The River Wye © Welsh Water

3. Strategic Responses

Strategic response 17. Protecting our critical wastewater assets

Faced with an increased risk of disruption, for example, from an increase in severe weather as result of climate change, and reduced customer acceptability of pollution events, we will improve the resilience of our critical wastewater assets, which have high environmental and customer impacts of failure.

Customer impact

Resilient wastewater assets are seen as a key driver to avoid interruption to wastewater services and protecting the environment. Customers interpreted this to cover interventions, such as building walls around sites to stop them flooding thereby preventing damage to equipment. They were also adamant that wastewater from flooding should not in any way affect clean water supplies (Welsh Water, 2016).

Responding to future trends

As a result of climate change, storms will increase in frequency and intensity, increasing pressure on our treatment works and the likelihood of pollution events.

Welsh Water service robustness is compromised by both critical assets, which may have limited resilience to challenges including flooding, coastal erosion and loss of power and ageing assets that are reaching the limit of their service life or beyond. These assets could also be compromised by security and cyber threats particularly as increased automation and connectedness means that individual asset resilience is no longer sufficient.

The failure of these assets could lead to significant customer service and environmental impacts.

Strategic response

We have assessed the resilience of critical assets to: security, flooding, coastal erosion, catastrophic failure, contamination, loss of power and cyber threat and have identified the following resilience measures:

- Complete security upgrades;
- Install cyber security measures;
- Install flood resilience;
- Improve power resilience;
- Upgrade control systems;
- Improve treatment flexibility;
- Make improvements to maintain access;
- Develop, test and refine business continuity plans for key assets; and
- Provide coastal erosion prevention (specifically measures at Cardiff wastewater treatment works).

We have also recognised the need to develop best practice resilience design and operational standards.

Research and innovation

Welsh Water will explore the following research topics to support this strategic response:

- Undertake research into flood risk, using a wider historical data record, and flood resilience approaches to protecting and operating assets during floods;
- Research sewage treatment processes, which can recover or absorb shocks such as load or flow peaks;
- Research approaches to recovery after major disruptions to assets to better inform contingency planning; and
- Understand small scale treatment processes that may efficiently serve smaller communities.

We will work with Category 1 and 2 emergency responders on carrying out this research.

Co-operative approach

We will work with the supply chain to develop resilient solutions for assets. We will actively collaborate with the following identified partners:

- The SSE Group;
- Western Power Distribution;
- Critical supply chain partners;
- Network Rail;
- Local Authorities particularly Highways and Flooding; and
- Natural Resources Wales and the Environment Agency.

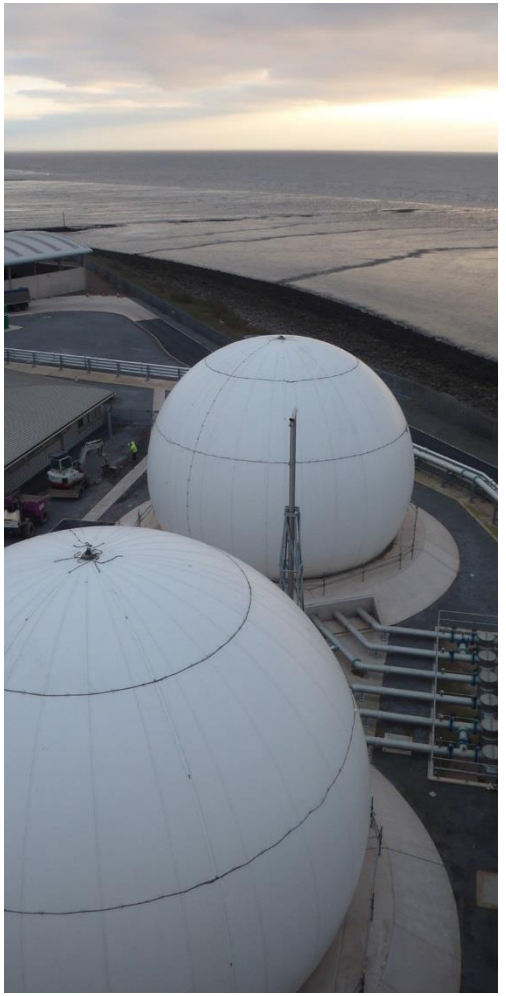


Figure 93 : Cardiff wastewater treatment works © Welsh Water.

3. Strategic Responses

Strategic response 17. Protecting our critical wastewater assets

Customer promises

Safeguard our environment for future generations

Reducing the impact of waste water on clean water sources will help to protect these resources for future generations.

Putting things right if they go wrong

Improved resilience of wastewater assets will allow Welsh Water to better respond to unforeseen events.

Create a better future for all our communities

Increased resilience to shocks and stresses for assets will enable Welsh Water to continue providing a high quality service to customers into the future.

Well-being goals

A prosperous Wales

Reduced outages and resilience to shocks and stresses will contribute to productive communities across Wales.

A resilient Wales

A better capacity to adapt to change will support a resilient Wales.

Figure 94 : Pwll Pumping Station experiencing flooding in 2016. © Welsh Water.

3. Strategic Responses

Strategic response 17. Protecting our critical wastewater assets

Direction of travel

Improved Customer Outcomes

By having resilient wastewater service assets protected against security incidents, flooding, coastal erosion, catastrophic failure, treatment flexibility, control systems, loss of power, access restrictions and cyber threats, we will;

- Reduce the risk of serious pollution events (category 1 and 2). This will be a reduction from the current average levels of two pollution incidents a year, on average;
- Reduce the risk of serious flooding incidents (affecting multiple properties). This will be a reduction from the current average level of 1 serious flooding incident a year;
- Aim to eliminate flood damage to our assets, ensuring effective service provision.;
- Aim to maintain our reputation as a credible and effective provider of an essential service by reduced customer outages, pollution and flooding events; and
- Help to meet increasing customer expectations that our service provision can withstand or recover quickly from ‘shocks’ or ‘stresses’.

Scope of work

This intervention is a risk based approach focusing on dealing with the most strategic and critical assets where there is a high consequence of failure, and which cannot be mitigated by operational measures. The critical assets have been identified as 26 (of the 835) wastewater treatment works and 10 (of the 2237) sewage pumping stations.

To improve the resilience of these vulnerable assets, we will undertake a number of specific upgrades. These include completing security upgrades, upgrading control systems and improving power resilience. We will also install flood resilience, improve treatment flexibility and make improvements to maintain access. Where appropriate, we will also provide coastal erosion risk reduction measures (specifically at Cardiff wastewater treatment works). For our wider asset base, we will also develop, test and refine business continuity plans.

We will invest in resilience upgrades at our critical waste water assets to protect them against physical risks such as vandalism, flooding, power outage, variable sewage effluent quality and coastal erosion as well as cyber attacks. The total cost of these upgrades is expected to be around £400m.

3. Strategic Responses

Strategic response 17. Protecting our critical wastewater assets

Case study: Newport Nash wastewater treatment works

Newport Nash wastewater treatment inlet works

Improvements have been made at the wastewater treatment works to improve resilience of the current asset configuration and ensure that properties in the network are not flooded due to problems at the works.

Issue

Newport Nash serves a catchment of around 160,000 properties. It was identified that there was no bypass at the inlet works so any failure of the equipment could result in the sewage backing up to houses. The inlet is often a pinch point at a treatment works, as there is a significant amount of rubbish in the sewers, which has to be screened at this early stage. It is very easy for some of this to cause a blockage and, without a bypass, the effect would be to slow the flow of sewage coming into the works, which could flood up to 60 properties.

Action taken

A bypass has been constructed at the inlet works to ensure that flow can be diverted in the event of a blockage.

Result

This has resulted in reduced risk of environmental damage and property flooding.

Improving power resilience at wastewater treatment works

Power is critical to ensure that there is sufficient supply to keep our wastewater treatment works running in an emergency situation.

Issue

Through our resilience risk assessment we have identified a number of wastewater treatment works that do not have a resilient power supply. For example, some are reliant on a single electricity sub-station or do not have standby generation capability that is sufficient to operate the site. There are risks that the power supply could fail leading to the wastewater treatment works stopping. In this circumstance there is potential for a significant environmental pollution event or sewage backing up in the network and flooding customer properties. 22 of our most critical works have identified problems with limited resilience.

