DRAINAGE & WASTEWATER MANAGEMENT PLAN

Dŵr Cymru Welsh Water Drainage and Wastewater Management Plan 2024

Final - November 2023

IN PARTNERSHIP WITH

rps ATKINS Member of the SNC-Lavalin Group wsp

Version	Detail	Date
1.0	DRAFT – for consultation.	July 2022
2.0	Revised draft	May 2023
3.0	Draft Final	September 2023
4.0	Final for Publication	November 2023

Contents

List of Figures

List of Tables

Preface

We have completed our first DWMP. This DWMP is being published as a final version after a 10-week consultation. We thank you for your comments on what we have produced and your opinions on how to prepare future DWMP's. We appreciate your comments on our approach to customer and environmental priorities, and how those priorities are to be used in the production of future plans.

This plan is different to other plans we have prepared; it not only tries to answer how we remain compliant with our operating licence, but it also tries to prepare the company for future challenges to society.

One of these challenges is the legacy of combined sewers, which are reliant on storm overflows to prevent localised customer flooding. We need to transition to separate foul and surface water sewers to reduce the need for storm overflows where possible, whilst maintaining our performance. The cost of achieving this during the 21st century is challenging. The environmental benefit of achieving this separation over time is to reduce nutrients, such as phosphates and nitrates, entering rivers, seas and groundwater. This is a major driver to achieve high standards set out in the water framework directive.

We need to set out the complexity of the drainage issues across our operating area. Our combined sewers often accept inflows of surface water from roads, car parks, building roofs and even land drainage, which we do not own or control. We need to work closely with other stakeholders, and need their ongoing support, to gather the evidence and deliver the right long-term solutions.

Our DWMP shows that the costs of making this transition will be significant. The DWMP provides an evidence base to begin discussion with Welsh Government, and our regulators, on the pace of change that they expect to see which will also be acceptable to you, our customers. It goes beyond the current focus on storm overflows, influencing long-term integrated drainage priorities for Wales and the border areas of England where we operate. We need access to funding to enable us to alter assets that are not owned by, or the responsibility of, the water company to bring about the real change that our customers and stakeholders wish to see. We are recommending that a National Drainage Programme is put in place alongside the National Environment Programme so that there are clear links for all parties, and actions for stakeholders to carry out and contribute towards our country's future in a Team Wales style.

The National Environment Programme includes investment in outcomes that are needed to meet today's challenges; however, this level of investment will impact customer bills. In our approach, we have considered how to include a methodology to proactively drive environmental improvements and we ask NRW/EA to work with us on this to agree an approach that fits alongside the current NEP methodology in readiness for DWMP29.

We recognise that stakeholders are looking to us to re-address storm overflows and minimise their use. Our preferred approach considers how to make widespread improvements at an affordable rate for our customers. We have estimated that to remove storm overflows and customer flooding would cost upwards of £13bn if it were possible and practical to be achieved everywhere. Welsh Government has carried out a similar estimate and suggest the cost is even higher, near to £48bn. This quantum, when considered as a bill increase, is not tenable and unlikely to be acceptable to our customers. Ultimately, the pace of the improvements we can make will be heavily dictated by the scale of water and sewerage bills that our customers can afford to pay now and in the future.

The pace of improvements required is also linked to real changes on the ground and the availability of contractors and the associated skilled workforce. This is a short-term issue as it will take time for the supply chain to adapt. There will also be an impact while construction work is taking place; we are mindful that customers have asked us to be considerate when developing our approach, so they do not feel that we are continually causing disruption. We need to ensure that we can explain why we have made these decisions.

As part of developing our first DWMP, we have followed the national DWMP Framework but have also developed our own innovative approaches to planning, which allow choices to be made in terms of what needs to be achieved in the short term, and then creating a pathway for each local area to maintain progress to that destination.

This builds on principles developed by all companies for water and sewerage planning to gain a holistic catchment approach to finding risks, developing options to resolve those risks, and providing an indicative timeline of when that risk may materialise and when the solution will need to be resolved.

The Plan and the regional summaries lay out the types of risks that we are facing, the strategic option types that are needed in each location to address those risks, and a high-level cost to get to improved performance in our wastewater systems.

This Plan has been written to explain the approach we have taken, the pace of change that is realistic and how we can integrate our approach with other stakeholders to deliver the best solutions for our customers and the environment we all share. We have identified several different investment scenarios to get us to our long-term destination in systematic, affordable steps.

We thank you for providing your opinion on which approach to take for our next cycle. We will introduce the preferred choices in our approach while developing the next Plan. The Plan, and the regional summaries which support it, lay out the types of risks we are facing, the types of strategic options that are needed in each location to address those risks, and a high-level cost to get to a future improvement. The Better River Quality Taskforce has also informed us of the milestone we need to achieve in terms of combined sewer overflow (CSO) improvements, and we will continue to work with the taskforce until we achieve the goal.

Alongside the Plan, we have undertaken a Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) of the options developed so far. These documents are also available to view.

How to use these documents

This suite of documents which make up our DWMP are as follows:

The Plan – A technical appraisal of risk, utilising different methodologies to inform and establish local and national best practice. This includes a strategic option assessment to aid understanding of the scale of the task to manage future pressures, supported by a staged option appraisal methodology. The document also includes programme appraisal methodology to ensure consistency with other long-term planning in the water industry and examples that highlight how we propose to undertake this detailed assessment in the second DWMP cycle.

The Technical Summary – A technical account of the first cycle plan presenting methodologies carried out.

The Non-Technical Summary – A Stakeholder facing summary of the key points and messages from the main plan.

The Area Summaries – A series of summaries, setting out the proposed regional (L2) and local (L3) strategy, risks, options, and preferred options.

Strategic Environmental Assessment and Post Adoption Statement– A formal review of the potential environmental impact of the proposals being promoted by the DWMP, to ensure that the most sustainable options are being promoted.

Habitats Regulations Assessment – A formal review of the potential impact of the DWMP proposals on protected habitats.

The suite of customer facing documents – A set of stage-based publications to continually engage with customers and stakeholders as the Plan develops.

- The DWMP Customer leaflet - a quick-read overview for customers
- The Strategic Context – produced at the end of the Strategic Context phase of each cycle.
- How and where and we want to work with you – produced at the end of the Risk Assessment stage of each cycle.
- The Options process – produced at the end of the Options Development phase of each cycle.
- The Programme – produced at the end of the Programme Appraisal stage of each cycle.
- The Statement of Response to the public consultation of the draft DWMP.

The documents produced have been written to engage with different audiences, assuming differing levels of understanding. The same material has been used to inform each document and the same message, strategy and principles have been reiterated.

Customers are directed to the suite of customer-facing booklets as these set out the principles and strategies of wastewater and drainage planning in a simpler and easier to understand format.

The Non-Technical Plan is aimed at stakeholders and councils and provides more detail, but still references the same strategies and principles.

The Plan and the Technical summary are aimed at our regulators and contain detailed information regarding methodology and practice. These documents are set out this way to inform the change between non statutory and statutory status.

A glossary of common terms used within these documents can be found in Appendix A.

1 Introduction

Usk Valley, Wales Photo by Jeff Greenidge on Unsplash

1.1 Welsh Water

Welsh Water is the sixth largest of the ten regulated water and sewerage companies in England and Wales. We are responsible for providing over three million people with a continuous, high-quality supply of drinking water and for taking away, treating, and properly disposing of the wastewater that is produced.

Our sewerage systems collect domestic wastewater from drainage outlets around your home and carry it through a network of underground pipes to our treatment works. Here the effluent is cleaned and returned to the environment.

We're a bit different to other water companies

We are a 'Not for Profit' organisation. We don't have shareholders and we put every penny our customers provide right back into keeping bills down and looking after your water and the environment we all share – now, and in the future[1].

[1] If you would like more information, it can be found at https://corporate.dwrcymru.com/en/about-us/company-structure/glas-cymru

The water industry is a regulated business.

We are a licensed water and sewerage provider. We're regulated by Ofwat (The Water Services Regulation Authority) and the environmental regulators, Natural Resources Wales (NRW) in Wales and the Environment Agency (EA) in England, and the drinking water inspectorate (DWI) who are specifically focused on drinking water.

In the wastewater and drainage sector we are regulated principally to reduce the impact we have on the environment and to make the best use of our available funding.

We are also subject to the policies and legislation of the Welsh and UK governments. Regulators act on behalf of the Government to make sure we follow regulations and guidance.

As our company is a regulated business, there are also other important official bodies that carry out functions. In particular, the Consumer Council for Water (CCW), provides an independent voice for water customers in Wales and England. Similarly, Natural England is a regulator that provides science-based practical advice on the environment (in England). In Wales this function has been incorporated into Natural Resources Wales.

1.1.1 What does Welsh Water do?

You might be surprised by how much we do – everything from managing the sewerage and water networks, treatment of sewage and drinking water, to serving customers and working with our local communities:

	**SERVING OUR CUSTOMERS**	
1.4 million homes and businesses	3 million people in most of Wales, Herefordshire, and parts of Deeside	Over 600 million litres of wastewater treated on an average day
	**OUR COMPANY**	
The 4th largest company in Wales	Employ over 3,000 people	Completed a £1.5bn investment programme 2010-15
	**OUR ASSETS**	
Maintaining over 30,000km of sewers and over 26,500km of water mains	Managing over 800 wastewater treatment works including improvements to meet new environmental standards and 69 Water Treatment Works	Looking after more than 2500 Sewage pumping stations and 679 water pumping stations and over 2,000 combined storm overflows (CSOs)
	**IN THE COMMUNITY**	
One million visitors to our reservoir sites and visitor centres every year	Over 164,000 children have visited our education centres to date	Looking after 40,000 hectares of land

1.1.2 Where do we operate?

Figure 1 below shows our operating area for water supply and sewerage services.

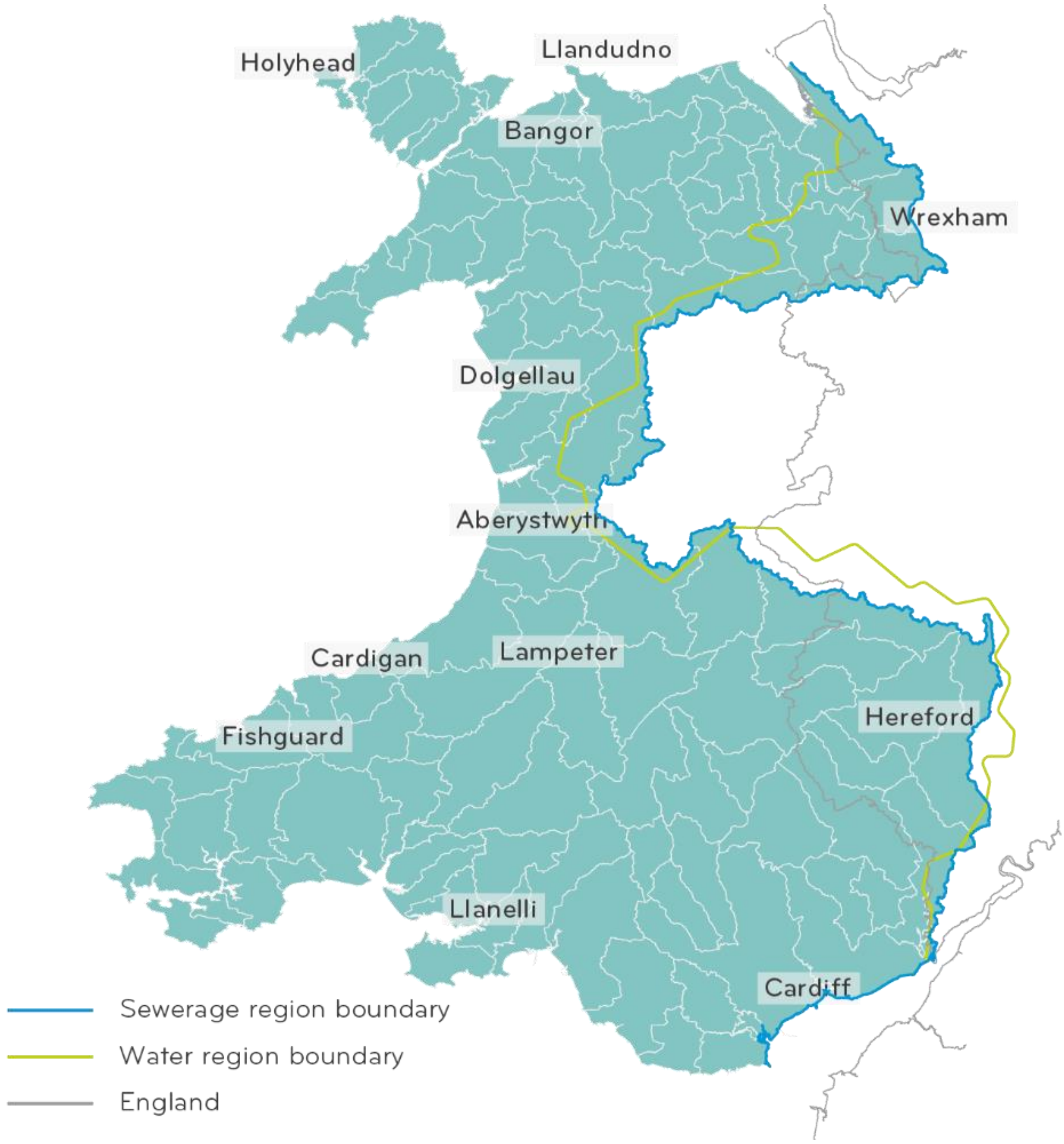


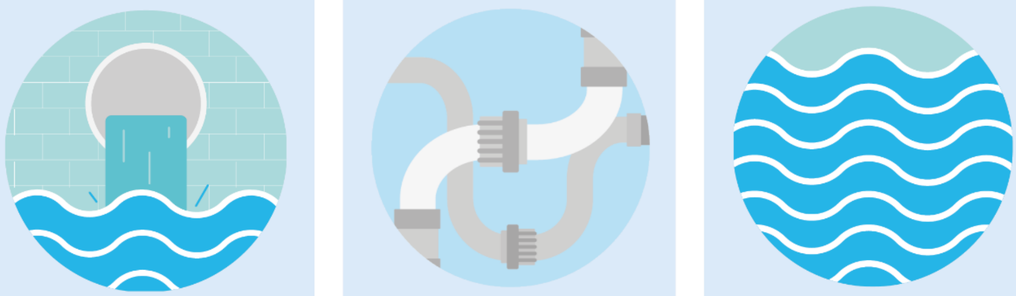
Figure 1 - Our Operating Area for both water supply and sewerage services

1.1.3 Services covered by the plan.

The DWMP will consider wastewater networks (foul, combined and surface water), interconnecting third-party owned drainage systems and wastewater treatment works. It will also consider the impact on the waters we discharge to, including rivers, streams (and other water courses), estuarine and coastal waters.

As a result, we have developed a plan that considers our own wastewater systems (sewerage), as well as the impact in wet weather from those interconnections with other drainage systems (drainage) and how we react to extreme flooding (Flood) – as shown in Figure 2.

- **Sewerage** (foul, combined and surface) – how to collect, transport, treat and return it to the environment.
- **Drainage –** (Lakes, Rivers Streams, Land, Roads, Surface water systems) – how to route rainwater efficiently, from the time and place where it falls, through the communities we live in, to reduce disruption to our everyday lives.
- **Emergency flood planning** – How we return to service as quickly as possible after a flooding event.