Actions to be taken

Options for improving the works will be considered to find the most cost beneficial solution. They are likely to include laying additional power supplies to site, installing additional standby generation, installing plug-in-points where mobile generation capability is maintained nearby or innovative approaches using new battery technology or fuel cell capability.

Expected Result

Welsh Water will have confidence that works can continue to operate in an emergency situation, reducing the risk of environmental damage or property flooding.

Figure 95: Newport Nash wastewater treatment works. © Welsh Water

3. Strategic Responses

Strategic response 18. Promoting a circular economy and combatting climate change

Faced with a changing climate and increased energy costs, we will aim to become an energy neutral business, whilst maximising the opportunities to reuse treated water and other potentially valuable natural materials, contributing to the circular economy in our local region.

> *"The circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimising negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital"*
>
> (Ellen McArthur Foundation, 2017)

Customer impact

Customers are aware of 'environmentally friendly' companies and recognise that most companies have commitments to increase their energy consumption from renewable sources. Therefore they feel it's right that Welsh Water should also be following this commitment (Accent, June 2013).

Current research suggests that customers are more aware of climate change and its potential impacts and believe Welsh Water has a duty to plan for unknown eventualities (Welsh Water, 2015).

Our delivery of services depends on a broad and diverse supply chain, and the way we deliver these services has impacts on the responsible and efficient use of resources in the local economy.

Responding to future trends

The UK is facing the challenge of the "Energy Trilemma": how to maintain a secure, low carbon energy supply at an affordable cost. The government has a legally binding commitment to reduce net CO_2 emissions (equivalent) from 1990 levels by at least 80% by 2050 (Committee on Climate Change), and in the future new regulation may require specific generation and emissions reduction figures. Moreover, there is increasing recognition of how organisations can contribute to a circular economy, that recognises waste as a resource rather than a cost (Ellen McArthur Foundation, 2017).

Currently, Welsh Water uses a large amount of electricity (467 GWh in 2015/16) to pump and treat water and wastewater. Between 2011 and 2016 the price of delivered electricity increased by 59%, and grid supplied energy is likely to get more expensive in the future. Its possible that the impact of increased winter rainfall (caused by climate change), and tightening of effluent quality regulation, could further increase the energy required for pumping and treatment.

Ofwat has proposed that changing regulation in the market could help to exploit sludge as a bioresource, both for energy generation and as a fertiliser product (Ofwat, 2015). It has been estimated that the market for sludge could be worth up to £780m (WWT Online, 28th November 2016) and therefore exploiting this could provide long term value for our customers.

Strategic response

The business proposes to become energy neutral through self-generation, energy efficiency and a transition towards a circular economy approach. Some of the generation will still require the export (and subsequent re-import) of electricity via the national grid and local distribution networks. More progress in demand management can be made through adoption of energy efficient equipment, whilst future designs for treatment and pumping systems must prioritise energy efficiency. Specific actions will include:

- Review the way we manage the construction and operation of our assets and align this with the circular economy approach;
- Supporting the redesign of works replacements and upgrades to minimise consumption;
- Adopting proven emerging technologies and efficient control systems to minimise our energy consumption and CO_2 emissions;
- More efficient and resilient supply chain – through improved procurement platforms, payment procedures, diversifying single sources of supply and testing the resilience of our suppliers;
- Expanding our renewable generation portfolio, including environmentally sensitive hydropower as appropriate; and
- Investigating energy storage facilities to increase resilience and manage energy demand.

Figure 96 : A storm. Climate change is likely to lead to an increased frequency of extreme weather events in Wales. By texaus1, Creative Commons License (CC-BY-2.0)

3. Strategic Responses

Strategic response 18. Promoting a circular economy and combatting climate change

Research and innovation

Welsh Water will explore the following research topics, in collaboration with our supply chain, to support this strategic response:

- Research a wide range of energy efficient new water and sewage treatment processes (particularly for our aged rural wastewater treatment processes) and monitoring to measure, manage and encourage energy efficient behaviours;
- Research alternative uses for sludge, and wider resource recovery, in order to maximise the value of waste as part of a circular economy;
- Continue the development and roll out of a variety of renewable energy technologies;
- Identify additional sources of sludge and develop sludge treatment to maximise efficiency;
- Further roll out of demand side management, tailoring our electricity consumption and generation to meet Grid demands, prevent black-outs and reduce costs;
- Pilot the use of battery technologies to store surplus energy and increase resilience;
- Research low-emissions transport options for Welsh Water's fleet of vehicles;
- Support our colleagues to undertake relevant courses of study and qualifications (for example, we currently support MSc in Energy Systems at University of Cardiff); and
- Research heat recovery technologies from sewers in order to support our aim of becoming a net carbon neutral business.

Co-operative approach

We will actively collaborate with the following identified partners:

- Energy supply chain like renewable energy developers to identify the most effective solutions to increase energy self-sufficiency;
- Energy Supply Companies;
- We will work with developers and property owners to implement District Heating and Combined Heat and Power schemes, using wasted heat from these assets;
- Local suppliers to ensure we maximise efficient delivery, innovation and environmental protection for example through chambers of commerce;
- Welsh Government;
- Local authorities;
- WaterSource; and
- Business customers opportunities for greater use of treated wastewater (grey water).

Customer promises

Safeguard our environment for future generations

Improved process efficiency and the development of renewable resources will help to protect the environment.

Fair bills for everyone

Reduced reliance on volatile energy costs will help Welsh Water to protect its customers from price fluctuations and increases, helping to ensure fair bills for everyone in the future

Create a better future for all our communities

Through the development of low carbon energy sources, and improved energy efficiency of assets, we will be responding to the desires of our customers and helping Welsh Water to mitigate climate change and provide a better future for global communities.

Well-being goals

A prosperous Wales

The development of renewable resources, improved process efficiency, and collaborative research with universities will help to create an innovative, low carbon and productive society in Wales.

A globally responsible Wales

A reduced carbon footprint and more efficient use of resources will support global efforts to mitigate the effects of climate change and support the circular economy.

A resilient Wales

An energy-neutral system, with a reduced carbon footprint, will support social, economic and ecological resilience and the capacity to adapt to future change.

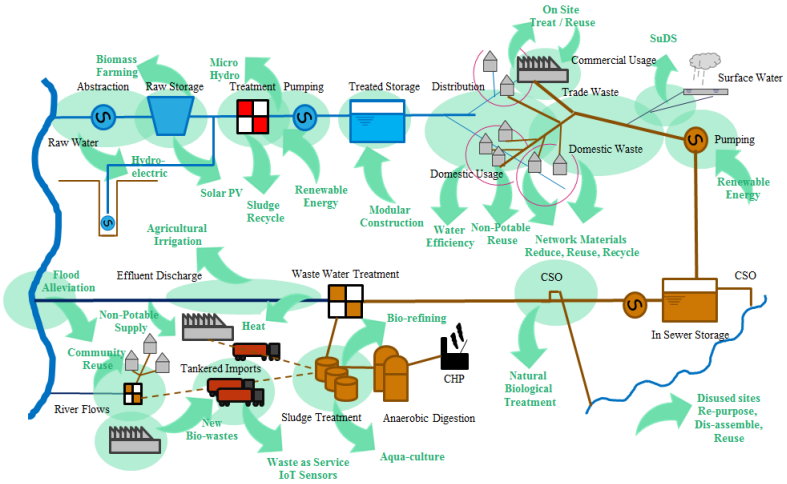


Figure 97 : Circular economy opportunities in water and wastewater systems. © Arup

3. Strategic Responses

Strategic response 18. Promoting a circular economy and combatting climate change

Direction of travel

Improved Customer Outcomes

- By delivering an energy neutral business we will increase self-supply of electricity and decrease reliance on grid supply. This will mean that we will have control over more of our energy supply so that we can better predict costs and provide better value for our customers;
- This scenario will increase our deployment of energy efficient treatment processes and assets, for example, modern, low energy rural wastewater treatment methods;
- We will enhance our reputation by achieving an energy neutral business;
- By being energy neutral, we will have reduced our carbon emissions by over 80% and played our part in achieving the Welsh Government's target set out in the Environment (Wales) Act (2016);
- Review the way we manage the construction and operation of our assets and align this with the circular economy approach; and
- Review opportunities to improve the resilience of our supply chain and positive contribution of Welsh Water to the local economy.

Scope of work

We believe that we should play our part in combatting climate change, and as part of these we plan to establish Welsh Water as an energy neutral business by 2050. To achieve this we plan to support the design of any works replacements to minimise energy consumption, by implementing mechanical and electrical upgrades. We predict this could save 50 GWh of energy per year.