Sewage

The 'sewage' plan is about how we protect customers and the environment under normal rainfall conditions. We particularly want to make sure that we can prevent sewage spills in dry weather when they are most likely to have the greatest impact on the environment.

Drainage

The 'drainage' plan is how/ where we need to work with others to manage drainage, not just in our sewers, but also in other urban drainage systems (such as highway drains) to reduce their impact during heavy rainfall.

Flood

The 'flood' plan is how we work with others to reduce the risk of our sewers being overwhelmed, causing flooding in severe storms. This can affect the communities we serve. In this first plan we have focused on the sewage and drainage plans. When we update our plan in the future we will include a flood plan.

Review of Consents

The Review of Consents Plan is about how we assess possible futures that impact our decisions on the Sewage, Drainage, and Flood Plans. We work with others to ensure that the National Environment Programme, proposed National Drainage Programme, and National Infrastructure Plans are considered in our investment.

Figure 2 - Definition of sewage, drainage and extreme flooding

1.1.3.1 Sewerage

The sewerage network performs the critical public health function of protecting customers by transporting the sewage away from their homes and places of work, to a point where it can be treated and returned to our rivers and the sea safely. In our towns and cities, the responsibility for most of this sewerage infrastructure falls to the water and sewerage company (Welsh Water). Across our operating area we are responsible for around 36,000km of sewer.

In many parts of that operating area, this sewerage infrastructure originates from the Victorian era, where sewage and rainwater (from roofs, yards and often roads) are carried in the same pipe, known as a combined sewer. Such an approach relies on overflows from these sewers into the environment, as a means of protecting customers from sewer flooding during heavy rainfall. We have inherited over 2,000 of these overflows, which continue to serve the role they were designed for in reducing flood risk to customer homes and businesses, but their impact on the environment is under increasing scrutiny.

In those combined sewers, surface water, which could safely be discharged to rivers and streams, is often pumped, and then treated before it can be returned to the environment – increasing the sizes of pipes needed to carry the flows, the capacity of our treatment works and the cost of maintaining the service. This approach, which was right for that time in history, is now perceived as being less acceptable in a 21st Century sewerage system but will require significant investment to address.

On newer, post war developments, the concept of separate foul and surface water sewers was introduced. In some cases, this infrastructure ensures that rainwater is soaked away into the ground or drained to a nearby stream. However, where the ground conditions were not suitable or no nearby streams were available the surface water was again connected into the nearest combined sewer.

In January 2019, the Welsh Government implemented Schedule 3 of the Flood & Water Management Act 2010, requiring an independent assessment and approval of the surface water drainage implications of new development and the use of sustainable drainage systems (SuDS) for the management of surface water flows. Through the hierarchy embedded in the Statutory Standards for Sustainable Drainage Systems (Government W. , 2018) surface water should only be discharged from new developments to our combined sewers as a last resort when all other options have been exhausted.

1.1.3.2 Drainage

The Water UK DWMP Framework (WaterUK, 2018) defines 'drainage' within DWMPs as –

> *The total water company network served by a wastewater treatment works (WwTW), and interaction points with non-water company drainage systems. Drainage also includes water company surface water assets not draining to a WwTW.*

Over time, human intervention has altered the natural drainage patterns of our environment. The responsibility for drainage, including the drainage of roads, the drainage of land, streams, rivers, and other watercourses is now divided between local authorities, Natural Resources Wales, the Environment Agency, land and property owners and Welsh Water. Especially during, or following heavy rainfall, drainage systems owned by other stakeholders can flow, or overflow into our sewerage system, placing additional pressures on our infrastructure, which it may not have been designed to cope with.

Even in our existing urban areas, green land that naturally allows the infiltration of water is being replaced by impermeable surfaces during the extension of roads and buildings, in a process known as 'urban creep'. The loss of these permeable surfaces within urban and rural areas creates increased rates and volumes of surface water runoff into watercourses and other drainage systems, including our sewers. These changes only increase the potential for flooding when those drainage networks become inundated during heavy rainfall events.

This disparate ownership, and the interaction between drainage networks in our communities only emphasise the need to work collaboratively to understand the location of these drainage systems, how they interact and how we can manage their impact on the sewerage system. The DWMP has put increasing focus on the need to develop joint working arrangements so that more efficient and sustainable decisions can be made about the future of our urban drainage and that all involved get a say in the decision and contribute to the future arrangement.

What are 'assets'?

This is an item of property owned by a person, local authority or company.

Sewer assets form a part of the network of sewers, pumping stations and sewage treatment works and anything else which is needed to operate the sewerage system.

Drainage assets include culverts, ditches, and pipes.

National Infrastructure assets include flood defences and sea defences.

1.1.3.3 Flooding

Extreme floods are occurring more and more frequently. The Met Office has indicated that with the continued onset of climate change, named storms will continue to increase from an average of 7 per year to an average of 10 per year. This statistic highlights the need to prepare for these events. New thinking also suggest we need to not only consider protection to stop a flood getting into the asset, but also to return the asset to working order after an event has occurred.

The inherent set up of wastewater assets and its requirement to discharge into a river or a sea after treatment means that fundamentally assets owned by the company will be built where there is a high risk of flooding. We already make plans to protect the property so it doesn't flood, but we cannot protect against every flood event. In the flooding industry it is now recognised that there needs to be a point where we plan for the asset to flood but make arrangements within the asset so that the asset is returned to usefulness as soon as practicable. This includes moving electrics off the ground and building with materials that do not soak up water.

As a company that operates in areas of flooding along rivers and seas, we have a duty to work with Government to contribute to national infrastructure such as flood defences along river sides. We work collaboratively with Government to ensure that our assets comply with the level of protection expected.

We also have a role in emergency planning to work with other utility organisations to provide emergency responses. During flooding this includes delivering bottled water and other support. These plans are created as part of our duty as a water company, and we enact these plans jointly to ensure that if an event were to occur, we would be prepared and the plan is actionable.

Climate change has already brought big changes including heavy and unpredictable rainfall which happens more often. We are seeing increases in the amount of water being collected and returned to the sewer. This puts more pressure on the sewer network which has a fixed capacity, and it means we have to use our storm overflows more often to protect homes and businesses from flooding.

1.1.4 Types of Systems

The types of systems that are in operation are shown in

Table 1 below.

Table 1 - Types of Systems

Foul only systems	Have a network that manages sewage.	For these systems, 'solve' could mean in future 100% containment.
Combined systems	Have combined systems to manage drainage.	For these systems, 'solve' means in the future 100% containment of all rain events which is not deliverable, or variations of 100% containment options based on different storm frequencies and intensities.
Surface water only	Have networks (natural and human created) that drain rainfall to water courses generally without treatment.	For these systems, 'Solve' is difficult to define by a single organisation as drainage takes everyone.

Storm overflows

What a storm overflow does and is it wanted anymore?

Storm overflows are designed to operate when it's raining, or shortly after, to help the sewerage system cope as it drains. They provide pressure relief and protect customers from flooding. They were designed over 100 years ago to fix a problem where people were dying from water borne diseases. The decision to mix rainwater with sewage has led to our current position. Our urbanised areas are dry and have fewer green parks and woods. This highlights the need to review how storm overflows currently work, and whether there is a need for them anymore.

However, some storm overflows are now operating regularly throughout the year, not just during heavy rainfall events as they were initially designed for. They are there to protect customers from flooding.

1.1.5 Why is this document being published?

This document has many aims. The first of which is to provide a trial plan that supports Government in its preparation of the future regulation of DWMP's enacted in the Environment Act 2021. The industry requested a trial cycle to introduce and show new approaches, while also trying to embed what could be expected as a new statutory plan.

Another aim of the plan, particularly in this first cycle ('Cycle 1'), is to look beyond the tried and trusted wastewater methodologies by drawing on experience from a wide range of stakeholders. In doing so, it will improve how plans are put together and developed and will improve the integration of methodologies to improve efficiency.

The plan sets out to tell you how and what we are doing and to involve you in our decision making with regards to the methods, communications, pace and limitations of the approach.

We have also developed our first plan summaries; one for each region (Level 2) and local river system (Level 3). The summaries are structured so that we can add more information over time as and when it becomes available and when strategic changes occur locally.

1.2 What is a DWMP

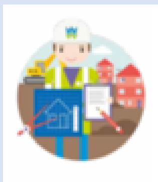
The DWMP is a long-term planning study that looks at drainage and sewerage needs over the next 25 years as a minimum. It looks at future trends and embeds an approach of working together with others to develop a shared vision for the future of environmental water quality, drainage, and wastewater management. Ultimately, it is a water company, customer driven plan to achieve the best outcomes for the environment we operate in and for our customers across Wales and adjoining parts of England.

> *‘A drainage and wastewater management plan (DWMP) will set out how water and wastewater companies intend to extend, improve and maintain a robust and resilient drainage and wastewater system. The plan must take a long-term view … with a minimum period of 25 years. The framework for DWMPs has been developed in response to the need to improve the approaches taken by the water sector to long-term drainage and wastewater planning with a view to providing greater transparency, robustness and line of sight to investment decisions that lead to cost to customers.’*
>
> Water UK, September 2021

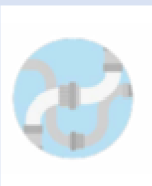
Our customers are at the heart of everything we do, and this includes the development of the DWMP. We are including customers at every step to make sure we create a long-term plan that benefits people and the environment we all share.

This is a customer driven Plan that will set out how we intend to manage future challenges brought about by population growth, urban creep and climate change

It will set out how we intend to extend, improve and maintain drainage and wastewater systems across Wales and the areas of England that we serve.



It plans for the long-term, setting out targets that are appropriate to the risks we face, for a minimum period of 25 years that covers both England and Wales.



It is a best practice approach -built on established processes including Water Resources Management Plans (WRMP) and Sustainable Drainage Plans.

It demonstrates greater transparency, robustness and line of sight to investment decisions that affect our customers.

> Developing this Plan will help us work towards our Welsh Water 2050 vision to “earn the trust of our customers every day” and to achieve our mission of becoming “a truly world-class, resilient and sustainable service for the benefit of future generations”.

This first version of the DWMP is referred to as ‘Cycle 1’, in which some elements of the plan have been developed, whilst other areas are still being established. During this initial non-statutory voluntary phase[2], several techniques and tools have been trialled, with best practice being incorporated into future DWMP cycles. The plan is based on our Welsh Water 2050 strategic vision and Government First Guiding principles that were provided part way through the process.

1.3 The need for a DWMP

In 2019, Ofwat published their strategy: ‘Time to Act, together’ (Ofwat, Time To Act Together, 2019). The document highlights the future challenges to the water industry, including growth, climate change and changing customer habits. Ofwat set out their ambition to work with the sector to see improvements being made at a greater pace of change, together with evidence of long-term strategic planning, which demonstrates the overall direction of travel.

The National Infrastructure Commission (NIC) have also stated that companies need to be prepared for future population change and increase in extreme climatic weather events to develop resilient wastewater systems - ‘*a truly resilient system is also able to respond effectively to as yet unknown, or difficult to predict challenges’* (NIC, 2019).

The water industry has experience in developing long term management planning for water resources, an approach that has been maturing for over 20 years. Despite that, the industry has not had a similar method for wastewater planning to ensure that adequate investment is targeted towards our drainage infrastructure to ensure it remains suitable to meet the long-term needs of customers and the environment.

Medium-term sewerage planning has been undertaken for many years, the need to consider wastewater treatment systems alongside requires plans that incorporate local development plans which themselves cover 15 years, the needs driven by the water framework directive, the future pressures of interactions with other drainage systems, the challenges of climate change and the legacy of our combined sewer networks was recognised by the water industry at the turn of the century to require a change to an alternative approach. To address this, WaterUK set up the 21st Century Drainage Programme (WaterUK, 2018) with a vision of enabling the UK water industry, with support from a wide range of stakeholders, to develop a framework of practical tools for the delivery of long-term drainage and wastewater planning.

---

[2] The DWMP is currently in its first 5-year cycle and is being produced on a non-statutory basis for early 2023. The Plan will become a statutory requirement as Section 79 of the Environment Act (2021) inserts a new ‘Drainage and sewerage management plan: preparation and review’ section (94A) into the Water Industry Act 1991 (legislation change currently outstanding).

1.3.1 The potential benefits

The anticipated outcomes and benefits of the DWMP process are summarised in Figure 3, below.

Figure 3 - Anticipated DWMP Process Outcomes

In conjunction with existing planning tools, and other initiatives from the Water UK 21st Century Drainage Programme, we have adopted the DWMP to achieve the following benefits:

- A collective view of the current and future challenges and actions needed to respond to them.
- Transparency and consistency in planning approach to the production of the DWMP.
- Greater confidence for customers, regulators, and stakeholders through the creation of a 'line of sight' from identification of risks to the investment decisions taken to address them.
- Responsive and flexible plans that can respond to rapid changes such as climate change and population growth.
- Supporting the development of plans for economic growth and resilient communities across Wales.
- A platform for effective engagement with customers and stakeholders.
- A culture of partnership working and co-creation of solutions that will benefit the economy, society, and environment over the long-term.
- Better investment decisions made by unlocking combined funding sources.

1.3.2 The need for collaboration

As shown in Figure 4 below, DWMPs will only fully realise their potential in delivering a robust and resilient drainage and wastewater service we aspire towards, by working in partnership with key stakeholders at both strategic and local levels.

Ofwat's 'Time to Act, together' document emphasised the importance of working collaboratively to preserve our future environment as well as maintaining an acceptable level of service for customers: "Work with environmental regulators and UK and Welsh Government to ensure the next environment programmes (Water Industry National Environment Programme [WINEP] in England and National Environment Programme [NEP] in Wales) and plans for the water sector (including the Drainage and Wastewater Management Plans) bring forward the greatest strategic benefits to both customers and the environment; and in Wales, ensure that they enhance biodiversity and promote the resilience of ecosystem" (Ofwat, 2019).

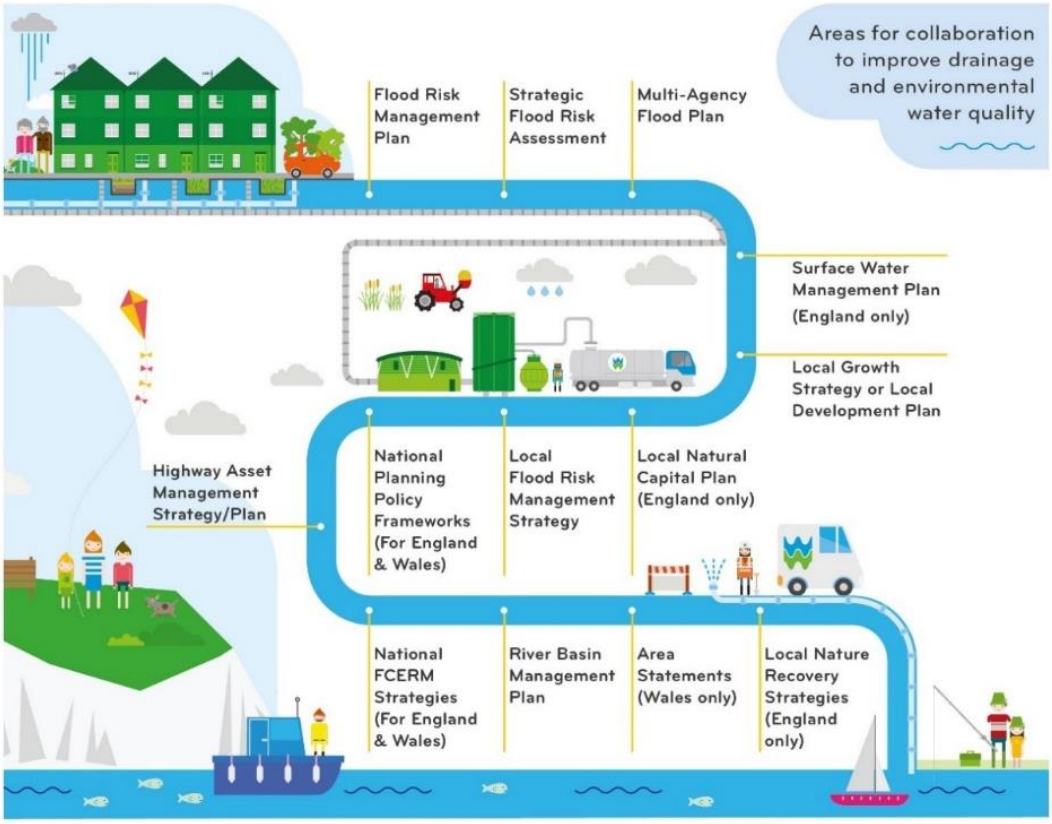


Figure 4 - Documentation and Policy collaboration

Areas for collaboration can range from opportunities to help raise awareness with customers and stakeholders, to the introduction of sustainable drainage or natural flood management measures to slow the movement of surface water.

In other areas, there can be the implementation of measures that improve the quality of our rivers and coastal waters. This could be from the alignment of place-based planning or green/blue space objectives to improve the resilience of communities.

By working in synergy with our key stakeholders, interest groups, communities, and our customers, the DWMPs will complement and integrate with other existing plans and strategies that manage drainage and environmental water quality. Figure 4 lists key plans and policies managed by other organisations that influence on or impact the DWMP, and vice versa.

1.3.3 Future requirements

This first cycle of the DWMP is not a legal requirement. However, Welsh Water, together with the other UK water and sewerage companies, has committed to prepare a plan in readiness for this planning approach becoming a statutory requirement.

Whilst companies have been undertaking medium to long-term planning of their sewerage systems for many years, the methods utilised have not provided Government with a common, robust approach, where standard levels of service are being planned across all areas.

Governments are now preparing for the statutory phase of the plan. To this end the Environment Bill included provisions for the introduction of a statutory requirement for DWMPs in existing primary legislation. Secondary legislation to support the introduction of this statutory requirement is also currently being considered by Government. The Environment Bill was given royal assent in November 2021. The clauses within it are anticipated to be translated into primary legislation during 2023.

Following discussion with the Welsh Government in January 2019 we have had regard to the developing wording of section 79 of the Environment Act 2021, which in its final form reads as follows:

> *(2)A drainage and sewerage management plan is a plan for how the sewerage undertaker will manage and develop its drainage system and sewerage system so as to be able, and continue to be able, to meet its obligations under this Part.*
>
> *(3)A drainage and sewerage management plan must address in particular—*
>
> *(a)the capacity of the undertaker's drainage system and sewerage system,*
>
> *(b)an assessment of the current and future demands on the undertaker's drainage system and sewerage system,*
>
> *(c)the resilience of the undertaker's drainage system and sewerage system,*
>
> *(d)the measures the undertaker intends to take or continue for the purpose in subsection (2),*
>
> *(e)the likely sequence and timing for implementing those measures,*
>
> *(f)relevant environmental risks and how those risks are to be mitigated, and*
>
> *(g)any other matters specified by the Minister in directions.*

Recognising the lack of any supporting secondary legislation to provide expansion on the above we have considered the principles contained in the existing secondary legislation for Water Resources Management Planning (Government, Water Resources Management Plan Regulations 2007, 2007). Not only does this provide support to the company while we are developing new systems and procedures, but it also provides evidence as to where the mature WRMP approach can, and cannot, be adopted in the delivery of the DWMP.

Despite the non-statutory status of this plan the Welsh Government is the devolved government for Wales and has powers to manage the environment. The Welsh Minister will direct DCWW to publish plan when the process is statutory however during this phase the water company Board will carry out this final action in 2023, the Board has provided their direction to publish this plan as a Final DWMP24.

1.4 The First Government Guiding Principles[3]

The DWMP Guiding Principles have been produced by DEFRA, Welsh Government, Environment Agency and Natural Resources Wales and Ofwat jointly laying out seven guiding principles for the DWMP. These guiding principles set out the key principles that are to be included in DWMP planning. The footnote link contains the full guidance, and these are discussed further in Section 2.2.

1.5 Ofwat expectations for strategic Planning frameworks at PR24

In addition to the Guiding principle which Ofwat jointly produced, Ofwat published their expectation for water companies undertaking strategic planning in their letter to companies on 17th November 2021. This letter similar to the guiding principles arrived during the process. A second expectation was added when the final PR24 and beyond: final guidance on long-term delivery strategies (OFWAT, PR24 and beyond: Final Guidance on Long-Term delivery strategies, 2022) was published in April 2022 which was received after we had produced our plan.

1.6 Welsh Water 2050

The DWMP is a blueprint for achieving our corporate strategic vision, which we outlined in our Welsh Water 2050 document, published in March 2018 (DCWW, 2018). Welsh Water 2050 set out to identify significant future trends, assess how these will impact on us and our customers, and to consider how they might be addressed. The DWMP will refine that assessment through a best practice approach, which has been built on established long-term planning processes, such as WRMPs and Welsh Water's former wastewater planning approach, known as Sustainable Drainage Plans (SDPs).

Developing the DWMP will help us work towards our Welsh Water 2050 **Vision** to:

> *"earn the trust of our customers everyday"*

and to achieve our **Mission Statement** of becoming:

> *"a truly world-class, resilient and sustainable service for the benefit of future generations"*

1.7 DWMP Water UK Framework

The DWMP approach has been developed with several key stakeholders within the water and drainage sector and builds on the principles outlined in the Drainage Strategy Framework of 2013 (Ofwat, 2013). To align with the processes being adopted by the rest of the water industry we have based our approach on the DWMP guidance, published by Water UK (2018), and we have also integrated the best parts of WRMP processes from the 2020 Guidance (EA/NRW/OWS, 2020), whilst adapting our approach in Wales to align with the Welsh policy priorities of, for example, the Wellbeing of Future Generations Act and the Environment (Wales) Act. The overall process steps, as presented in the Water UK framework, are outlined in the schematic in Figure 5, below.

---

[3] https://www.gov.uk/government/publications/drainage-and-wastewater-management-plans-guiding-principles-for-the-water-industry/guiding-principles-for-drainage-and-wastewater-management-plans

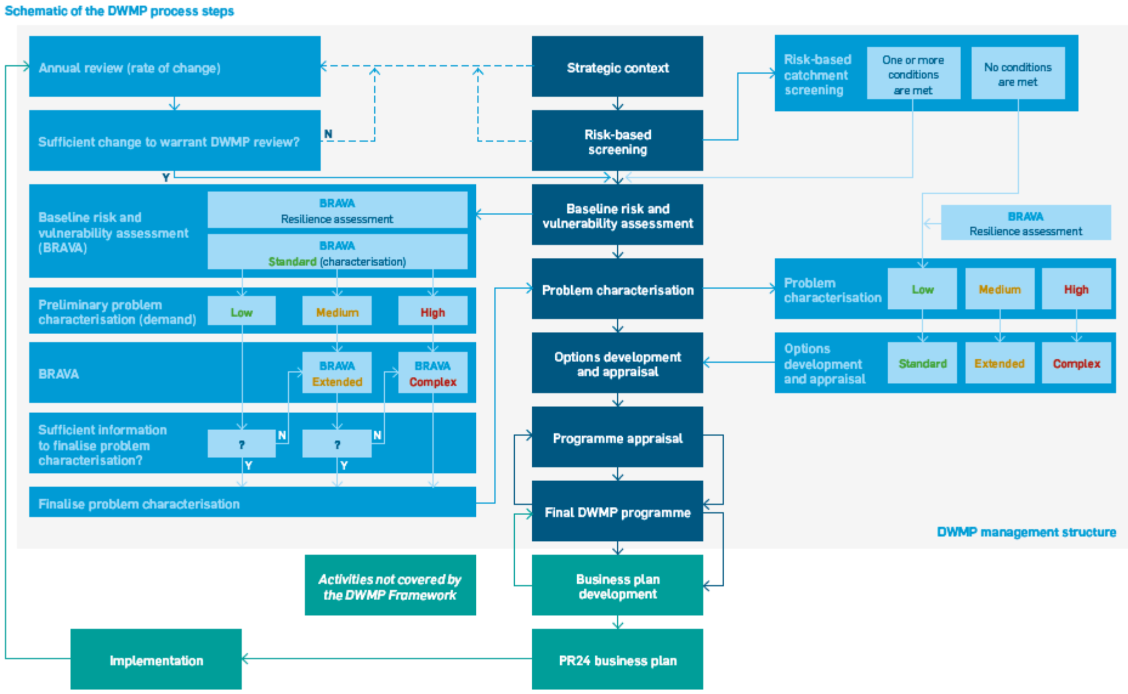


Figure 5 - Water UK DWMP Framework

Each of the key steps are highlighted in dark blue in Figure 5 and reflect key areas of technical work undertaken in the delivery of this DWMP. Our approach to the delivery of these stages reflects the structure outlined above. Further details on each of these framework steps can be found in the later sections of this report:

- **Strategic context** – As above, supported further by our activity
- **Risk based catchment screening** – See 'Risk Assessment – Risk Based Screening' (Section 4.5)
- **Baseline Risk and Vulnerability Assessment (BRAVA)** – See 'Risk Assessment – Baseline Risk and Vulnerability Assessment' (Section 4.6)
- **Problem Characterisation** – See 'Risk Assessment – Final Problem Characterisation' (Section 4.8)
- **Options development and appraisal** – See 'Options Development and Appraisal – Building Our Plan' (Section 5)
- **Programme appraisal** – See 'Programme Appraisal' (Section 6)
- **Final DWMP programme** – See 'Our Plan' (Section 11)

The light blue areas shown in Figure 5 represent the individual processes required for each stage.

A key element of the DWMP framework is to ensure that there is early, continued, and effective engagement between companies and stakeholders at both a company-wide level and more locally. Partnership working and collaborative planning will be essential to delivering resilient wastewater and drainage systems.

In following this structure, we must also consider:

- The need for a company level output, rather than just community level proposals.
- The need for more transparent and structured planning.

- The need to consider impacts on customers and the environment.
- The need to be proportionate in our approach and look at risk.
- The structure and geography of our organisation, our partner organisations and stakeholders, and the communities we serve.

The Environment Act 2021 will bring the added dimension of a statutory requirement to deliver the plan, combined with a legislative and regulatory process to be followed, to the second cycle of the DWMP.

1.8 Planning hierarchy

A key part of the DWMP is making sure that there is early, continual, and effective production of information and engagement between different organisations and stakeholders at different scales; both at company and local level.

If we are to deliver resilient wastewater and drainage systems, we must work together with others and consider different planning areas from national to local.

Plan areas must consider impacts on customers and the environment together with the structure and geography of the communities we serve.

Historically, Welsh Water has had three geographical wastewater planning levels. The first was the entire company wastewater operating area, which was defined at the time the company was privatised in 1989. The second was the WwTW catchment level, which included the wastewater network draining to each treatment works. The third, was known as the Drainage Area Plan (DAP) or Sustainable Drainage Plan (SDP) level, reflecting discreet modelled sections of the sewerage network.

The Water UK framework defines three new levels of planning which direct the granularity of the assessments being undertaken, and the levels at which the outputs of the DWMP will be consulted on and published. These levels are outlined in section 1.8 (Planning Hierarchy).

The Water UK DWMP Framework therefore required Welsh Water to define geographical areas which aligned with the definitions of those different plan levels.

Several existing organisation and government boundaries were considered, such as Council administrative boundaries, Natural Resources Wales Area Statement boundaries (NRW, Operational Areas, 2022), and River Basin Management Planning Boundaries, amongst others.

NRW Area Statements comprise six land-based areas and one marine based area. It was concluded that the Area Statement boundaries were mainly not water-based and were therefore not a useful delineation of the flooding and water quality impacts of the sewerage system. Areas Statements also do not apply to the areas of England that we operate in, and so were deemed inappropriate as the basis for our Level 2 boundaries. Whilst Area Statements are mentioned in this plan, alignment with them does not currently form part of the DWMP framework process.

Council administrative boundaries were also reviewed. As with the Area Statement boundaries, it was concluded that they were not appropriate as a means of defining our Level 2 and Level 3 areas.

WFD defined Districts and the smaller reaches of Water Body IDs, used in river basin management plans (RBMPs) were also considered. Internally the WRMP boundaries were also considered. However, the Tactical Planning Units (TPUs) are parts of river systems within a river basin catchment combined at a higher level than specific WFD water body ID’s or reach.

As a result, whilst river basin planning districts were selected as the basis for our Level 2 areas, we concluded that we needed areas that allowed us to discuss the hydrology and hydrogeology of catchments with our stakeholders while also being able to work internally at the WwTW catchment level 4 and to even smaller risk clusters.

For Level 2 Strategic Planning Units, the plan boundaries were closely aligned with River Basin Planning Districts. For Level 3 Tactical Planning Units (TPU), we have aligned the plan boundaries closely with Reaches of river within a River Basin Planning District, using aggregations of our WwTW catchments.

The result of this exercise is that the Company Operational Level (Level 1 or L1 area) has been broken down into 13 Strategic Planning Units (Level 2 or L2 areas), which are based around River Basin District (RBD) Catchments.

These catchments have been further subdivided into 106 Tactical Planning Units (Level 3 or L3 areas), strategically grouping wastewater treatment works based on the watercourse they impact and the population size they serve.

In addition to the above, the original WwTW catchment levels are still used internally within Welsh Water and are classed as Level 4, or L4, areas. These areas are a subdivision of a Tactical Planning Unit (TPU), and further subdivisions are being made and trialled for use in future DWMP planning cycles. It is important to note that the discussion and conclusions within this document are directed towards L3 and above. Where a discussion is made at a more granular level to L3 this is because an assessment has been found to be required at a very detailed drilled down level or had to be built up from a detailed bottom-up level. While learning while applying the DWMP Framework It has already been noted that strategically level 2 and 3 are sufficient but internally the detailed granular levels. These levels are currently defined as but only sparce reference in this document.

We have developed a structured approach to plan areas for the DWMP which is set out below in Figure 6.

Figure 6 - DWMP Planning Hierarchy

These plan levels are adapted from the nationally agreed Water UK framework to ensure they are tailored to our organisation, customers, and stakeholders.

The plan levels also inform how we engage with different groups as part of the DWMP.

For example, we need to use a different approach to speak to a local community about their wastewater concerns when compared to sharing data with other organisations at a national level. The choices made to describe these planning levels ensures we have a more structured and responsive approach to engagement that is tailored to different people's needs.