We hope to expand our renewable generation portfolio by 250 GWh per year, with a financial payback period of 15 years. Moreover, we will look into energy storage facilities (for example, batteries, biogas, hydrogen) to increase resilience and enable demand side response, by avoiding use of the National Grid when energy is most expensive.

Finally, to improve our impacts on the circular economy we aim to explore opportunities for maximising benefits from bioresources produced as part of our operations and to look for opportunities to work with local businesses as a part of our supply chain.

We plan to establish Welsh Water as an energy neutral business by 2050 by investing in mechanical and electrical upgrades to minimise energy consumption, increasing renewable energy production, and maximising benefits form bioresources. A total net cost of only £50m is anticipated as the energy conservation and renewable energy generation projects will reduce grid energy consumption and, therefore, energy costs.

3. Strategic Responses

Strategic response 18. Promoting a circular economy and combatting climate change

Case study: Five Fords Energy Park - sustainable wastewater treatment works

Issue

As one of the largest companies in Wales, we use a lot of energy to pump and treat our water and wastewater. To achieve an energy neutral wastewater service, help manage the effects of climate change and reduce our costs and carbon footprint, we are investing in renewable energy. Our aim is to generate at least 30% of our energy needs by 2020.
To achieve our aspirations, we are developing a range of renewable projects across our sites, with Five Fords Energy Park near Wrexham being one of the largest of these.

Actions

We are combining renewable technologies on one site at Five Fords to have an energy positive, carbon negative site (having no net carbon emissions, meeting all its own energy needs and exporting any excess renewable energy into the National Grid, from where that energy can be re-imported at another works). Technologies currently implemented at the Energy Park are:

- Combined heat and power (CHP) utilising gas generated through anaerobic digestion. The CHP engines are used to complement the gas to grid generating at peak times when our demand for electricity is high or when the price of imported electricity is high as well as when additional heat is required for the processes on site;
- Bio-methane injection (gas-to-grid). This enables the treatment and injection of biogas produced on site to be injected into the gas network and comprises three main elements – the biogas upgrade unit, the grid entry unit and the propane plant. It removes the CO_2 in the biogas to leave almost pure bio-methane, which is then injected into the national gas grid; and
- Solar photovoltaic panels. 10,000 solar panels were constructed on the site as part of the array.

By 2020 these will be complemented by:

- A wind turbine;
- A hydropower installation on the outfall from the Works;
- Advanced aerobic digestion (AAD) which will make full use of the gas to grid capacity.

Result

The current configuration of AD / CHP, gas-to-grid and Solar PV has been running successfully since mid-2015. The gas to grid plant runs consistently, producing 10 GWh/year, sufficient to provide heating to 856 homes and equivalent to a carbon saving of 2,200 tonnes CO_2 (equivalent). The solar PV array generates 2 GWh a year of electricity, which is mainly used on site and saves carbon emissions of 1,000 tonnes a year.

Looking to the future, total carbon savings and energy production are set to triple with the implementation of the wind turbine, hydro initiative at the works outfall and the ADD plant.

The Five Fords Energy Park has transformed a ‘routine’ wastewater treatment works into a sustainable and carbon neutral site. By combining multiple renewable technologies we have created a showcase site, demonstrating our intent to manage the electrical, gas and heat demands of a site and meeting those needs from renewable sources. In doing so, we are well on the way to creating a microcosm of the ‘smart thinking’ that we will be the foundation for our journey to 2050.

Figure 98 : Five Fords energy park. © Welsh Water

4. Helping to Create a Better Future for Communities

Contribution to the Well-being of Future Generations Act

The Welsh Water 2050 strategy considers both the direction of travel for our own business and outlines the impact we want to have on the people, wider economy and natural environment of our operating area in Wales and England.

The strategy contributes to the wider goals of the Well-being of Future Generations (Wales) Act 2015 (Welsh Government, 2016c) and the Water Strategy for Wales (Welsh Government, 2015a). It also contributes to addressing the risks and opportunities outlined in the State of Natural Resources Report (Natural Resources Wales, 2016).

Contribution to the Well-being of Future Generations Act

The Well-being of Future Generations (Wales) Act 2015 is about improving the social, economic, environmental and cultural well-being of Wales, to create a country that we all want to live in now and in the future. It places a duty on public bodies in Wales to think about the long-term, work more cohesively with people and the communities, prevent problems and take a more joined-up approach. Welsh Water is not a public body under the Act. It sets out goals that these organisations must work towards to carry out sustainable development. It is one of the first pieces of legislation at a national level that aligns with the UN Sustainable Development Goals (SDGs) and the UN's 2030 Agenda. This alignment is shown in a shared focus on sustainable consumption, decarbonisation, health, equality, economic growth and resilient ecosystems.

The Well-being of Future Generations (Wales) Act 2015 does not apply directly to Welsh Water, as we are not a public body. However, our approach set out in Welsh Water 2050 and our mission statement are very closely aligned with the Welsh Government's own long-term policy agenda. The 18 Welsh Water 2050 strategic responses make a significant contribution to the seven well-being goals, as described throughout this report and shown in Table 6.

Public policy in England

We believe that this long term approach aimed at improving the well-being of future generations is equally relevant to our customers in England. We will have a close regard to the future direction of UK government policy and will ensure that our activities in England are closely aligned with them.

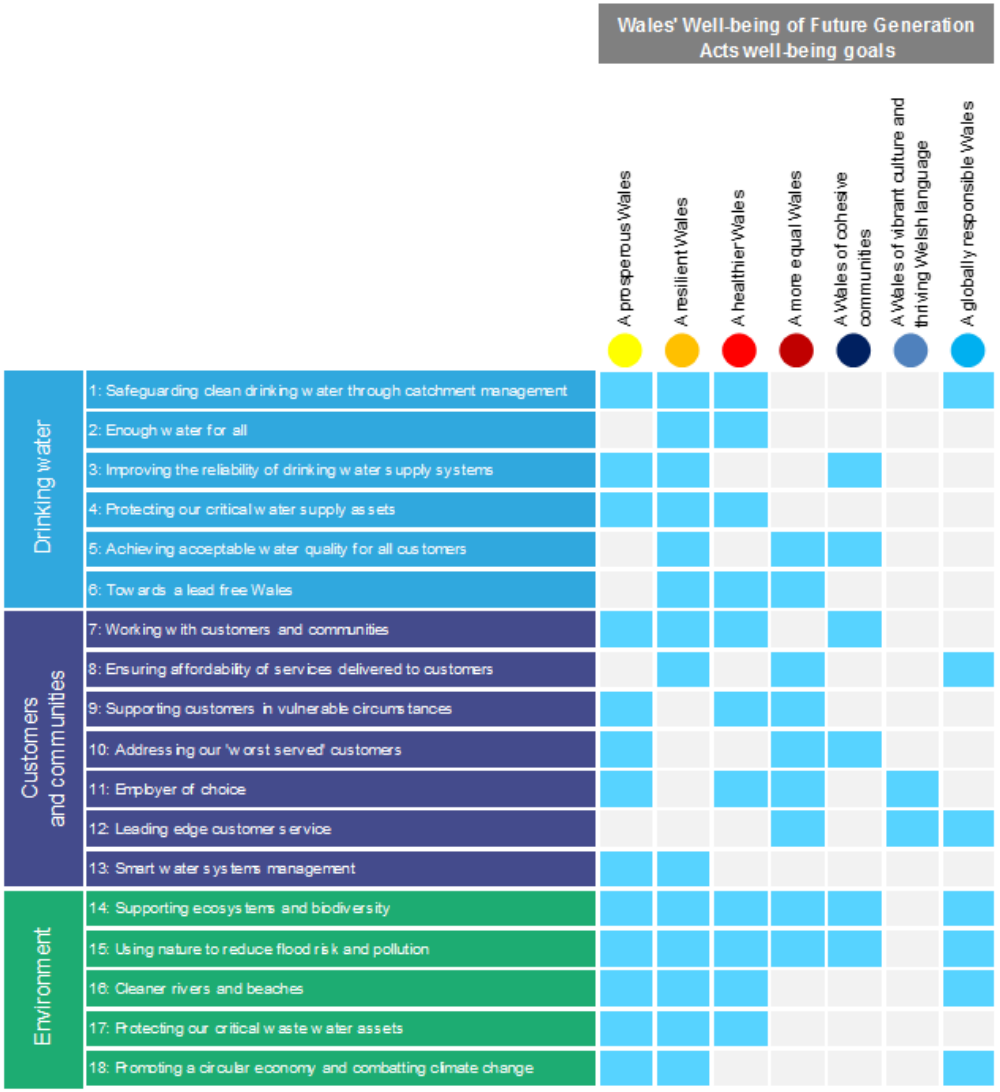


Table 6 : Links between Well-being goals and strategic responses

4. Helping to Create a Better Future for Communities

Environment (Wales) Act 2016

The Environment (Wales) Act 2016 aims to enable Wales to meet the demands on natural resources, ensuring that ecosystems remain healthy and resilient, while supporting jobs, housing and infrastructure. It provides a legislative framework to both enable sustainable management in a more joined up manner and tackle climate change. The Act introduces an enhanced protection for biodiversity, new controls to reduce waste, and statutory emission reduction targets.