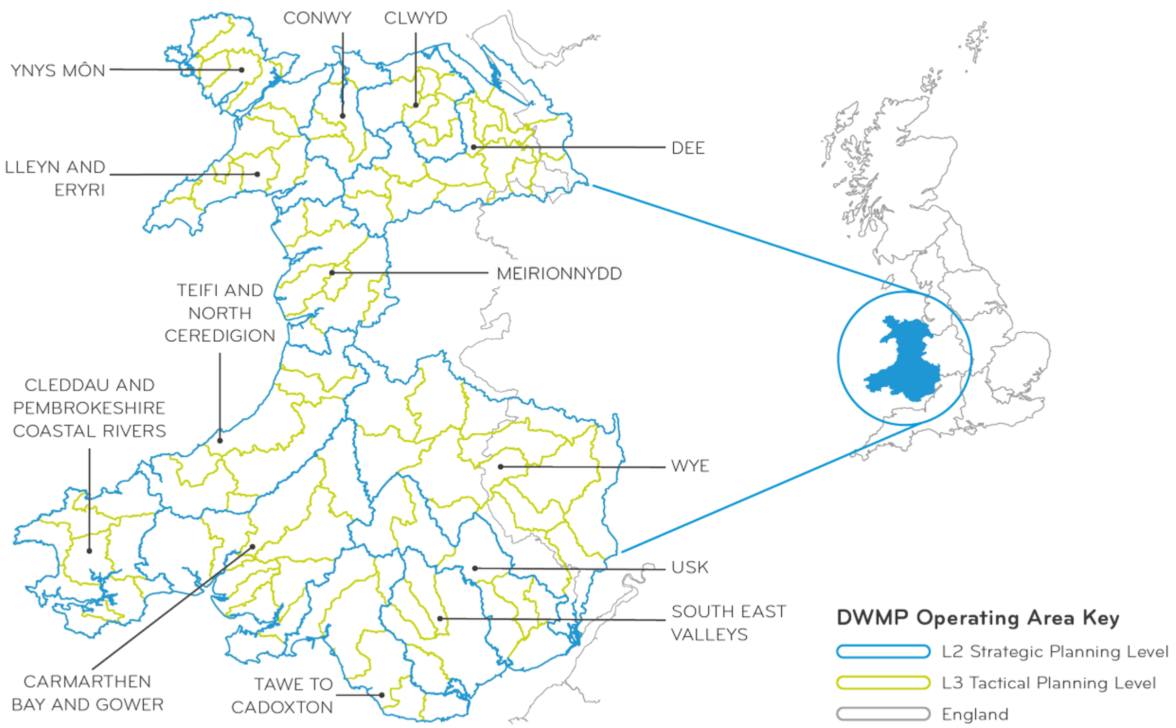


Figure 7 - Map showing the DWMP Hierarchy for Level 1, 2 and 3

Figure 7 shows a map of Welsh Water's supply area, divided by blue border lines into the 13 strategic planning units – also known as Level 2 or L2 areas, and divided again by green border lines into the 106 Tactical Planning Units – also known as Level 3 or L3 areas. The company operational supply area is also known as Level 1 or L1. We have included in Figure 7 reference to more local levels of planning with the first being WWTW Catchments also known as Level 4 or L4. In operational terms there are more layers beneath these levels and work will be undertaken to further refine them going forward.

The benefit to creating plans at differing planning levels is that risks and opportunities and final programmes of work can be communicated to inform the local risk.

1.9 The structure of our plan

This document forms the main plan, developed as part of a suite of documents, which together formulate the DWMP.

This suite of documents is laid out as follows:

- **The Main Plan** – A technical appraisal of risk, utilising different methodologies to inform and establish local and national best practice. This includes a strategic option assessment to aid understanding of the scale of the task to manage future pressures, supported by a staged option appraisal methodology. The document also includes programme appraisal methodology to ensure consistency with other long-term planning in the water industry and examples that highlight how we propose to undertake this detailed assessment in the second DWMP cycle.

- **The Technical Summary** – A Technical account of the first cycle plan presenting methodologies carried out
- **The Non-Technical Summary** – A stakeholder facing summary of the key points and messages from the main plan.
- **The Area Summaries** – A series of summaries, setting out the proposed regional (L2) and local strategy (L3), risks, options, and preferred options.
- **Strategic Environmental Assessment and Post adoption Statement**– A formal review of the potential environmental impact of the proposals being promoted by the DWMP, to ensure that the most sustainable options are being promoted.
- **Habitats Regulations Assessment** – A formal review of the potential impact of the DWMP proposals on protected habitats.
- **The suite of customer facing documents –** A set of stage-based publications to continually engage with customers and stakeholders as the Plan develops.

  - The DWMP Customer leaflet - a quick-read overview for customers
  - The Strategic Context – produced at the end of the Strategic Context phase of each cycle
  - How and Where and we want to work with you – produced at the end of the Risk Assessment stage of each cycle
  - The Options process – produced at the end of the Options Development phase of each cycle
  - The Programme – produced at the end of the Programme Appraisal stage of each cycle.
  - The Statement of Response to the public consultation of the draft DWMP.

The DWMP brings together previous methods of drainage planning with the latest direction from UK governments through the Guiding Principles and sets out our approach to meet their requirements (Defra, 2022) to manage the major political and environmental challenges of economic growth, behaviour change (such as urban creep) and the climate emergency.

Each year on the anniversary of the plan's publication we will publish an annual review of progress. This will be undertaken for the first time in 2024.

1.10 Planning for a secure sustainable service

This plan sets out what a DWMP is, and which areas are geographically covered. It identifies the roles of Government[4] and regulators, stakeholders, communities, and customers. The plan also introduces the legislative context within which we must operate.

To be able to deliver a long-term sustainable wastewater service that meets legislative requirements, the needs of customers, and protects the environment it is critical that all stakeholders do their part to support the development and delivery of the DWMP.

[4] Government during this document is UK Government and generally in Wales is referred to Welsh Government. For simplicity the remaining references to government will be Welsh Government as they will administer the Welsh Water Plan

To achieve that collaboration the water resource management plan process follows three key stages, which we have sought to replicate in the DWMP:

a. Pre-consultation and preparation of draft plan
b. Publish the draft plan and carry out a formal consultation
c. Assess consultation responses, revise the draft plan, and after direction, publish a final plan

The following sections outline the roles of the key players in the development of the plan, the actions required to be carried out and who is required to deliver them to create a joint DWMP.

1.10.1 The water company

It is the water company's responsibility to deliver the plan. The actions that the company is required to undertake are to:

1. **Coordinate with other organisations,** government and regulators to ensure the plan is developed.
2. Prepare a draft plan, **Undertake Environmental Assessment of the plan's proposed outcomes,** incorporate the Strategic Environmental Assessment (SEA) in the process and the complete a Habitats Regulation Assessment (HRA) where there are possible risks to designated areas and species.
3. **Communicate the plan** to customers, stakeholders, regulators, and Government
4. **Carry out a formal consultation of the draft plan and the SEA and HRA** and address any responses in a formal report named a Statement of Response (SOR).
5. **Revise the plan** based on those consultation responses including the preparation of a Post Adoption SEA statement and review the HRA in an iterative process against the final Programme Appraisal.
6. **Publish a final plan** when Government has given their endorsement in line with Ministerial directions.

1.10.2 Government

Welsh Water is a company that operates 'wholly or mainly in Wales'. As such, it is the responsibility of the Welsh Government to provide the initial direction to enable the plan to be developed. Such direction is usually provided in a suite of legislation that is yet to be written. The legislation is likely to include Regulations, Directions and Guiding Principles. The first Guiding Principles for Drainage & Wastewater Management Plans (Defra, 2022) was published after much of the first cycle plan had been developed. The guiding principles have been incorporated into the plan but as a result of its late arrival there has been limited time for those guiding principles to steer the direction of the plan. However, it will be extensively used to steer and direct the plan in the development of Cycle 2.

Before publication of the plan, the Welsh Government must also agree that the water company has addressed issues of national security appropriately within its plan, and then direct the company to publish the final plan, once they are satisfied that it meets with any ministerial direction.

1.10.3 Regulators

In the context of the first cycle DWMP, the Government has not specified how it will gain assurance that the plan meets the objectives set out within the newly enacted section 94A of the Water Industry Act 1991, and the 'Guiding principles for drainage and wastewater management plans' (Governments, 2022). In a WRMP context that role of advisor to Government would be performed by Natural Resources Wales and the Environment Agency, but in the context of the DWMP, Natural Resources Wales and the Environment Agency are currently considered as stakeholders to the plan.

Ofwat, which is appointed by Government as economic regulator to the water industry, will be carrying out its economic assessment of the proposals developed in this plan, as part of the 5-yearly price review process for the sector. Ofwat's role has not changed due to the newly enacted section 94A either and during this non statutory phase Ofwat is also considered as stakeholder.

1.10.4 Consumer Council for Water

The Consumer Council for Water (CCW) provides an independent voice for customers in Wales and England. It carries out research and work alongside us to challenge our performance and efficiency. Through the DWMP we will be considering issues that could have material impacts on customers, from expectations over acceptable performance of our sewerage systems to impact of improvements on customer bills. As a result, CCW is a key stakeholder in the DWMP.

1.11 Responsibilities through the stages of the DWMP

The DWMP process is assumed to be on par with the WRMP and will follow the steps set out in Figure 8. There is a list of activities that we the water company undertakes as the lead on the plan and the flow chart indicates stages where third parties and Government play their part in the process. In addition to water companies, the Government and regulators, there are other organisations and people involved in planning drainage in urban areas – and the DWMP:

- Local councils plan future housing and businesses, deal with new or extended roads, and manage most urban and highway drains.
- Natural Resources Wales and the Environment Agency manage the amount and quality of water in our rivers and seas. They also manage drainage as part of the water cycle, such as river flooding and coastal defences.
- Land and asset owners are responsible for looking after their own land and making sure their drainage assets are fit for purpose (some of which pass flows to the sewerage system). This includes important national infrastructure such as reservoirs and water courses.
- Groups with environmental or social concerns that are affected by our drainage and sewerage infrastructure.
- Customers and the communities we serve.

Welsh Water is responsible for managing sewerage and sewage treatment alone, but we also are responsible for our sections of drainage infrastructure. To manage drainage, we must work together with the different organisations and people listed above. This highlights how important it is for us to work together with others to deliver the plan.

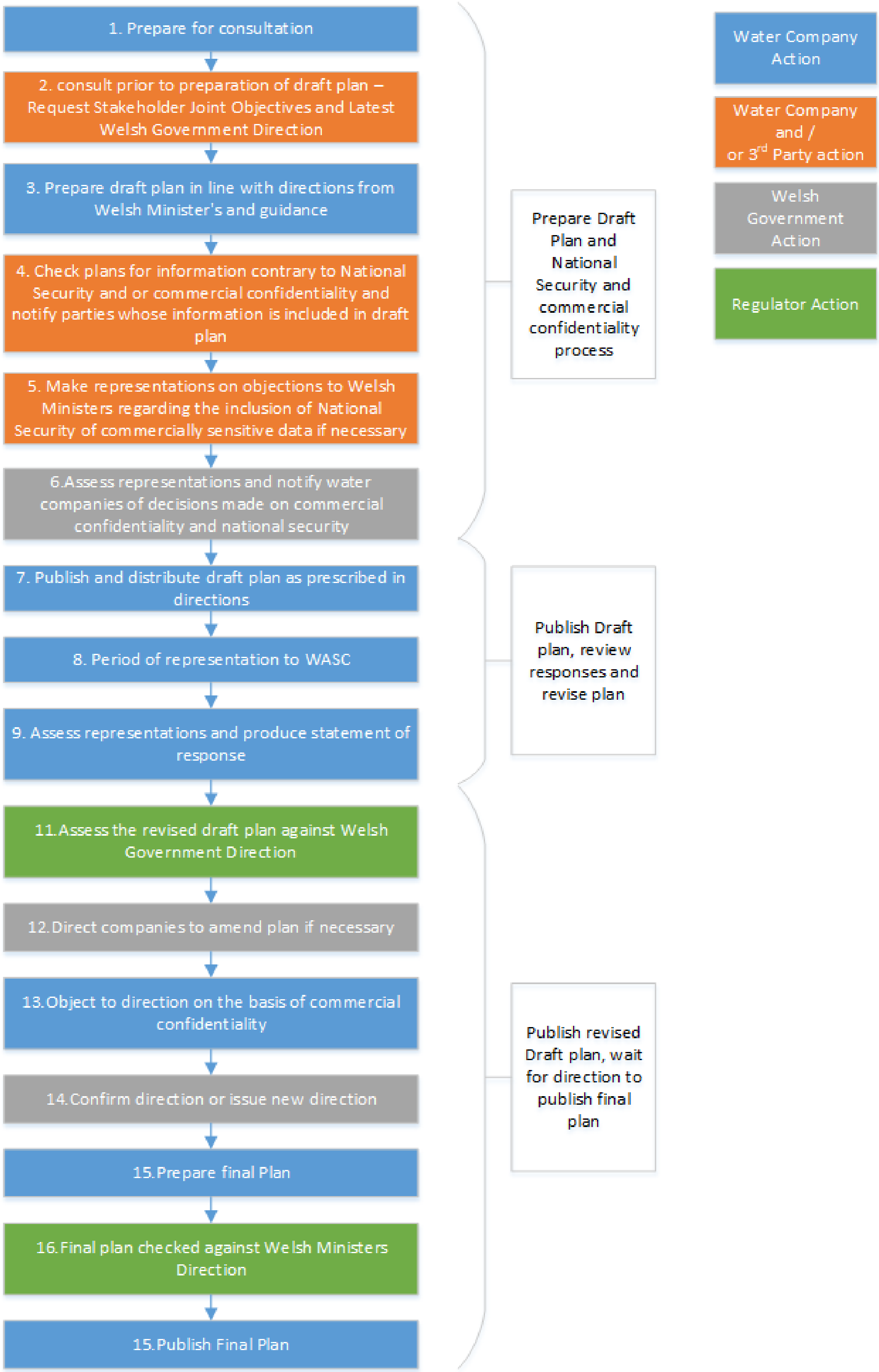


Figure 8 - Responsibilities through the stages of a DWMP format, taken from the WRMP Guideline

1.11.1 Stakeholders

It is the responsibility of the water company to engage with key stakeholders to develop the relationships and understanding necessary to complete catchment investigations, create proposals and deliver solutions.

It is the responsibility of those stakeholders to participate in developing the plan by providing information, attending collaborative meetings, and supporting the development of joint programmes of work. There will often be a need to provide representation at project and community forums to demonstrate a united approach between agencies, and to facilitate the delivery of the work programme. Critically, the role of stakeholders also includes working to align their own long-term strategies and work programmes with the DWMP.

In this context, the term ‘stakeholder’ includes regulators that have a vested interest in the plan’s development, such as Natural Resources Wales and the Environment Agency.

1.12 Why do we need a framework?

As a water company, the decisions we make today will affect our customers and the environment we all share for generations to come. There is a need for longer term planning but the approach to this historically varies between different water companies. These individual approaches make it difficult for our regulators to compare and consider plans from across the whole of the UK, with information not always being produced or shared in the same way.

This means there is not enough consistency and transparency to reassure governments, and our customers, that this key service will remain fit for purpose into the future.

The goal of the DWMP is to bridge this gap – it is an opportunity to work more effectively with other organisations to deliver the best outcomes for everyone in a sustainable and planned way, where we can work as partners, as set out in the Wellbeing of Future Generations Act, to meet the needs of our customers and stakeholders.

We have worked with the Welsh Government, regulators and national groups as part of Water UK to achieve better consistency between water companies.

All water companies have been putting together their first DWMP during the 2020-25 period.

We believe our approach to planning the DWMP delivers what is best for customers and the communities where we operate and has been produced as efficiently as possible given the high level of uncertainty regarding the change from non-statutory to statutory standing of future plans.

The goal of the DWMP is to put together an integrated plan which covers all the areas we operate in. The DWMP will help us to do the right thing for our customers and the environment for the long term. It ensures we have a joined-up and more effective approach to addressing some of the biggest challenges we face including climate change, a bigger population and growing urban areas.

Although the DWMP is not currently a statutory obligation for water companies in Wales and England, it is included within the Environment Act (2021), and we anticipate will be made mandatory in 2023.

1.13 How we work with regulators to manage uncertainty in the future, and how we incorporate that change in planning

We work closely and collaboratively with our regulators to ensure that we are compliant with current legislative requirements. As part of this dialogue, which takes the shape of Strategic Liaison Groups and Technical Working Groups that are focused on, for example, River Water Quality, our regulators provide guidance and insight into any future policy changes that may impact and shape our investment programmes.

In addition to working closely with our regulators, we engage with local authorities and other key local stakeholders. By doing so, we can better understand the needs and concerns of our customers and protect the environment.

1.14 Key drivers

We have engaged with our customers and stakeholders throughout the process to help shape the key drivers to develop the DWMP and our long-term planning:

- Environment challenges

Tightening environmental standards, climate change and a growing population will all put more pressure on making sure we have effective drainage and wastewater management.

- Behaviours and expectations

We need to meet everyone's expectations and ensure systems are adaptable, fit-for-purpose and responsive to changes in technology. This means that we will need to understand how our changing societal needs can be met, and where we can help ourselves to reduce the risk of flooding and our impact on the environment.

- Resilience

We need to look at the factors that challenge us, respond to an uncertain future, and think about things that can be difficult to predict. We need to be able to cope with and recover from disruptions, maintain services for our customers and protect the environment.

- Integrated planning

We need longer-term and integrated planning carried out by all those responsible for drainage and more effective procedures for others to work with us (in the form of the DWMP) to ensure we can meet the scale and complexity of these challenges.

1.15 Objectives

There are three overall objectives for the Plan. The objectives reflect our focus on resilience for the future, whilst providing best value for the customers of today and tomorrow:

Water quantity

Reducing the risk of flooding to communities.

Water quality

Improving water quality for the environment

Resilience and maintenance

Making sure we can adapt to changes in the future, whilst also maintaining important services and protecting the environment

Resilience

Ensuring a resilient wastewater and drainage network is vital and includes many organisations working together on a range of different areas, from assets and systems to people and culture. Being resilient ensures that we are ready to meet the challenges of 2050 and beyond.

Our themes are supported by national planning objectives that allow for comparison between companies by our regulators, as well as company-specific objectives that forecast risk and aid in planning. These objectives will inform our action plans and assist us in achieving our vision, mission statement and Welsh Water 2050 objectives.

Just as important as what is in the plan is what is not in the plan. For this iteration we have not included Biosolids or Odour risks. We have included Carbon but not as a strategy but as a calculation of the consequence of solutions. As the plan develops more and more of our assets and 3rd party assets will be included.

1.16 Level of service

Our regulators measure our performance at a company level with various annual performance measures. We are considering measuring not just performance, but also the level of service that our customers and the environment experience at a local level. The calculation of levels of service is not a simple task as it includes:

- The combination of all performance objectives in a local area.
- Assessing the gap between the current level of service and the expected level of service.
- Comparing the current and future situation to the desired level of service.

In a Level of Service plan at a localised area, all of the expected performance measures need to be met, together with a plan in place to achieve the desired level of service. These are then considered through the plan layers to come to a conclusion on level of service at level 2, and then at the company level of service Level 1.

To calculate the level of service, we need to first understand at a local level the volume of flow in the sewer, and the limitations of each of the assets in the whole system. Underlying the process is a need to understand the capacity of all assets that work together. Using this approach, we can define capacity at a local level.

Performance Measures at a local level are included in Table 2 below. They are generally the same as the national and local objectives for the DWMP. Priorities for the environment are also listed in Table 2 below; our regulator has outlined these in order of importance.

Table 2 - Performance measures and priorities for the environment

Customers	Any incidents which can affect our customers; This may include: • Flooding inside or outside homes and businesses; and • Flooding which can affect roads.
Environment	Prioritising where the most damage could occur which can affect the environment. Considering frequency, intensity and seasonality of events; and This may include: • Protecting environmentally sensitive areas; • Protecting Bathing and amenity waters; and • Protecting other river and coastal waters.

It's also important that we have enough data on assets to feed into an assessment of level of service. We currently have information on sewerage, but for drainage there is information missing. This information is missing because we do not own the assets; they may be owned by a Local Authority, for example. This again highlights the need to work together with others and manage drainage in an integrated way.

Pollution in rivers – where does it come from?

Water pollution in our rivers comes from lots of different sources. There's water from rainfall runoff from agriculture, mining, urban runoff, storm overflow, forestry and roads.

The quality of the water will vary depending on the substances it can pick up as it drains to the rivers contributing to pollution levels.

Think about when there's heavy rain – water runs through soil, litter, and anything else that's been left on our roads and pavements. This can all end up in our rivers causing pollution.

How do we manage river quality?

As a water company, we look at our impact on river and coastal water. We test and report on the quality of water which is discharged from our wastewater treatment works.

In addition, we look at how much of the pollution going into our rivers and coastal waters comes from different sources. This helps us to better understand how our service contributes to the river, and it informs where we may need to focus our investments to help protect the environment.

Climate change may change the water levels in our rivers, particularly during dry summers. This will make it harder to ensure our rivers remain healthy.

Integrated Water Resource Management (IWRM)

This is the term that introduces the concept from the United Nations in support of the sustainability development goal 6. The approach promotes coordinated management and development of water and land in order to maximise economic and social welfare without compromising sustainability of vital ecosystems.

The benefit of drawing on a worldwide approach will allow us to consider threats and opportunities already considered on a worldwide context and consider them within our national context.

As a water company, we must report on our performance against a range of different measures requested by our regulators, Natural Resources Wales, Environment Agency and Ofwat.

As part of the DWMP, we have looked at the level of service we provide to our customers and the environment locally and compared this with our view of what we need to provide to deliver a wastewater network which is fit for the 21st century. This includes dealing with the current concerns such as storm overflows and tackling other issues that allow us to respond to the big challenges we face in the near- and long-term future.

Our overall goal is to ensure that we can achieve the expected level of service in all the areas we operate. This can take a long time and requires very significant investment, many billions of pounds. The DWMP helps us to set out the steps we need to take to reach these destinations. We are proposing the following stages to achieve our environmental and customer destinations:

- We start with the worst problems and focus on fixing them first and also focusing on the area that have a designated status;
- We then move onto the 'next worst' problems until the point at which we have planned how to address all the identified problems; and
- This approach allows us to maximise benefits we can deliver for both customers and the environment jointly, and it ensures we can deliver these benefits as quickly as possible.

To explain Level of service and the milestones to be achieve the graph in Figure 9 shows 3 zones of increasing risk to storms. The blue area is experienced most often at about 240 days in an average year, the green area is experience less often but still for over 115 days in an average year and the 3rd pink area is experienced the least at about 7-10 days in an average year.

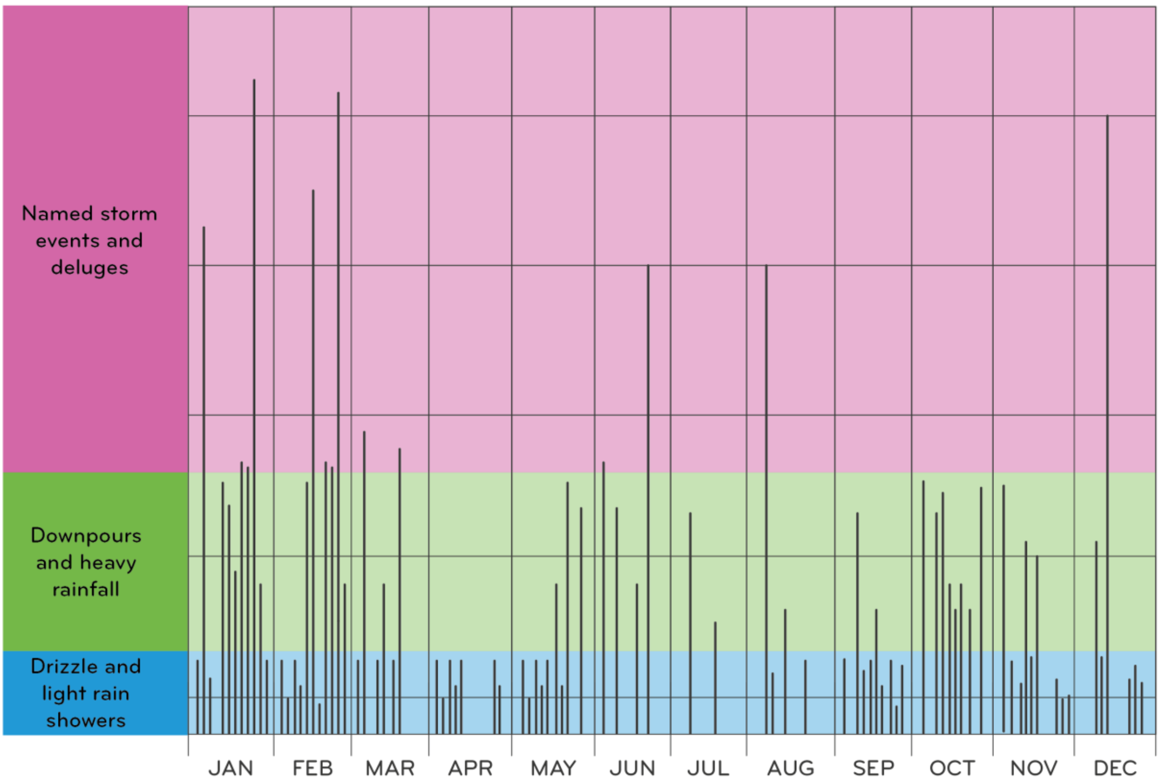


Figure 9 - Idealised graph of rainfall intensity and milestone zones of planning

The speed to achieve the desired Level of Service is limited by affordability and the practicalities of reengineering the drainage systems of communities. The matrix in Figure 10 has been drawn to show how planning priorities will progress. We have started to investigate and create solutions in the top left box marked where there could be perceived to be the most environmental harm in a Special area of conservation (SAC) and where customers experience more than one flood internally to their property. We will then move on to the SAC locations and where customers have or predicted to experience a single internal flood to their property. the matrix is highlighting that we need then to move on to special areas of scientific interest (SSSI) and for the same customer priority and so on until we have plans in place to address each classification of both Environmental priority and customer priority.

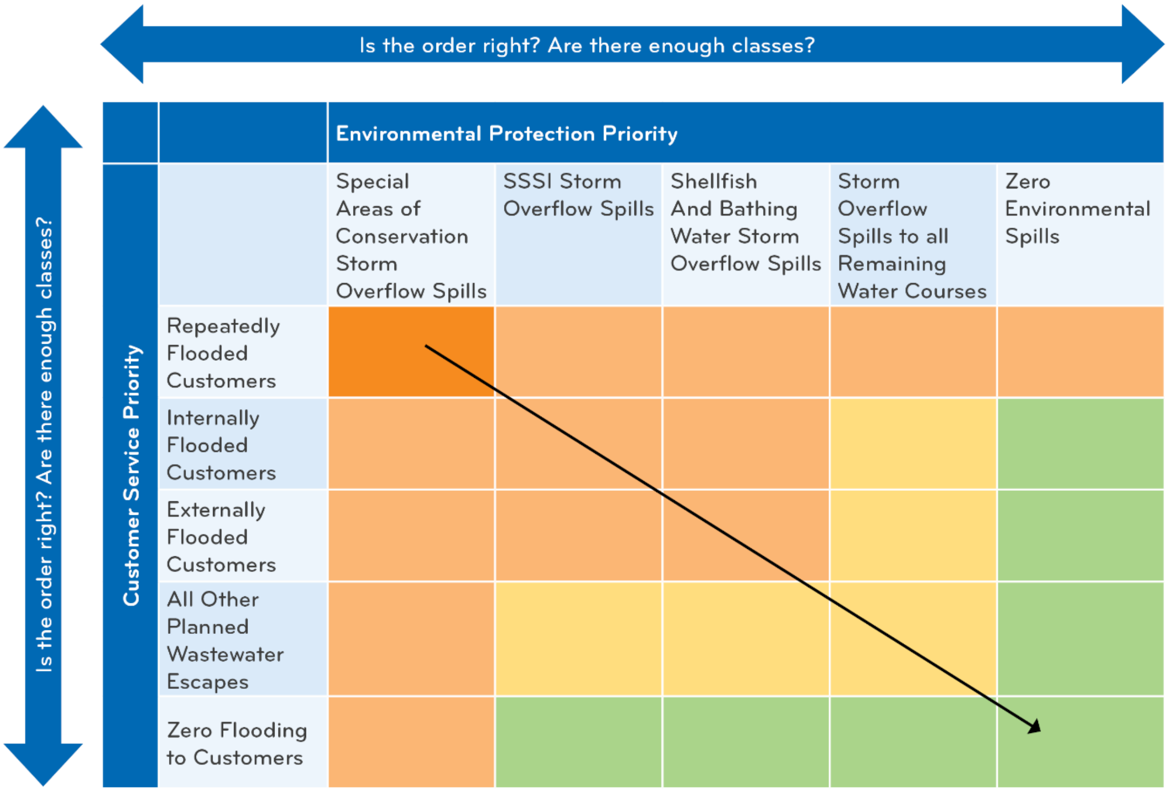


Figure 10 - Order and Priority of planning

It should be noted that where a location has multiple designations the locations have been categorised under the highest designation and other designations within the regions will also be addressed by the plan simultaneously.

How does this relate to the DWMP?

The DWMP is being used to inform and define the level of service based on the capacity of the sewerage and drainage system we are providing now, and what level of service we need to provide in future.

This is different to anything we have been asked to do previously as it is a new obligation under the recently enacted Environment Act 2021 which has asked us to calculate capacity.

1.17 Policy

We have chosen to set our ambitions and believe the right solution should be driven by climate action as well as efficient use of funds. However, we recognise that there are barriers to the delivery of our Plan and the achievement of our goals, which depend on policy change at a Welsh and UK government level. The DWMP has trialled new approaches to achieving our strategic aims and we hope that this will provide government with the evidence it needs to consider new legislation that enables us to achieve our ambitions. Since we acknowledge that this kind of policy change takes time, we have ensured that options that depend on policy change are only considered for delivery 10 years from the commencement of the Plan.

1.18 Governance and Assurance

Internal governance and assurance have been critical to developing a plan of this scale in a way that meets corporate expectation and supports the needs of external stakeholders. This plan has been created in consultation with several local and regional forums, challenge groups, staged review sessions and ultimately Board approval sessions. The Plan has brought with it the need to set up the regulatory assurance process, specifically around the DWMP, in readiness for the statutory phase and all these have now been trialled, tested, and implemented during Cycle 1. The overview of the internal governance process is set out in Table 3 below.