The key parts of the Act relating to Welsh Water's activities are:

Part 1: Sustainable management of natural resources: enables proactive and joined up management of Wales' resources. As part of this framework, Welsh Water is placed under a strengthened duty to maintain and enhance biodiversity in the exercise of our functions and, in so doing, promote the resilience of ecosystems.

Part 2: Climate change: Welsh Ministers have powers to implement statutory emission reduction targets, including at least an 80% reduction in emissions by 2050 and carbon budgeting to support their delivery.

Part 4: Collection and disposal of waste: waste management processes will be improved by increasing business waste recycling, better food waste treatment and increased energy recovery.

Parts 5 & 6: Fisheries for shellfish and marine licensing – clarifies the law in relation to shellfisheries management and marine licensing.

Part 7: Flood & Coastal Erosion Committee and land drainage: this both clarifies the law for environmental regulatory regimes including flood risk management and land drainage and creates a committee to act in an advisory role.

The 18 Welsh Water 2050 strategic responses contribute to the many of these key themes of the Environment (Wales) Act, as shown in Table 7.

		Environment Act Opportunities				
		Sustainable management of natural resources	Climate change	Collection and disposal of waste	Fisheries for shellfish and marine licensing	Flood & Coastal Erosion Committee and land drainage
Drinking water	1: Safeguarding clean drinking water through catchment management	■				■
	2: Enough water for all	■				
	3: Improving the reliability of drinking water supply systems		■			
	4: Protecting our critical water supply assets					
	5: Achieving acceptable water quality for all customers					
	6: Towards a lead free Wales					
Customers and communities	7: Working with customers and communities					
	8: Ensuring affordability of services delivered to customers					
	9: Supporting customers in vulnerable circumstances					
	10: Addressing our 'worst served' customers					
	11: Employer of choice					
	12: Leading edge customer service					
	13: Smart water systems management	■	■			■
Environment	14: Supporting ecosystems and biodiversity	■	■		■	
	15: Using nature to reduce flood risk and pollution					■
	16: Cleaner rivers and beaches				■	
	17: Protecting our critical waste water assets					
	18: Playing our part in the supply chain, local economy and circular economy	■	■	■		

Table 7 : Links between the Environment (Wales) Act and strategic responses

4. Helping to Create a Better Future for Communities
Contribution to the Water Strategy for Wales

The Welsh Government's Water Strategy for Wales (Welsh Government, 2015a) focuses on how Wales can increase the resilience of our whole water system (both natural and managed) in order to maximise the benefits and reduce costs to customers, businesses and the environment.

The strategy sets out six key themes:

- **Water for nature, people and business** – this theme works towards a sustainable relationship between people and the natural water environment. Possible interventions include, for example, reforming abstraction licensing and reducing diffuse pollution through catchment co-operation and payments for ecosystems services;
- **Improving the way we plan and manage our water services** – this theme works towards streamlining existing legislative, regulatory and planning processes associated with water services management, wastewater and sewage management, and will seek to apply nature based solutions;
- **Delivering excellent services to customers** – this theme aims for excellent customer service. In the main, it covers affordability of water services and the uptake of social tariffs as well as the costs and benefits of metering;
- **Protecting and improving drinking water quality** – this theme covers improving drinking water quality through review of private water supply regulations, the possible transfer of water supply pipes to water supply companies and promotion of approved plumbers schemes;
- **21st century drainage and sewage systems** – this theme aims to encourage the construction of sustainable urban drainage systems through the publication of National Standards, undertake a review of current drainage ownership, and give guidance on septic systems; and
- **Supporting delivery** – this theme aims to ensure that the Welsh Government supports the delivery of the Water Strategy for Wales through reviewing the structure of Government, water regulators, stakeholders and companies and setting out its priorities in a statutory Strategic Policy Statement.

The 18 Welsh Water 2050 strategic responses contribute to the six key themes of the Water Strategy for Wales, as shown in Table 8.

		Water Strategy for Wales Themes					
		Water for nature, people and business	Improving the way we plan and manage our water services	Delivering excellent services to customers	Protecting and improving drinking water quality	21st century drainage and sewerage systems	Supporting Delivery
Drinking water	1. Safeguarding clean drinking water through catchment management	■		■	■		
	2. Enough water for all	■	■		■		
	3. Improving the reliability of drinking water supply systems	■	■	■	■		
	4. Protecting our critical water supply assets		■	■	■		
	5. Achieving acceptable water quality for all customers		■	■	■		■
	6. Towards a lead free Wales		■	■	■		■
Customers and communities	7. Working with customers and communities	■		■			
	8. Ensuring affordability of services delivered to customers	■		■			
	9. Supporting customers in vulnerable circumstances	■	■	■			
	10. Addressing our 'worst served' customers		■	■			
	11. Employer of choice		■	■			■
	12. Leading edge customer service	■	■	■			■
	13. Smart water system management		■	■			■
Environment	14. Supporting ecosystems and biodiversity	■	■		■		
	15. Using nature to reduce flood risk and pollution	■			■	■	■
	16. Cleaner rivers and beaches	■				■	■
	17. Protecting our critical wastewater assets			■		■	
	18. Playing our part in the supply chain, local economy and circular economy	■		■			■

Table 8 : Links between the Water Strategy for Wales themes and strategic responses

4. Helping to Create a Better Future for Communities

Contribution to the State of Natural Resources Report (SoNaRR)

The State of Natural Resources Report (Natural Resources Wales, 2016), referred to as SoNaRR, sets out the state of Wales' natural resources. It assesses the extent to which natural resources in Wales are being sustainably managed, and recommends a co-operative, proactive approach to building resilience.

SoNaRR centres around a natural resources and well-being risk register which records each of the risks against the Well-being of Future Generations (Wales) Act 2015 goals for each of the habitat types in Wales.

SoNaRR also identifies six areas which Natural Resources Wales believes hold the greatest opportunity for mitigating the risks identified, whilst contributing to the well-being goals. These six areas are:

- Green Infrastructure in and around urban areas;
- Increasing woodland cover, and bringing more of our existing woodlands into appropriate management;
- Coastal zone management and managed realignment;
- Maintaining, enhancing and restoring floodplains and hydrological systems;
- Better soil management; and
- Utilisation of our uplands to deliver multiple benefits.

The 18 Welsh Water 2050 strategic responses are aligned with the six opportunities identified in SoNaRR, as shown in Table 9.

		SoNaRR Opportunities					
		Green infrastructure in and around urban areas	Increasing woodland cover & appropriate management of woodlands	Coastal zone management and managed realignment	Maintaining, enhacing and restoring floodplains and hydrological systems	Better soil management	Utilisation of our uplands to deliver multiple benefits
Drinking water	1: Safeguarding clean drinking water through catchment management	■	■		■	■	■
	2: Enough water for all		■		■	■	■
	3: Improving the reliability of drinking water supply systems				■		
	4: Protecting our critical water supply assets	■		■			
	5: Achieving acceptable water quality for all customers						
	6: Towards a lead free Wales						
Customers and communities	7: Working with customers and communities				■		■
	8: Ensuring affordability of services delivered to customers						
	9: Supporting customers in vulnerable circumstances						
	10: Addressing our 'worst served' customers						
	11: Employer of choice						
	12: Leading edge customer service						
	13: Smart water systems management						
Environment	14: Supporting ecosystems and biodiversity	■	■	■	■	■	■
	15: Using nature to reduce flood risk and pollution	■	■			■	■
	16: Cleaner rivers and beaches		■		■	■	■
	17: Protecting our critical waste water assets	■		■			
	18: Promoting a circular economy and combatting climate change					■	

Table 9 : Links between SonNaRR opportunities and strategic responses

5. Next Steps

Welsh Water aims to become a truly world class, resilient and sustainable water service for the benefit of future generations.