At key stages of the Plan an overview of the process for that stage, together with a high-level summary of the next planned stage, has been provided and feedback sought, which has been incorporated into the Plan. The DWMP team has been keen to use the same presentation material with quarterly challenge groups and internal scrutiny teams in the interests of transparency and consistency. An annual update has been provided to our Quality and Environment Committee (QEC) (a committee of the Glas Cymru Board), to explain progress with the development of the Plan.

Table 3 - Group breakdown and role

Oversight Group	Role Description
DCWW Quality and Safety Committee Approving body	Provides the recommendation to take the Plan to Board and provides company direction and review. This group is chaired by a member of the Glas Cymru Board and provides a scrutiny role over company performance.
DCWW Drainage Policy Group (DPG) Approving body	Provides specific high-level assessment on aspects of drainage policy within the DWMP, including reviews of proposals that align with the Welsh Water 2050 strategy, or set corporate direction. This group is made up of Welsh Water representatives only and is chaired by the managing director of Wastewater, Business Customers and Energy.
Independent Environmental Advisory Panel (IEAP) Advisory body	Provides independent challenge, scrutiny, and advice to Welsh Water to allow us to maximise benefits for customers and the environment. The group includes Welsh Water staff and representatives from external organisations that plan and manage infrastructure, flood and pollution risk and the water environment.
Independent Challenge Group (ICG) Approving body	Helps to ensure that current and future customers are at the heart of the DWMP. Includes Welsh Water staff and external organisations that represent customer views (for example Consumer Council for Water).

DWMP Steering Group Advisory panel	Helps to review and recommend best practice. Includes Welsh Water staff and key stakeholders

There is also a coordinating role at both a UK level and at Welsh Government level. These DWMP steering groups ensure that best practice is shared amongst the water companies as implementation organisations and with all other parties as each has a role to play to bring about the change required to ensure we have a process that is fit for the 21st Century.

1.18.1 Internal Audits

1.18.1.1 Technical Assurance

Along with our partnered consultants, Atkins, RPS and WSP, all technical assessments have been completed in line with industry best practice and latest available guidance. Modelling activities have been completed in line with the CIWEM UDG Code of Practice (CIWEM Urban Drainage Group, 2017). Where existing models have been used for assessments, these have undergone a 'fit for use' assessment and have been strategically upgraded to increase confidence in the outputs. All companies have achieved assurance to ISO9001 and ISO 140001

Other assessments have been carried out to consultant internal assurance processes such as the SEA and HRA which is assured to ISO9001 and ISO140001.

1.18.1.2 Programme assurance

The annual performance review process reviews progress against the performance commitment. In this case to produce the plan in stages culminating in customer level documents for each topic and the main documents as laid out in the Water UK DWMP Framework. These have been carried out annually and reported to the Board as part of annual performance reporting. This includes external assurance by an external auditor.

1.19 How the consultation has influenced the plan

The plan has been revised based on comments from the analysed consultation responses and conclusions made from the customer research. We have, where it was possible, altered our methodology and applied those alterations within the final Plan. Where we need to reflect on requests, develop our approach based on direction from consultation responses or have not been able to address the comment in time to publish this final Plan, we have written our commitment to carry out more work as part of future cycles within Chapter 9 of our Statement of Response to the consultation.

The key highlights are summarised in Table 4 below.

Table 4 - Response to consultation feedback

	Your Comments	Our Actions
1	We want you to continue working with stakeholders and engage at every stage of the Plan.	We have updated our Engagement Strategy to include more detail on how we will work with stakeholders and engage now, and in the future, as the Plan continues to develop.
2	We want to see updates to the DWMP documents as a way of keeping everyone up to date.	Our updated Engagement Strategy sets out how we are:

	We also want to see clear signposting on guidance for customers. There needs to be direct communications for those who request it, including a commitment to working at a local level and involving communities.	• Producing a range of different documents on key areas of the Plan to keep you informed. • Investigating the best options for signposting customers to guidance and initiatives. • Committed to having more direct conversations with stakeholders and working at a more local level to engage with communities.
3	The Plan needs to reflect our comments around legislation, planning processes and guidance.	We have provided more detail to explain how our Plan considers future policy and planning changes.
4	The Plan needs to reflect the DWMP framework.	We have included the framework guiding principles in the final DWMP.
5	We want to see how you have reflected our feedback on risk and risk assessments.	More detail on monitoring change, growth and emissions scenarios, maintenance and resilience has been added to our risk assessments.
6	The Plan needs to have more detail on the option development process, including information on specific aspects such as the priority matrix, solution examples, and the link with river quality.	We have added more detail on how we have developed options including: • Targeted prevention as a risk solution. • Examples of nature-based solutions and community catchment programmes. • More information on the link between options and river quality impacts.
7	There needs to be more detail explaining how your methodology aligns with the Ofwat long-term delivery strategy.	We have added a chapter to the Plan titled ‘Adaptive Planning’ setting out how our methodology aligns with the long-term delivery strategy.
8	We want to see some more detail on the programme around affordability, deliverability, costs, and links with other work, such as pricing reviews.	We have added more detail to the Plan programme on how affordability, deliverability and financing dictate the pace of change. We have added a comparison table of the least cost programme with the best value plan, together with information on how our methodology integrates price reviews, management planning, the NEP and CSO road map.
9	The SEA and HRA needs to reflect our feedback including the addition of a post adoption statement and a review of negatively assessed options.	We have updated the SEA and HRA to reflect comments from the consultation. A post adoption statement has also been prepared. Negatively assessed options have been reviewed with the inclusion provided in the methodology.
10	Will the L2 and L3 summary documents be updated?	We have continued to develop the L2 and L3 area summary documents and added more detail.

11	How is the environmental improvement budget distributed? What about the budget for improving storm overflows?	We have added a chapter to the Plan titled ‘The Review of Consent – the National Environment Programme’ which provides more information in these areas.
12	We would like more detail on the delivery strategy and small zone approach.	We have added a chapter to the Plan titled ‘Our plan’ explaining our delivery strategy and the small zone approach which has been altered to reflect feedback.
13	Some of the wording, terminology and areas of the Plan are difficult to understand.	We have updated wording and terminology in the Plan, and other DWMP documents, to address this feedback.

As part of DWMP29 and in response to the feedback gathered during cycle 1, we aim to:

- Develop an annual update to increase customer awareness in the planning process and prepare them for the development of community level forums from 2030 to 2035.
- Develop further the current suite of customer documents and use these at the end of each stage to keep customers informed of the latest wastewater and drainage progress through bills, posters, and social media.
- Provide information to customers regarding their responsibility to manage wastewater and climate change, including SuDS and ways to reduce blockages, alongside local surgeries currently given by water colleagues.
- Use the Investment strategy again in DWMP29, to manage wastewater and produce plans that manage additional rainfall up to a deluge, always meeting the sewage plan.
- Investigate beneficial options to improve response times when something goes wrong, starting with 'responses to customer flooding during dry weather' and then 'rainfall considered similar to light drizzle.'
- Explore the option to protect a wide area against the impact of storms in an average year in the next plan DWMP29.
- Explore ways to manage customer flooding and prevent floods as emphasized by our customers. Our stakeholders have shown support for managing rainfall separately from sewage and addressing the root causes of issues. We will collaborate with regulators, stakeholders, and customers to investigate solutions towards achieving this goal.
- Address the concerns raised by stakeholders regarding the Wales Better River Quality Taskforce during the consultation. Our goal is to reduce sewer overflow spills, and the DWMP can aid in achieving this by developing strategies to minimize spills into our rivers. As soon as the Taskforce has defined 'ecological harm', we will incorporate our commitment to this objective into DWMP29.
- Work with stakeholders to identify opportunities throughout catchment areas and explore the best means of involving and keeping communities informed while still providing a realistic expectation on delivery.
- Review the approach to SEA and historical sites to consider incorporating additional benefits to solutions to ensure access, build in a sympathetic fashion, and work jointly with historic site owners to support understanding regarding decisions made.

- Produce more examples from the catchments already prioritised to demonstrate how solutions solve the root cause, meet the affordability challenge, ensure the schemes are deliverable, and promote green solutions where possible.

This cycle of the DWMP has been trialling new approaches and methodologies and trying to conclude industry-wide best practice all at the same time. There have also been many differing opinions regarding what a DWMP is and what it provides. As an industry we recognise that management planning and its application to wastewater and drainage still requires many years of continued development between Governments, our regulators, regional and local stakeholders and customers. It is our intention to continue to drive new methods of working and drive best practice by continued joint working at an industry level, while remembering that in Wales we still need to continue to comply with different laws and regulations.

We will strive to ensure that as 'Team Wales' we will drive more efficient investment for our customers and that our investment plans start to bring out what is needed to be done without monetary constraint and then allow the price control process to manage the pace of change, which is highly influenced by the investment capabilities of water companies, councils and Government.

As one of our customers stated at a customer research venue, 'I pay my taxes, my council tax and my water bills. Be efficient with the money.'

We have taken the knowledge provided by our consultation and the work developing our DWMP and used it to prepare our business plan at a strategic level. This DWMP has confirmed that the programmes of work that we are putting forward are supported by our customers and stakeholders, and that the journey plans which were updated following the consultation now contain the focus of programmes that need to be delivered continually to drive change.

We will develop further the current suite of customer documents and use these at the end of each stage to keep our customers informed of the latest wastewater and drainage progress.

1.19.1 Endorsement from our regulators, consultees and customers

We were commended on our draft Plan, and it was acknowledged that the Plan includes a large extent of detail.

It was suggested that we carry out continued engagement and development of the plan with others.

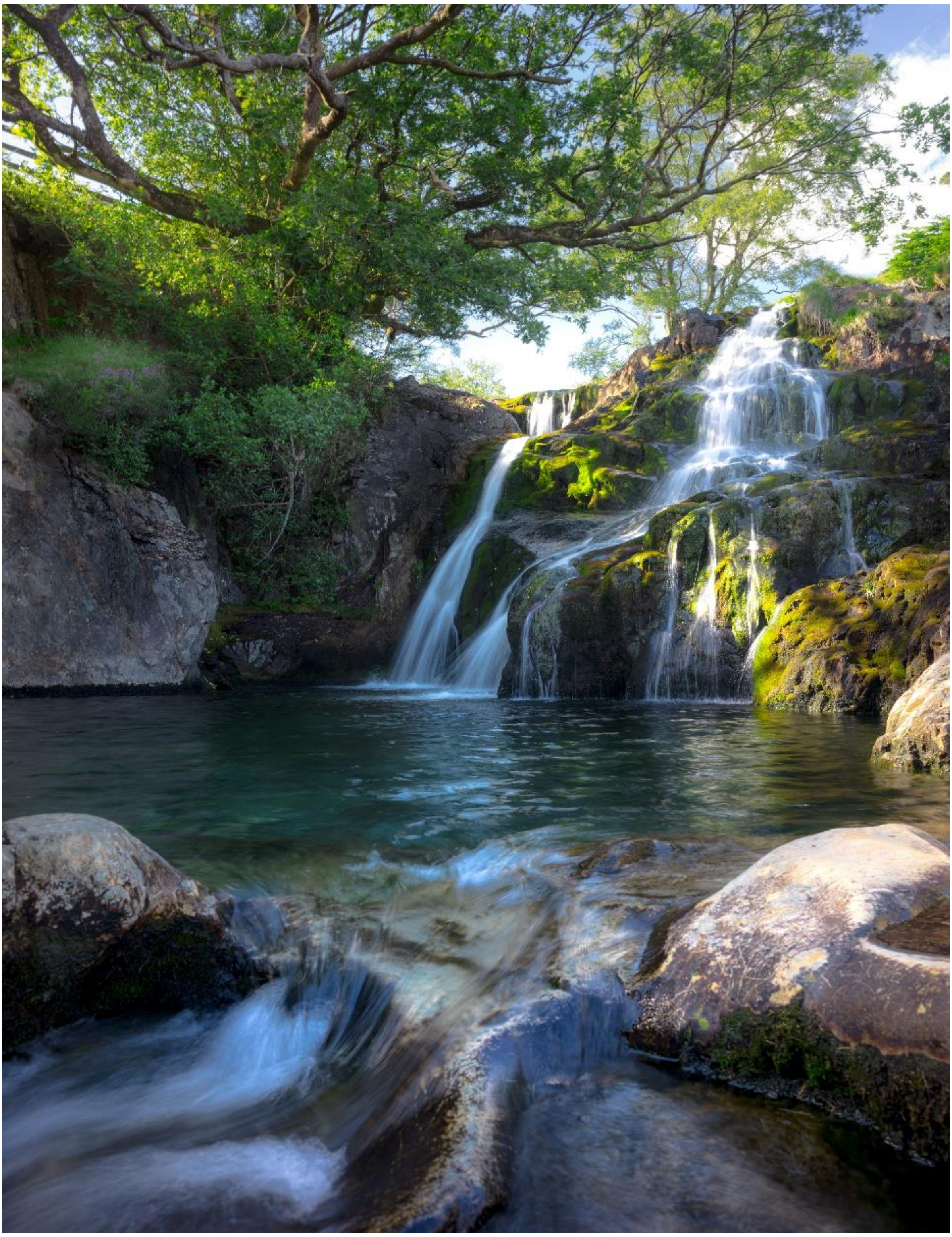
As part of our next steps in engaging with stakeholders, we will investigate the relationship between town councils and country councils with regards flooding and pollution and how they interact with one another.

We will also work closely with Welsh Government to develop resources, processes and legislation to enable us to create co-funded solutions more easily.

1.19.2 Affordability

Customers and stakeholders agreed with our approach to continue to work with them to explore how to create affordable incremental plans with agreed increments based on the DWMP24. We will continue to engage proactively and explore opportunities to provide more detailed examples using joint trials to provide real life examples to aid understanding and demonstrate incremental adaptive planning.

2 Strategic Context



Snowdon Watkin Path Waterfall
Photo by [Daniel Seßler](#) on [Unsplash](#)

2.1 DWMP Framework

The DWMP approach has been developed with several key stakeholders within the water and drainage sector and builds on the principles outlined in the Drainage Strategy Framework of 2013 (Ofwat, 2013). To align with the processes being adopted by the rest of the water industry we have based our approach on the DWMP guidance, published by Water UK (2018), and we have also integrated the best parts of Water Resources management planning processes from the 2020 Guidance (EA/NRW/OWS, 2020), whilst adapting our approach in Wales to align with the Welsh policy priorities of, for example, the Wellbeing of Future Generations Act and the Environment (Wales) Act. The overall process steps, as presented in the Water UK framework, are outlined in the schematic in Figure 11.