To enable this aim our first steps are to implement the strategic responses detailed in this document in partnership with communities and organisations.

We will deliver research and innovation to continue to support this implementation in the long-term. We will support implementation of this innovation by developing greater alignment between the research and innovation teams and operational groups.

We aim to embed Water 2050's strategic responses and approaches into our everyday business, our culture and the all the work our staff undertakes. We will integrate our long-term objectives set out in 2050 into our business and expenditure plans for the next five years in particular; starting with our PR19 Business Plan, to be published in September 2018, which will cover the 15 years 2020 to 2035.

We will develop our staff to meet this objectives by refining our staff awareness and training programme.

The future trends we have identified in the this report are only a current snapshot of challenges and that we may face in the future. This means that we will need to be adaptable to future events that may occur. We will develop our understanding of future trends moving from a review of individual trends to scenarios for how these trends might play out in tandem.

We will continue to horizon scan to identify future trends as well as innovation opportunities and adapt our approach to incorporate these changes.

This means that to ensure Water 2050 remains our principal strategy in the coming years we will review and update this strategy every five years.

During these updates we will continue to involve the community in the decision making we undertake, and in the meantime working in partnership to deliver the current strategy. To further develop our relationship with others and enable co-creation we will create a stakeholder and customer engagement plan.

We look forward to working with you.

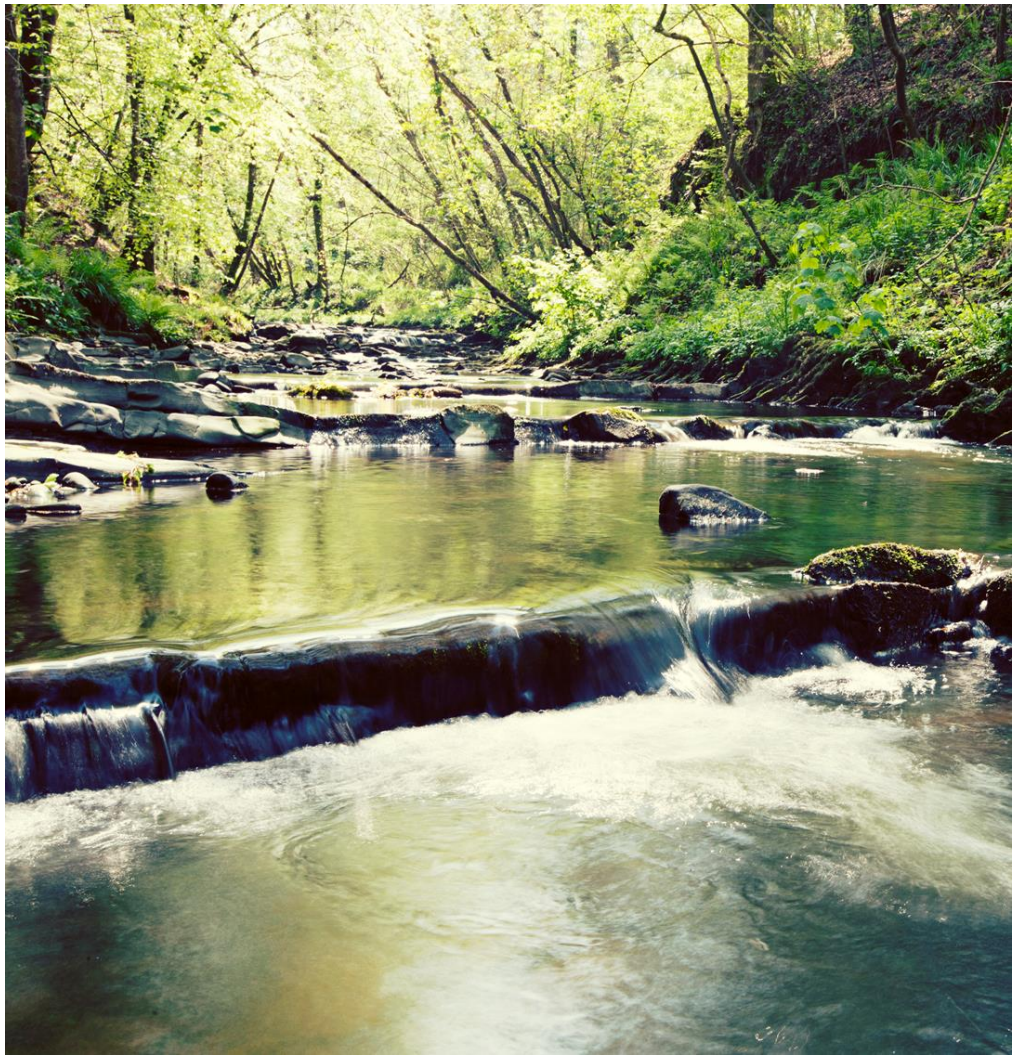


Figure 99 : Welsh River (CC BY 2.0) by philhearing

Appendix A : Background to the Development of Welsh Water 2050

Emerging future trends

Development of Welsh Water 2050

The development of Welsh Water 2050 included horizon scanning for future trends and future scenarios and the Welsh Water Resilience Framework.

We commissioned Cardiff University to undertake this horizon scanning in the 'Emerging Challenges to Resilience in the Water Sector' report. This identified future trends and drivers, future scenarios and potential research topics that would be key to enabling us to achieve our mission.

The Welsh Water Resilience Wheel built on this horizon scanning and a best practice literature review to create a framework to assess the current resilience of Welsh Water and identify any gaps.

Future trends

Potential drivers of major change were considered across the social, technological, environmental, economic and politico-legal realms. This identified that:

- Demographic change will be a key driver of future demand and pressure on water services, but water surplus in Wales could alleviate adjacent water stressed areas.
- Lifestyle choices by individuals impact water demand and will further stress the aquatic environment. However increased awareness of environmental issues, and innovative technologies, are opportunities to change behaviours towards water.
- Technological advances in nanotechnologies, genomics and big data provide opportunities for water and energy efficiency, water security and water resource management.
- Climate change will have a considerable impact on water quality, infrastructure, and services. While costly, adaptation here will be key to resilience.
- Land use changes in the uplands, in urbanisation and in lowland agriculture in Wales and adjacent regions are likely to interact with climate and demographic change to have major impact on water quality and quantity.
- Macroeconomic change may impact revenue streams, investment opportunities and pricing decisions, but short-term economic fluctuations are unlikely to prove problematical for planning purposes.
- Uncertainty over future energy prices is a planning challenge for water companies and is likely to be an important driver investment in renewable technologies.
- The recent Brexit decision is a significant area of uncertainty over the future direction in a wide range of areas that affect the water industry.
- Future constitutional change from the devolved Welsh government could simplify the policy making and implementation process and could act as a spur to innovation.
- The many challenges likely to be faced by water companies in the future question the appropriateness of existing models of governance.

Future scenarios

Scenarios were a valuable tool for assessing interactions between drivers of change and for describing dynamic processes and uncertainty in complex systems. They helped identify factors in the present that, while currently deemed unimportant, may become dominant drivers in future.

Among five scenarios reviewed, those based on market-orientated growth tended to have negative implications for the water environment, due to increased pressures on production. Scenarios focussed mostly on local production were also negative because of their reliance on intensifying domestic agriculture and industry. Those scenarios that were formed by the combination of a conservationist society and either a global economy or long-term sustainability generally had improved environment responses for example placing a higher value on social and ecological benefit.

Appendix A : Background to the Development of Welsh Water 2050

Formation of Welsh Water's Resilience Wheel

The Resilience Wheel (Arup, 2017) was developed by working alongside Arup and Cardiff University, based on research, Welsh context and global good practice.

The aim was to assist Welsh Water to:

- foster a shared understanding of global best practice;
- assess current resilience performance; and
- develop recommendations for a 2050 vision.

The working definition of resilience has been adopted from Ofwat (Ofwat, 2015).