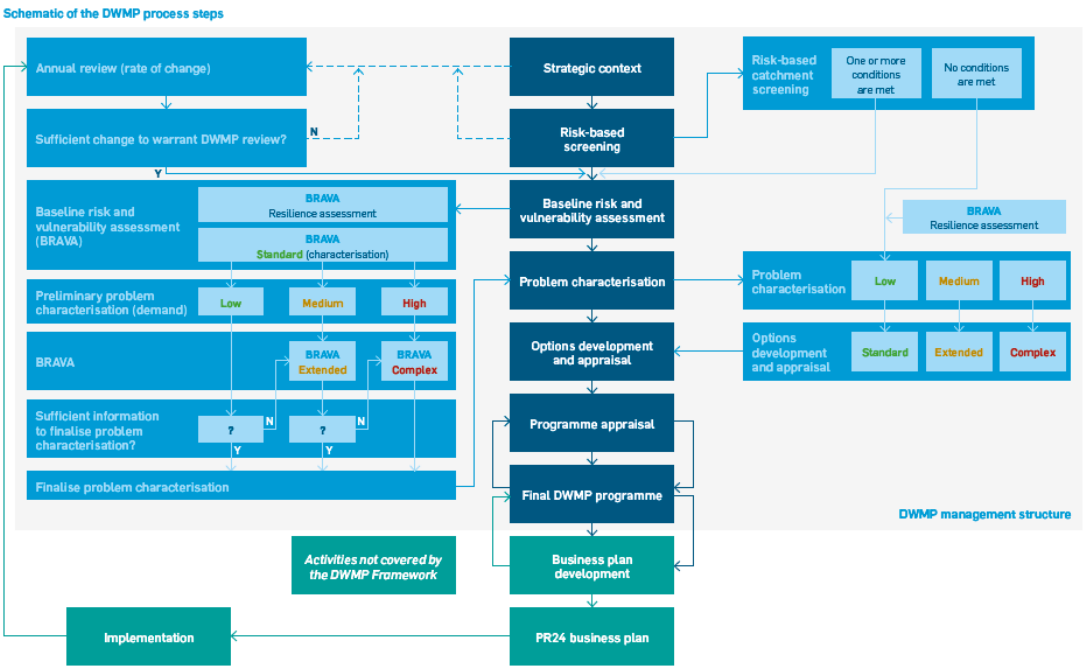


Figure 11 - Water UK DWMP Framework

This first cycle of the DWMP will provide a mechanism to convert our previous methods of wastewater planning (our Sustainable Drainage Plans) to the national approach set out in the DWMP Water UK Framework.

We have reviewed how we previously produced our long-term wastewater plans, together with the tools and techniques used. To supplement those techniques, we have developed and applied innovative new approaches, not previously utilised in wastewater planning. These include approaches that have been developed by the UK water industry for water resource management planning.

Whilst this framework is new to us, the entire process of collaboratively developing long-term wastewater plans is new to our stakeholders, regulators, and Government. We are currently working to finalise the procedures that we have been trialling and applying during this cycle, approaches that we will then develop and refine in Cycle 2 of the DWMP (2023 to 2029).

The Plan consists of five stages listed in

Table 5 below. Further details on each of these framework steps can be found in the later sections of this report:

Table 5 - Stages of the DWMP

Strategic Context	The first stage in the DWMP planning process identifies the big issues faced now, and in the future, as well as actions to address them. In 2019 we undertook Stage 1 'Objective Setting'. We opened the new plan for pre-consultation discussions which will continue all the way through the process and will start again in 2023 for cycle 2.
Risk Assessment	The Risk Assessment stage outlines information about drainage and wastewater issues that are already being experienced or have been identified. It will also analyse current and future risks and their causes. In 2020 we undertook Stage 2 'Risk Assessment'. We reviewed current performance and assessed future risks and aligned risks with other organisations risks. This stage will start again 2024 for cycle 2.
Options Development	The Options Development stage outlines the process of developing solutions to address the risks and their degree of uncertainty. In 2021-22 we undertook Stage 3 'Options Development and Environmental Assessment'. We developed options and created opportunities to work with others to reduce the risks found in stage 2. We carried out a consultation of the SEA and HRA and undertook environmental assessments to understand impacts to habitats, etc. and will start again in 2025 for cycle 2.
Programme Appraisal	The Programme Appraisal stage takes the preferred suite of solutions and assesses for various programmes and pace over the life of the Plan. In 2022 we undertook Stage 4 'Programme Appraisal'. We created a preferred set of solutions from the options and developed and prioritised those solutions over the life of the Plan. This will start again in 2026.
Draft DWMP and Final DWMP	Publishing the Draft DWMP for public consultation. In 2022 and 2023 we undertook stage 5 'Consultation period'. We carried out our public consultation of the draft DWMP in 2022. This involved public consultation with stakeholders, regulators and customers. Customers were also consulted via customer research.
	In 2023 we are publishing the final Plan, taking account of Government endorsement after taking account of the Statement of Response, plus the SEA and HRA and the post adoption statement of the SEA. This will start again in 2027/2028.

At the end of each cycle, Welsh Government reviews our Plan and gives its permission to publish if the Plan has met Government direction.

In addition to these stages, once the first Plan has been published, and annual review of progress against the published Plan will be undertaken. This takes place on the anniversary of the Plan publication date.

As with all new approaches, there will be a period of settling in and it is anticipated that during the first and second cycles there will be ongoing review of, and challenge to, the new methods, including a drive for further national consistency.

At the outset of our first cycle plan we committed to an iterative process, focused on our highest risk areas but recognising that it may take generations for customers to afford the infrastructure changes needed to continue to deliver a resilient drainage and wastewater service. This long-term approach addresses the historical legacies the industry faces, such as Victorian built sewers and the significant length of combined sewers and associated storm overflows.

2.2 The DWMP Guiding Principles

In February 2022, the UK government issued its ‘Guiding principles for drainage and wastewater management plans’ (Governments, 2022). The document set out the priorities and expectations of the UK and Welsh Governments, Ofwat, NRW and the EA over how the first, non-statutory, cycle of the DWMP would be produced. It also set out a vision for how future cycles of the plan would be delivered, setting the scene for our preparations for cycle 2.

It set out a clear expectation on other stakeholders, that they will participate fully in the development of and consultation on the DWMP, despite there also being no statutory requirement mandating their contribution to the process.

We have had regard to the guiding principles in the development of the DWMP but accept that the timing of their introduction has been too late to significantly influence the approach we have taken with the DWMP steps outlined in the previous section.

The principles have been reproduced in Table 6 directly from the updated August 2022 version published on the Government’s website.

Table 6 - DWMP guiding principles.

Key Principle	How we have incorporated these into our plan
1. Be comprehensive, evidence based and transparent in assessing, as far as possible, current capacity and actions needed in 5, 10 and minimum 25-year periods considering risks and issues such as climate change. Plans should also align, as far as possible, with other strategic and policy planning tools.	We have carried out several high-level capacity assessments, using the supply demand approach as the first step to determine if the wastewater treatment works can handle the total network volume during dry weather flow. This assessment is carried out every five years between 2020 and 2050. Additionally, we have performed the same assessment using four design storms for the same time periods, incorporating Growth and Demand reductions from the WRMP to align with the priorities outlined in publications by Welsh Government and NRW.

2. Strive to deliver resilient systems - that will meet operational and other pressures and minimise system failures.	In response to feedback from our customers and stakeholders, we have incorporated operational buffers into our plan by increasing the capacity of our network. This will allow us to react quickly and minimise any issues experienced by our customers. We are committed to continuously exploring opportunities to further enhance our customer service, which will be factored into our supply demand analysis through the use of Headroom, as well as in a general capacity assessment at company level.
3. Consider the impact of drainage systems on immediate and wider environmental outcomes including habitats and in developing options for preventative measures to include consideration of environmental net gain and enhancement	We have considered whether the framework supports the development of options that can be funded for preventative measures. We have addressed this by introducing a review of consents approach at a catchment scale. The introduction of the approach with support from our environmental regulator can bring together the forecast risks in a process that then can highlight the preventative measures to bring about environmental enhancement.
4. Be collaborative - recognising the importance of sectors working together to consider current and future risks and needs and to deliver effective solutions, setting out how they will do this, how they have engaged with and responded to stakeholders.	Throughout the development of our plan, we have engaged with stakeholders and key partners. Through these interactions, we have gained valuable insights into how we can work together to maximise the benefits of the DWMP for our respective organisations and communities. We have also identified barriers that need to be addressed, such as planning restrictions. While we acknowledge that collaboration requires time and resources (including staff), we remain committed to pursuing our shared goals. We will continue to lead on the development of opportunities and where opportunities overlap, we will look to progress solutions earlier.
5. Show leadership - in considering the big picture for an organisation's operational capacity to develop and deliver the plan, and mindful of linkages with other strategic planning frameworks.	As part of our efforts to improve drainage planning, we have led the development of a National Drainage Programme. We will take on the role of project management as the primary planning lead for all lower return period storms. In addition, we will advocate for new legislation to establish a joint long-term planning function, which will enable us to prepare pipelines of solutions well in advance of delivery. By doing so, we can help meet the Government's funding requirements for drainage overall.
6. Improve customer outcomes and awareness and that solutions and actions provide both value for money and consider societal benefits	We have trialled our detailed approach and we now have a methodology that will show customers the locations where schemes are required in order to meet their expectations and ambitions. Our methodology takes into account the unique characteristics of each area and recommends solutions that are best suited to address their specific needs. In some cases, traditional solutions may be appropriate, while other areas may benefit

	from more sustainable, environmentally friendly alternatives. These solutions are assessed based on their cost-effectiveness and potential societal benefits. We need time to continue to use this methodology to target more areas.
7. For Welsh companies, DWMPs should also demonstrate how they have been developed in line with the behaviours set out in the Wellbeing of Future Generations Act 2015, and how they will contribute towards the wellbeing outcomes. DWMPs should also set out how they will help the water companies and their stakeholders deliver their obligations under the Environment (Wales) Act 2016.'	We have worked collaboratively with our stakeholders to seek shared, long-term solutions for the benefit of the current and future generations and have ensured inclusivity in the stakeholders and customers we have collaborated with. Our customer research included a wide cross-section of society; our public facing materials are produced in formats that are available to all and are available in both Welsh and English.

2.3 Government and Ofwat expectations

2.3.1 Welsh Government Water Strategy for Wales

The Water Strategy for Wales (Government W. , 2015) was produced in 2015 and set out the Water Strategy or Wales Action Plan. It set out the key action relating to this plan as:

> *"We will establish a framework to identify any evidence, data or regulatory gaps and consider how these might be addressed to ensure that the sewerage undertakers, regulators and other key stakeholders have the correct tools to assist them in the management of our sewerage and drainage systems."*

We have been working with Government since the DWMP was introduced to address this action.

The Strategic Priorities and Objectives statement for Ofwat (SPS) (Government W. , 2022) was published on 6 July 2022. The SPS has five priorities

- Climate and Nature emergencies;
- Environment;
- Resilience;
- Asset Health; and
- Customer and community.

The document sets out how Ofwat is to carry out its function

- Embed the objectives and priorities set out in the SPS throughout its regulation of companies operating wholly or mainly in Wales.
- Set out how the relevant activities in its forward work programme deliver against the government's expectations and strategic priorities.
- Set out how its major decisions consider the specific circumstances of Wales and are consistent with government's expectations and priorities, for example, when establishing

the methodology for price reviews, publishing draft and final determinations or proposals for change to the regulatory framework.
- Have an effective framework to hold companies to account within its statutory remit.

2.3.2 Ofwat interpretation of Welsh Government direction to Ofwat

Ofwat's summary of Welsh Government's strategic objectives taken from PR24 methodology Creating tomorrow, together, Delivering Welsh Government Priorities for the Welsh water sector through our 2024 price review final methodology (OFWAT, 2022) and reproduced below:

- adopt an outcome focused approach that promotes an appropriate focus on addressing long-term risks, safeguarding long-term resilience and performance and ensuring that the timing of investment results in intergenerational equity;
- pursue a preventative approach by encouraging companies to understand and consider how problems could be addressed at source;
- deliver value for money for customers, communities and the environment and challenge companies to provide sustainable and effective support to vulnerable customers and customers who are struggling to pay;
- challenge companies to deliver best value solutions by encouraging investment that responds to multiple drivers or has multiple benefits and that takes account of outcomes and the wider environmental and social value of solutions;
- encourage companies to meaningfully involve, engage with and take account of the views of customers and stakeholders on long term outcomes, priorities and pace of delivery, and use effective collaboration to maximise the impact and effectiveness of regulation;
- deliver a cohesive and transparent regulatory framework that, taken as a whole, is proportionate, effective, transparent and efficient and challenges companies to provide clear and compelling evidence to underpin their investment plans; and
- challenge companies to seek new ways of working to deliver for customers and the environment more efficiently.

The document goes on to say through WRMPs and DWMPs, Ofwat expects companies to:

- Consider a wide range of options that mitigate the risks identified, including nature-based solutions, catchment-scale schemes and traditional grey infrastructure interventions.
- Demonstrate that adjustments to operational and maintenance regimes have been implemented before exploring enhancement options;
- Fully consider interdependencies with other stakeholders' strategic and opportunities for partnership working, including co-funding and co-delivery; and
- Make efficient use of current technology, such as smart metering, and investigate the use of emerging technology including smart data and networks.

2.3.3 Ofwat letter Expectations for strategic planning frameworks Nov. 2021

Ofwat sent a letter to the regulatory direction on the 17th of November 2021 providing additional information for companies to consider in the price review 2024 (PR24). The letter does not replace guidance but reinforces key areas from an Ofwat perspective. Which are reproduced below

To develop the best long-term strategies and business plans, companies need to:

- Engage effectively with regulators, customers and stakeholders throughout the development of plans under existing planning frameworks.
- Show continuity of planning by linking with, and where necessary, explaining the evolution of, previous long-term plans and setting out adaptive plans to reflect best value delivery into an uncertain future.
- Identify the most efficient ways to deliver best value over the long term, including partnership funding where appropriate.
- Support decisions by using common scenarios (and wider scenario planning as appropriate) using consistent data across all relevant frameworks.

The key areas expected to be incorporated and addressed through DWMP24 are

- Identification of optimised long-term programmes using long-term targets;
- Full consideration of a wide range of options to meet long-term challenges;
- Development of a best value plan using efficient costs and robust valuation of benefits;
- Presentation of an adaptive plan to address known issues and future uncertainties tested against a suitable range of scenarios; and
- Demonstration that stakeholder and customer views have been taken into account, and that partnership opportunities have been identified to enable co-funding and codelivery.

2.3.4 Ofwat Strategic Planning frameworks

The Key principles Ofwat set out in November 2021 are listed below in Table 7 and we show below how we have interpreted these into our plan.