> *'Resilience is the ability to cope with, and recover from, disruption, and anticipate trends and variability in order to maintain services for people and protect the natural environment, now and in the future.'*

Good practice review

A review was undertaken of resilience guidance, frameworks, strategies and implementation, including:

- City Resilience Index (used by 100 Resilient Cities network including Vejle, Rotterdam, Bristol and New York);
- OECD Resilient Cities;
- Sendai Framework for Disaster Risk Reduction;
- Cabinet Office Resilience Guidance;
- Global Risk Report, World Economic Forum;
- UKRN cross sector resilience;
- UK policy and sector guidance from the Cabinet Office, Environment Agency and Defra; and
- Ofwat guidance.

Welsh Water Resilience Wheel

Our review of frameworks and guidance documents clearly showed four key elements that are central to resilience frameworks: short-term shocks and long-term stresses, qualities, wheel, and process.

The short-term shocks and long-term stresses that may impact Welsh Water were identified in the good practice review and by the research undertaken by Cardiff University in the report 'Emerging Challenges to Resilience in the Water Sector' (Cardiff University, 2016). These are discussed in more detail in the section on 'Future Challenges'.

Shocks are disruptive events, which impact the ability to provide a high quality service, and stresses are chronic conditions, which weaken the function of the organisation or system in the long-term.

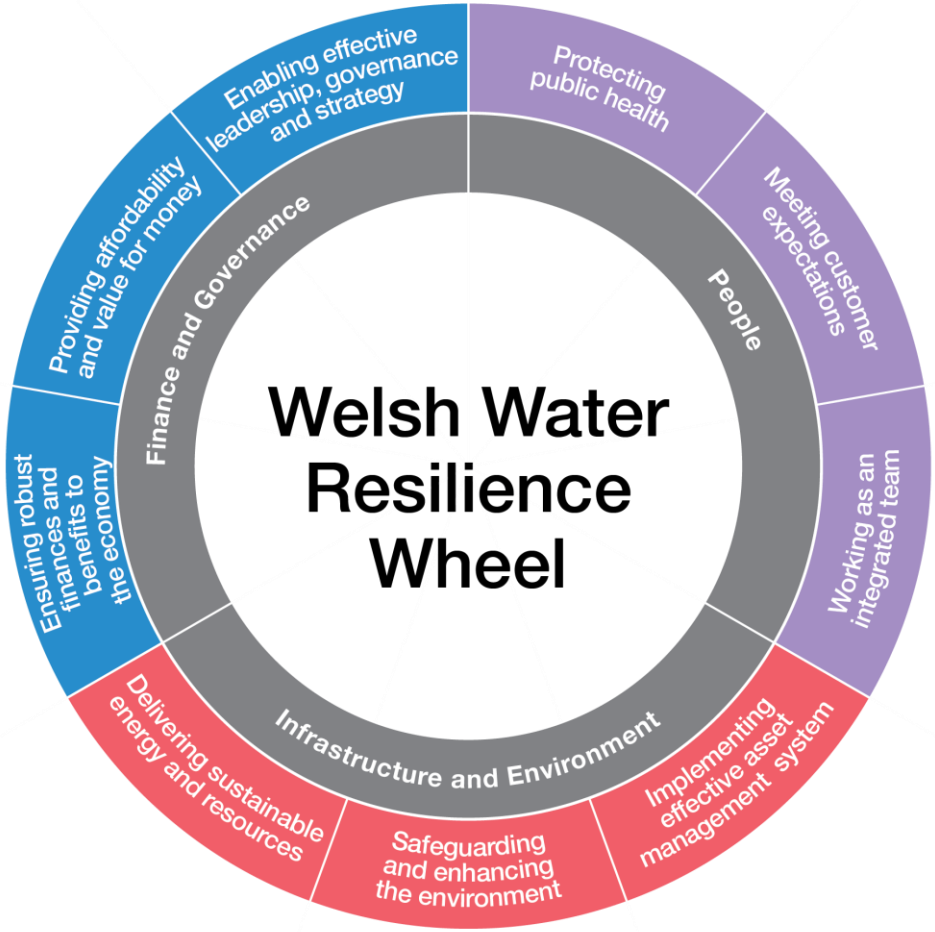


Figure 100 : The Welsh Water Resilience Wheel. © Welsh Water

Appendix A : Background to the Development of Welsh Water 2050

Formation of Welsh Water's Resilience Wheel

Principles of Working, detailed in Figure 101, are characteristics shown by resilient systems which are important to prevent the failure of systems, and enable appropriate actions to be undertaken. These principles, adopted by Welsh Water, align closely with the principles described in the Well-being of Future Generations (Wales) Act 2015.

The **wheel**, shown in Figure 102, provides an overview of the elements of a water utility company that need to be considered in improving resilience. The wheel comprises three dimensions (as shown in the inner wheel).

People are at the heart of the wheel; ensuring the health and well-being of our staff and customers, including in times of crisis.

Infrastructure and environment explores our role in protecting and enhancing the resilience of ecosystems and providing resilient man-made infrastructure to provide critical services, meeting the requirements of the Environment (Wales) Act 2016 (Welsh Government, 2016d).

Finance and strategy explores the way in which an organization needs to plan and operate flexibly, funding appropriate actions in a way that is affordable for all, with strong and effective governance.

The wheel includes nine outcomes that Welsh Water wish to achieve, and 40 indicators which detail what areas will need to be considered to meet them.

We used the wheel to assess our resilience through independently facilitated workshops with key staff, identifying critical areas of weakness, and actions and programmes to strengthen it. The wheel was based on the City Resilience Index, as applied to our customer promises.

The **process** is a methodology for implementation of The Wheel which covers the whole of the lifecycle, including goal development, best practice review, wheel generation, assessment of current resilience performance, development and prioritisation of recommendations for 2050 and regular evaluation of outcomes.

Figure 101 : Principles of working

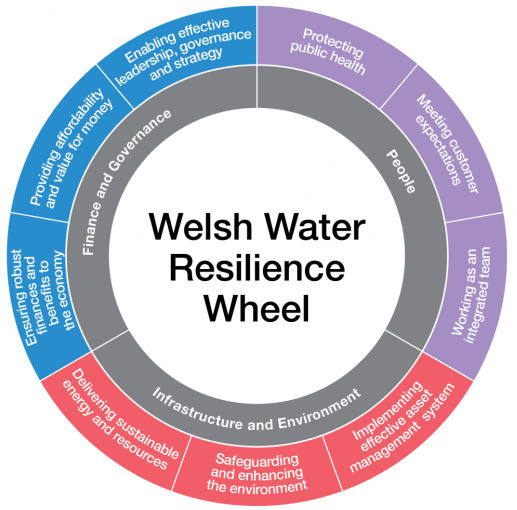


Figure 102 : Resilience Wheel and principles of working. © Arup

Appendix A : Background to the Development of Welsh Water 2050

Welsh Water's resilience performance

Welsh Water's Future Resilience Performance

Our initial view of current level of resilience is displayed on the wheel to identify areas of best-practice and areas for improvement, is shown in Figure 103.

The wheel has levels 1 to 4, which are used to assess the business against quantitative metrics and a qualitative vision of what an organisation looks like with differing levels of resilience. These levels are shown in Table 10.

This assessment will be reviewed at least every five years to ensure that our future Asset Management Plans are making prioritised progress towards best practice.

Level	*Definition*	*Explanation*
1	Meets legislation, with no further consideration of resilience	Meets legal requirements, such as the Urban Wastewater Treatment Directive
2	Follows guidance, but goes beyond this to achieve greater resilience	Identifies actions beyond those which are required by legislation in order to improve the long term resilience of the organisation, such as making use of existing technology
3	Current global best practice measures with a high level of resilience	Makes use of global best practice in order to develop a response that delivers a very high level of resilience, such as OECD Resilient Cities framework
4	Horizon scanning, dealing with plausible futures	Invests in research than identifies future trends and responses that go beyond existing best practice, such as potential emerging risks to public health.

Table 10 : Resilience performance definitions

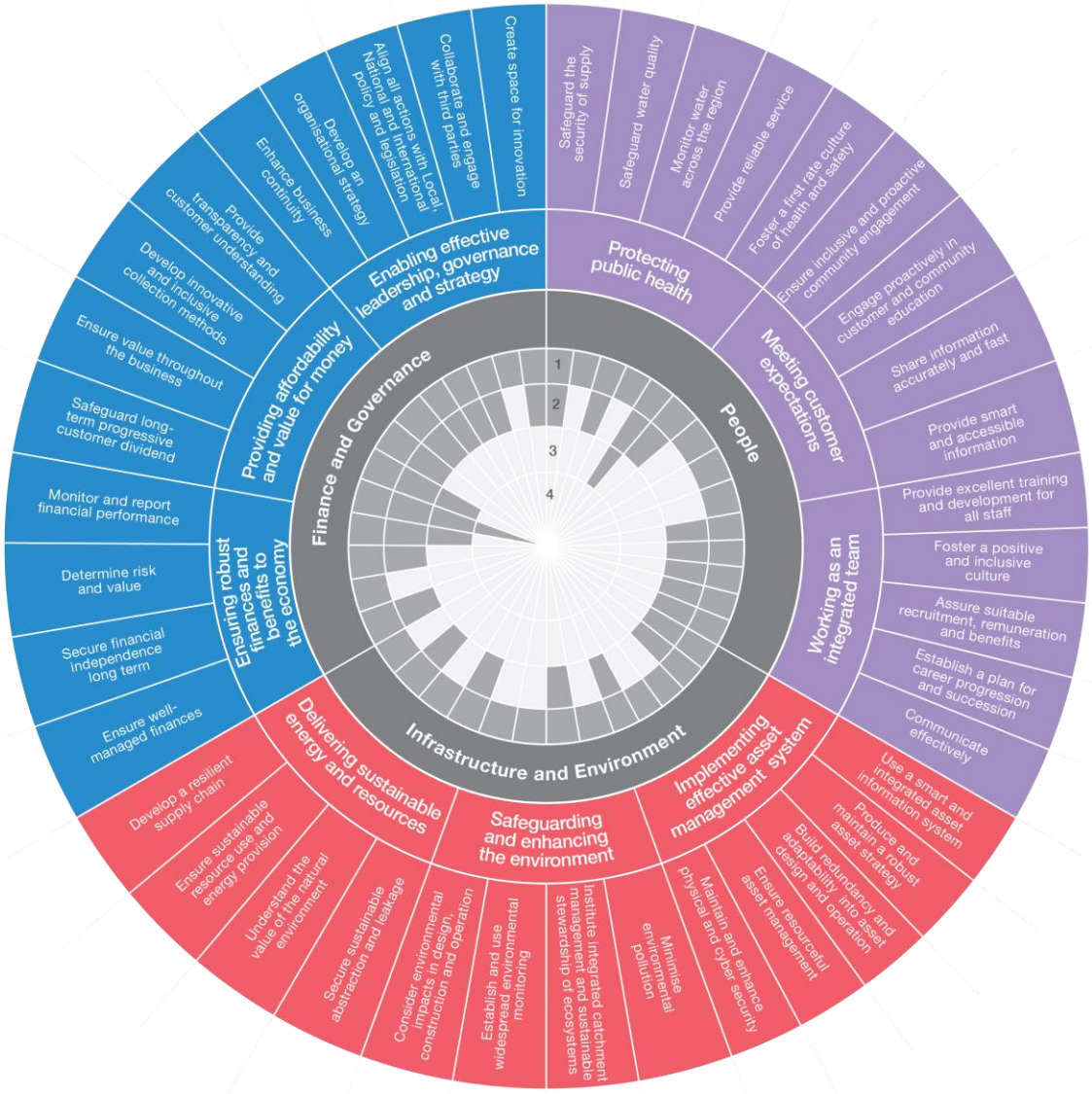


Figure 103 : An assessment of Welsh Water's current resilience © Arup (Arup, 2017)

Appendix A : Background to the Development of Welsh Water 2050

Welsh Water's resilience performance

Welsh Water's Future Resilience Performance

For the 2017 consultation we created two scenarios: comprehensive and progressive.

We have completed assessments of projected resilience performance in 2050 if we completed all of the progressive or all of the comprehensive scenarios. These are displayed in Figure 104.

Whilst our resilience would be greatly improved by 2050 were we to deliver the comprehensive scenario, there would remain areas for improvement.

If we were to pursue the comprehensive scenario for all strategic responses, the outcome of these actions is shown in figure 104 in black.

Similarly, if we were to pursue the progressive scenario for all strategic responses, the outcome of implementing these actions is shown in Figure 104 in grey.

This exercise will be repeated during the development of our 2020-2025 (AMP7) and 2020-2030 (AMP8) plans, to ensure progress is prioritised in line with our customers' expectations.

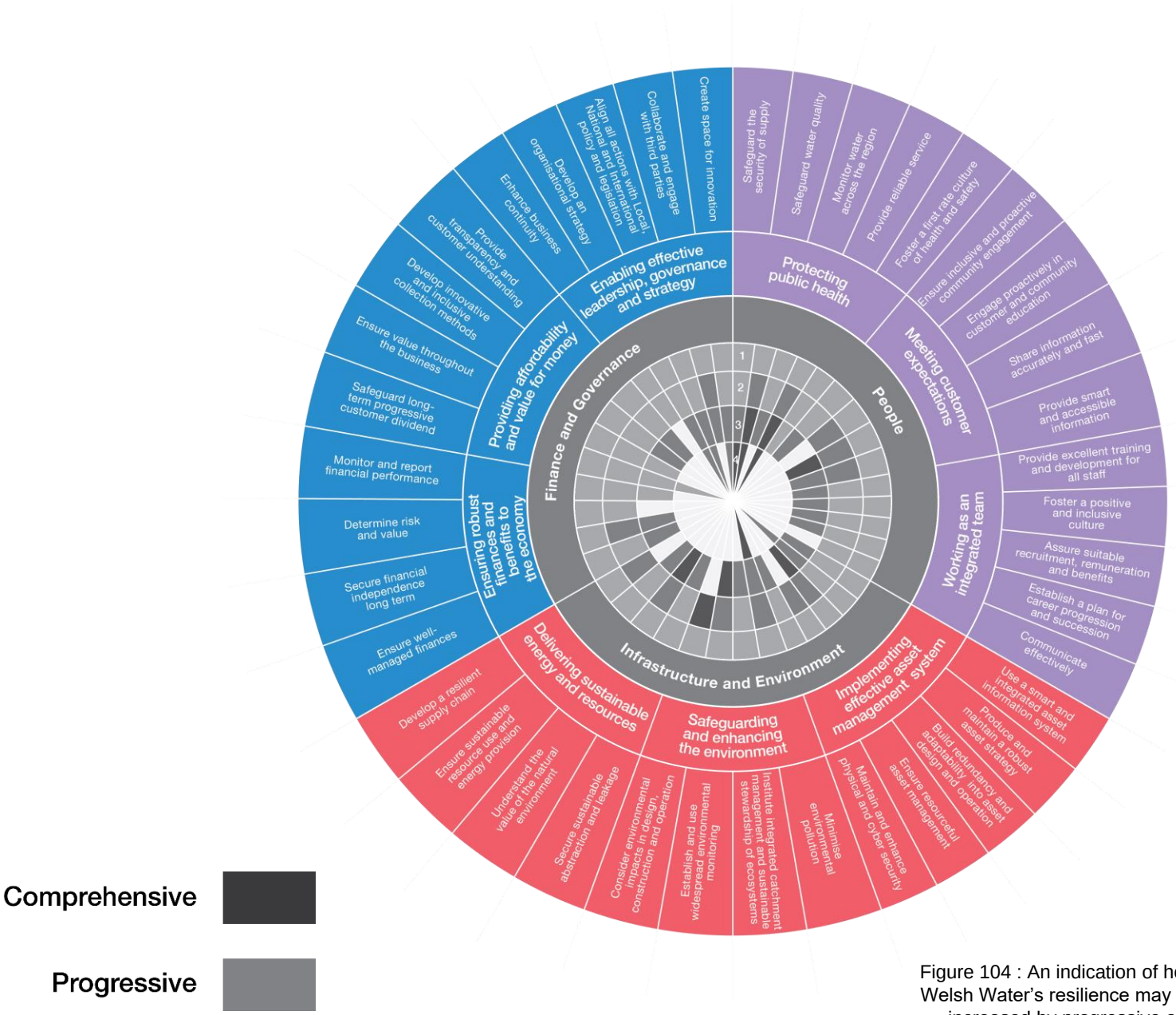
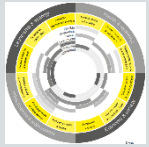


Figure 104 : An indication of how Welsh Water's resilience may be increased by progressive and comprehensive scenarios © Arup

Appendix A : Background to the development of Welsh Water 2050

Global best practice



City Resilience Index (CRI)

The City Resilience Index (CRI) was developed by Arup, supported by the Rockefeller Foundation, building on three years of research. The CRI provides a lens to understand the complexity of cities. It has four dimensions, twelve goals and seven qualities of a resilient system. The CRI has been used as a framework to support the development of resilience strategies in cities around the world, through the 100 Resilient Cities network.

(Arup, 2012)

OECD Resilient Cities

The Organisation for Economic Co-operation and Development (OECD) launched a report in 2016 investigating how cities can increase their resilience, applying it to ten cities around the world. It considers shocks and persistent pressures, seven qualities of a resilient entities, and four areas to build a resilience profile (economy, society, governance and environment) and policy recommendations.

(OECD, 2016)

Well-being of Future Generations Act

Welsh Government's Well-being of Future Generations (Wales) Act 2016 is world leading legislation which enshrines sustainable development as a statutory duty. It ensures that public bodies in Wales think about long-term planning and cohesive working with the public, prevent problems and take a more integrated approach. The Act includes seven well-being goals (described earlier in this report) and five sustainable development principles.

(Welsh Government, 2016c)

Cabinet Office Resilience Guidance

The Cabinet Office produced 'Keeping the Country Running: Natural Hazards and Infrastructure' guidance to improve the resilience of critical infrastructure and essential services. It identified four components of infrastructure resilience (resistance, reliability, redundancy, and response & recovery) and a four step cycle to build resilience (evaluate resilience, identify risks, assess risk and build resilience).

(Cabinet Office, 2011)

Global Risk Report, World Economic Forum

For over 10 years the Global Risk Report has focused attention on global risks and their interconnections. Climate change (and failure of mitigation) and extreme weather events have regularly been in the top five (for impact and likelihood) for the past six years. Water crisis has been in the top five risks (for impact) for the last five years.

(World Economic Forum, 2017)

UK Regulators Network Cross Sector Resilience

The UK Regulators Network (UKRN) is made up of the UK's economic regulators. This report focused on ways to tackle challenges to the resilience of the UK's national infrastructure. It particularly focuses on those that have cross-sector implications such as shared challenges and shared reliance.

(UK Regulators Network, 2017)

Ofwat Towards Resilience

Ofwat has recommended actions for water companies to take to improve resilience. These include developing an understanding of risk and failure, exploring clear routes for funding, planning for resilience at a regional and national level, developing metrics, public engagement and a consideration of reliance on other sectors.

(Ofwat, 2015)

Sendai Framework for Disaster Risk Reduction

Untied Nations Office for Disaster Risk Reduction (UNISDR) has created the Sendai Framework which is a 15-year, voluntary, non-binding agreement. It recognises the State has the main role to reduce disaster risk, but responsibility is also shared with other stakeholders, like local government, the private sector.

(UN Office for Disaster Risk Reduction, 2015)

Appendix B : Welsh Water 2050 potential costs.

Cost summary

At Welsh Water, we are acutely aware that any expenditure we incur is ultimately paid for by our customers through water and sewerage bills and that the areas of Wales and England that we serve include communities that are amongst the poorest in the UK.

Whilst there is clearly a great deal of uncertainty in seeking to project forward costs and customer bills over a 30 year time scale, we have carried out some indicative financial modelling to inform the development of Welsh Water 2050. This illustrative modelling suggests that, if we were to pursue all the potential actions for each strategic response we estimate that customer bills would increase by around 1% per annum above inflation. If we were to pursue the minimum actions for each strategic response, we estimate that customer bills would increase by inflation only.

For the purposes of the costs presented in in this document, we have assumed that technological advances and new innovative practices will present opportunities for reducing unit investment costs by some 1-2% a year (excluding the impact of inflation). If this could be achieved, it would mean that our unit cost of delivery would be some 50% lower in 2050 than it is today.

	Potential costs	
Welsh Water 2050 cost summary	*Lower estimate*	*Higher estimate*
Strategic responses	*£m*	*£m*
1. Safeguarding clean drinking water through catchment management	100	300
2. Enough water for all	500	500
3. Improving the reliability of drinking water supply systems	350	950
4. Protecting our critical water supply assets	300	300
5. Achieving acceptable water quality for all customers	450	1,800
6. Towards a lead free Wales	50	50
7. Working with customers and communities	0	0
8. Ensuring affordability of services delivered to customers	0	0
9. Supporting customers in vulnerable circumstances	0	0
10. Addressing our 'worst served' customers	250	250
11. Employer of choice	50	50
12. Leading edge customer service	150	150
13. Smart water system management	500	500
14. Supporting ecosystems and biodiversity	0	0
15. Using nature to reduce flood risk and pollution	800	2,100
16. Cleaner rivers and beaches	800	1,500
17. Protecting our critical wastewater assets	400	400
18. Promoting a circular economy and combatting climate change	0	0
Total	**4,700**	**8,850**

(1) Total cost is the investment cost plus the additional running costs to operate and maintain the investment net of any offsetting savings that result, and net of forecast improvements in efficiency from new technology and innovative ways of working. In some cases, the efficiencies more than offset the additional running costs, resulting in the total cost being less than the investment cost.

(2) Price base – all costs are stated at today's price levels i.e. excluding the effect of inflation.

Table 11 : Summary of total costs for all strategic responses

Appendix C : Delivering the Future Through Innovation

Recent case studies

At Welsh Water, we are striving to continuously innovate at every level of the organisation – both in terms of our internal operations, and how we work with external stakeholders. Some examples of innovative activities are given below.

Arfon's Eureka Moment

Improving efficiency and safety of filter maintenance

Occasionally, we use filters to investigate discolouration in our pipes, which are swapped at specific intervals. The process of swapping the filters over can be time consuming, involving welding and clamping.

Arfon Jones-Hughes, a member of our water distribution team in north Wales, came up with a new idea for improving safety, and reducing the time it takes to swap filters over. He found that a person's body weight cold be used as a counter lever to open and close the filter, and he built a prototype foot stand in order to test his concept. The prototype halved the time it took to safely replace a filter. His design won an award at our annual Health and Safety conference, and has been rolled out across the company.

Figure 105 : Changing a filter. © Welsh Water.

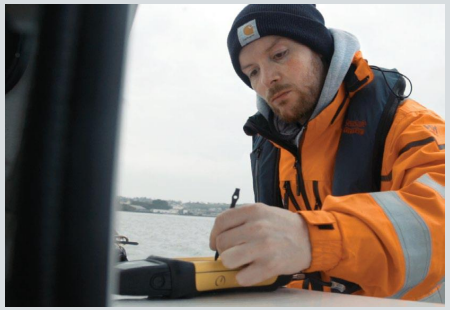
PestSmart

Sustainably managing weeds and pests

Our water monitoring programme had detected increased levels of pesticides and other chemicals in the environment, including in areas where we have never seen them before. This presents a risk to the environment and raw water quality.

PestSmart sees us working in partnership with Natural Resources Wales and the agricultural community to consider smarter and more environmentally friendly methods of weed, pest and disease control. This includes providing advice and practical solutions, as well as offering a free pesticide disposal service. Improving raw water quality will help to protect the environment, and reduces the need to use chemicals and energy in the final treatment process.

Figure 106 : Weed control. © Welsh Water.



Coastal Investigation

Safeguarding and improving water quality

Our coastal investigation programme has focused on improving the water quality of 49 bathing and shellfish waters in Wales.

This includes establishing our impact on Wales' marine waters and what needs to be done to improve water quality, both by us and by other stakeholders.

We have undertaken modelling to understand which assets need upgrading to meet water quality standards and are working with Natural Resources Wales what other controls are required to reduce diffuse pollution.

We plan to share our coastal models with Welsh Government, Natural Resources Wales and academia to assist in investigations.

Figure 107 : Marine surveying. © Welsh Water.

Geraint's Toolkit

The creation of new tools for sewer maintenance

During sewer blockage the tools available for the job were not always sufficient to remove the blockage. This meant that contractors were required to undertake excavation works to access the blockage.

Geraint Williams was given the freedom to create new ideas to remove these blockages. He created various prototype tools in order to access and remove novel blockages. This has prevented the requirement to dig up roads and gardens causing less disruption to our customers as well as providing costs savings.

Welsh Water have supported Geraint in filing seven patent application for each of these tools.

Figure 108 : Anaerobic Digester © Welsh Water.

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