Table 7 - Ofwat Key Principles

Key Principle	How we have incorporated these into our plan
1. Identification of optimised long-term programmes using long-term targets;	*We have used the framework to identify where to concentrate our priority assessment using the extended and complex decision at post risk assessment problem characterisation. For these highest priority sites and a small sample of lower priority sites for comparison we have developed suites of solutions that address risks between 2025 to 2030, 2030 to 2050 and 2025 to 2050 with both a least cost and preferred plans to support our decisions regarding best value. These have been optimised by Cost and Benefit using the Average incremental cost and Average incremental and social cost process originated from the WRMP past guides.*
2. Full consideration of a wide range of options to meet long-term challenges;	*We have at all sites considered the original long list from the DWMP Framework and developed this further by creating subcategory options taking the number to 83 possibilities. For every Level 4 catchment we have whittled these choices down to a short list. These have been used to create the journey plans at Level 3 TPU. Then for the extended and complex level 4 sites we have continued to drill down into the detail to produce the suites of solutions.*
3. Development of a best value plan using efficient costs and robust valuation of benefits;	*We have addressed this requirement by ensuring that our solutions link to our costing tool the Unit Cost Database. To ensure that all solutions are*

	comparable we have applied a single design storm to assess all storage solutions and time series rainfall for pollution risk. We have calculated the environmental benefit using the B£ST Tool. By doing this the cost versus benefit is standardised and varying risk from differing storm return periods is removed.
4. Presentation of an adaptive plan to address known issues and future uncertainties tested against a suitable range of scenarios; and	*We have created at a company level an adaptive plan using the long-term delivery strategy which was published as part of the Price review.*
5. Demonstration that stakeholder and customer views have been taken into account, and that partnership opportunities have been identified to enable co-funding and codelivery.	*We have put customer at the heart of our plan. At the outset we took the opportunity to ask our customers what they were willing to support. It was important to us that we applied a customer direction steer as part of the first ever plan. We have followed this us with a second research project that forms the customer voice during the public consultation and also sets the direction for the second plan DWMP29 completing the customer strategic direction phase. We have created opportunities for partnership within the plan itself. With 2 programmes of work covering SuDS for Schools and SW removal for Public Spaces. Both these programmes are multi-AMP programmes and will continue to be worked through in detail with our council and Government Organisation that own land and buildings as part of do what I do approach to retrofitting to resolve drainage and flooding. We will also include our own land and buildings in this approach to aid demonstration of retrofitting opportunities. Stakeholder engagement and partnership working is already a foundation in our approach what the DWMP will bring is transparency and consistency of approach to ensure that customer benefit from the approach that works for their area.*

2.3.5 Ofwat PR24 Welsh sector Priorities for a Long-Term delivery strategy

Ofwat's key 5-part requirements for the development of long term delivery strategies

- Ambition: what the company aims to achieve over the next 25 years;
- Strategy: how the company will aim to meet this ambition over the next 25 years;
- Rationale: why the long-term delivery strategy represents the best way of meeting the ambition;
- Foundation: the key assumptions and uncertainties underpinning the strategy; and
- Board assurance: how the company Board has challenged management to deliver a high-quality long-term delivery strategy.

2.4 DWMP Planning objectives

2.4.1 Introduction

During the strategic context phase, we discussed the common and company planning objectives with our stakeholders. It was noted almost immediately that they were very much Water Company specific and did not really apply to stakeholders. There were, however, our regulatory process which our regulators Ofwat and EA/NRW monitor us against. This automatically moved us away from company specific planning objectives and brought the plan to a more strategic level of themes.

To comply with our regulators, we also had to choose planning objectives (PO) to measure risk across the Company area. The POs adopted by DCWW are a combination of nationally derived common planning objectives to allow for industry comparison, supported by a series of local objectives which are bespoke to the priorities of our stakeholders and customers. We have chosen to align the local objectives with the PR19 Business Plan planning objectives as at the time of this phase of DWMP development PR24 had not commenced.

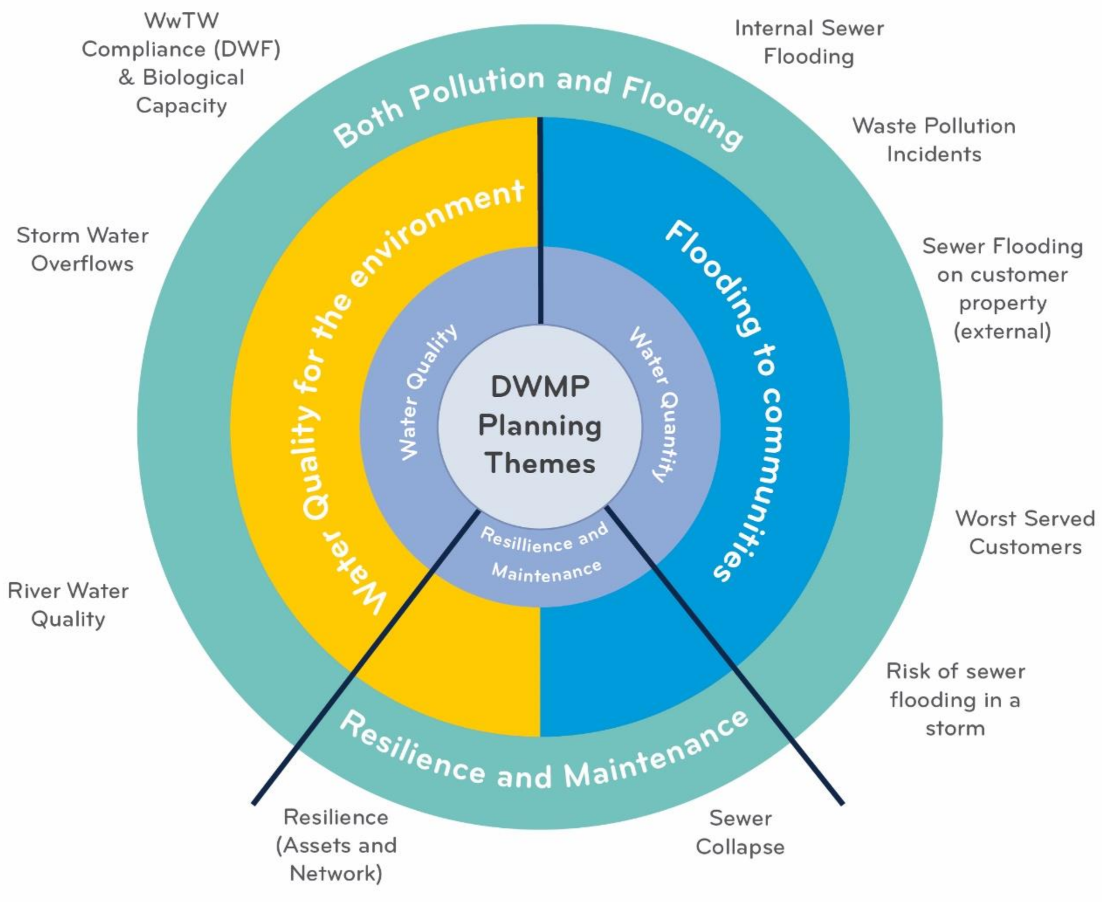


Figure 12 - Objectives Plan

We combined the Regulatory planning objectives with the themes to help communicate these POs clearly to external stakeholders and customers. These themes are grouped under three headings – **water quality**, **water quantity** and **resilience and maintenance** (Figure 12). The stakeholder title for Water Quality is “Improve Water quality for the environment” and for Water Quantity “Reduce flooding for communities”. Resilience and maintenance are a company asset driven requirement so does not have a stakeholder theme as stakeholders consider this as part of a water company activity. By aligning with the Company targets already set out in the business plan and Welsh Water 2050, we maintain continuity in messaging to customers and stakeholders. It also means that the DWMP will act as a roadmap to 2050 for the issues which have already been highlighted as long-term Company strategic responses to the challenges it anticipates.

Each of the planning objectives have a detailed definition and assessment approach. This ensures that we can accurately and robustly assess our performance against each of the objectives, and our regulator can compare our results with those of other companies.

The Common Objectives that have been requested by the Water UK Steering group are:

- Risk of sewer flooding in a severe storm (1 in 50-year storm)
- Internal sewer flooding
- Storm Overflow Performance
- Risk of wastewater treatment works quality compliance failure
- Pollution Risk
- Sewer Collapse

These are included in Figure 12 and form the basis of the results at a theme level.

We want to deliver continuous improvement across Wales and the borders which have different characteristics, such as high mountains or steep sided valleys and flat plains.

There are also new requirements for water companies outlined in the Environment Act highlighting the importance of having a robust understanding of the capacity of sewerage and drainage systems. The Framework was not created to do this.

We have developed a process for the Plan that aligns with the Water Resource Management Plan with the aim that this will allow us to target priority areas at a catchment level before having to analyse each individual planning objective. It allows us to monitor progress easier and carry out this assessment on an annual basis.

2.4.2 Defining DCWW Planning Objectives

Table 8 shows the planning objectives at the national level which are common across water companies in England and Wales.

Table 8 - National Planning Objectives

National planning objectives	Report 2020	Report 2050
Internal sewer flooding risk	✓	✗*
Pollution risk	✓	✗*
Risk of sewer flooding in a 1 in 50-year storm	✓	✓
Sewer collapse	✓	✗*
Storm overflow performance	✓	✓
WwTW compliance	✓	✓

*The national planning objectives have been designed for specific time horizons. All 6 planning Objectives are evaluated for 2020 but on X are not calculated for 2050 within Cycle 1.

Table 9, below, shows both the national and local planning objectives which are reported for each design horizon to 2050. Ofwat has defined parts of a water company's assets under specific business plans. Wastewater is split into 2 business plans Wastewater Network Plus and Biosolids which cover Sludge Management. This is a Wastewater Network Plus plan which covers assets under Wastewater Network Plus price control, this means that the DWMP will consider sewers, WwTWs and outfalls but the assessment will not consider biosolids in this first cycle. This approach has been adopted by other UK water and sewerage companies within their DWMP process. Biosolids may be included in future cycles of the DWMP depending on direction from Government.

Table 9 - DCWW Planning Objective Action Plan

Water Quality	Water Quantity	Resilience & Maintenance
WwTW Compliance (DWF & Biological capacity) Storm Overflow Performance	Worst Served Customers (HO) * Internal Sewer Flooding (HO) External Sewer Flooding (HO) * Waste Pollution Incidents (HO) Risk of Flooding in Severe Storm	Asset Resilience Wastewater (above ground))* Asset Resilience Wastewater (below ground) * Sewer Collapses Waste Pollution Incidents (OC) Internal Sewer Flooding (OC) External Sewer Flooding (OC) * Worst Served Customers (OC) *

* Local Planning Objectives

Each of the specific POs has a detailed definition, assessment methodology and approach. This enables the robust quantification and qualification of performance of each PO during each of the time horizons assessed as part of the DWMP. Table 10 below shows Planning Objectives with descriptions.

Table 10 - DCWW Planning Objectives with description and units

<table>
<tr><th colspan="2">Planning Objective</th><th>Description</th><th>Units</th></tr>
<tr><td colspan="4">Water Quality</td></tr>
<tr><td>National</td><td>WwTW Compliance DWF / Biological Capacity</td><td>STW Numeric performance limit compliance</td><td>% of population served</td></tr>
<tr><td>National</td><td>Storm Overflow Performance</td><td>Assessment of spill performance based on annual rainfall</td><td>Spill Count</td></tr>
<tr><td colspan="4">Water Quantity</td></tr>
<tr><td>National / Local</td><td>Internal Sewer Flooding (HO)</td><td>Properties affected by flood waters as a result of hydraulic overload conditions</td><td rowspan="4">Property Count</td></tr>
<tr><td>National / Local</td><td>Internal Sewer Flooding (OC)</td><td>Properties affected by flood waters as a result of causes other than hydraulic overload</td></tr>
<tr><td>National / Local</td><td>External Flooding (HO)</td><td>Property curtilage affected by flood waters as a result of hydraulic overload conditions</td></tr>
<tr><td>National / Local</td><td>External Flooding (OC)</td><td>Properties curtilage affected by flood waters as a result of causes other than hydraulic overload</td></tr>
<tr><td>National</td><td>Wastewater Resilience</td><td>Risk of flooding in a 1 in 50-year storm affecting population</td><td>% Resident Population</td></tr>
</table>

Planning Objective		Description	Units
Local	Worst Served Customers – Waste (HO)	Risk of repeat internal or serious external flooding as a result of hydraulic overload	Property Count
Local	Worst Served Customers – Waste (OC)	Risk of repeat internal or serious external flooding as a result of causes other than hydraulic overload	Property Count
Resilience and Maintenance			
National / Local	Waste Pollution Incidents (HO)	Pollution incidents as reported by EA/NRW (Category 1-3)	Incident Count
National / Local	Waste Pollution Incidents (OC)		
National	Sewer Collapses	Where structural deterioration has caused a collapse resulting in service failure	Incident Count
Local	Asset Resilience (above ground)	Assets assessed against a pre-defined set of resilience criteria	% score
Local	Asset Resilience (below ground)	Assets assessed against a pre-defined set of resilience criteria	% score

2.4.3 DCWW planning objectives

Every water and sewerage company has created targets and planning objectives, which are used to manage performance. These planning objectives are often company-level performance indicators and relate to the number of events, such as the number of environmental pollution incidents, or internal flooding events. In this first DWMP it was important to establish both an Environmental Destination and a Customer Destination which brings together all other planning objectives in a locality. This led to the creation of a themed approach to planning. Our Strategic Responses (see section 2.6.1 (Welsh Water 2050)) were merged to form **three objectives** for wastewater management planning which are:

- **Water Quantity** - Reduce the risk of (internal and external) flooding to communities
- **Water Quality** – Improving water quality for the environment
- **Resilience & Maintenance** - Adaptiveness to change while maintaining critical services and protecting the environment

Together, they will help achieve the **Welsh Water Vision** to 'earn the trust of our customers everyday' and our **Mission Statement** 'To become a truly world class, resilient and sustainable water service for the benefit of future generations'.

It is noteworthy at this point to bring in the concept that the Management plan does not inform the business of maintenance activities per se, however, the DWMP states that a level of maintenance is required on which the plan needs to prepare growth creep and climate change decisions on and then build in an element of resilience to that decision.

2.4.4 How Planning Objectives link to the themes and why customers and stakeholders support the approach

Our plan development was heavily influenced by customer research, to the point where we condensed industry planning objectives into three simple themes. This approach also proved effective in our initial engagement with stakeholder groups prior to Covid, allowing for a shared understanding from diverse perspectives. Our Strategic Context document demonstrated how the Themed Objectives aligned with Planning Objectives to create actionable plans. We made this modification to our plan based on customer feedback that highlighted a lack of knowledge surrounding wastewater and drainage. In response, we prioritised making our plan easy to understand.

2.4.5 Linking Themes and Strategies to Planning Objectives

As the plan developed it was noted that Planning in a detailed planning objective approach required intensive modelling and did not answer the main question asked throughout the development which was Where are we going? What does Solve the problem mean? And would not bring about change in a way the WRMP had done during its early development phases.

It should be noted here that this is the first Cycle of DWMP. In comparison with WRMP the maturity of the process is low and as such there is a need for more time to evolve during PR24 to ensure that the framework provides more alignment between performance measures and risks that could present in the future and both solutions to resolve current risk and those only aimed at future risks are considered as part of plan progression and resolved in a planned programme over time.

2.4.5.1 Engaging with our customers in the development of our Plan

We are committed to bringing the voice of customers into the heart of our business and the DWMP. We want to understand the views of our customers on key parts of the plan, particularly in terms of how quickly we make improvements as this will impact on their bills.

We have particularly ensured early research and ongoing engagement to provide opportunities for customers to help shape the development and speed of changes of the Plan.

We have also met regularly with the Customer Challenge Group who are an independent group of individuals from organisations that supply scrutiny of our plans from a customer point of view.

Throughout the development of the plan, we have worked closely with our customers through a series of research sessions. These sessions have informed us of customer awareness, expectations, and support for different options.

This has fed into the development of the Plan, ensuring that the outcomes are in the best interests of both existing customers and future generations who will benefit from it.

Our findings show a strong link between customer priorities and our objectives for the Plan; these include planning for the long term, acting in an environmentally friendly way and providing good value for money.

2.5 Plan direction and planning background

The DWMP sets out to manage both Sewage and drainage, to do this there is a need to understand the components of flow and their impact on water quality, sources of flow and owners of drainage, i.e. the water cycle at a hydrology level as well as understanding how a sewage catchment works and who is responsible for their upkeep. This evaluation can follow the principles of a mass balance equation, reviewing inputs and outputs to define base conditions as illustrated in Figure 13.

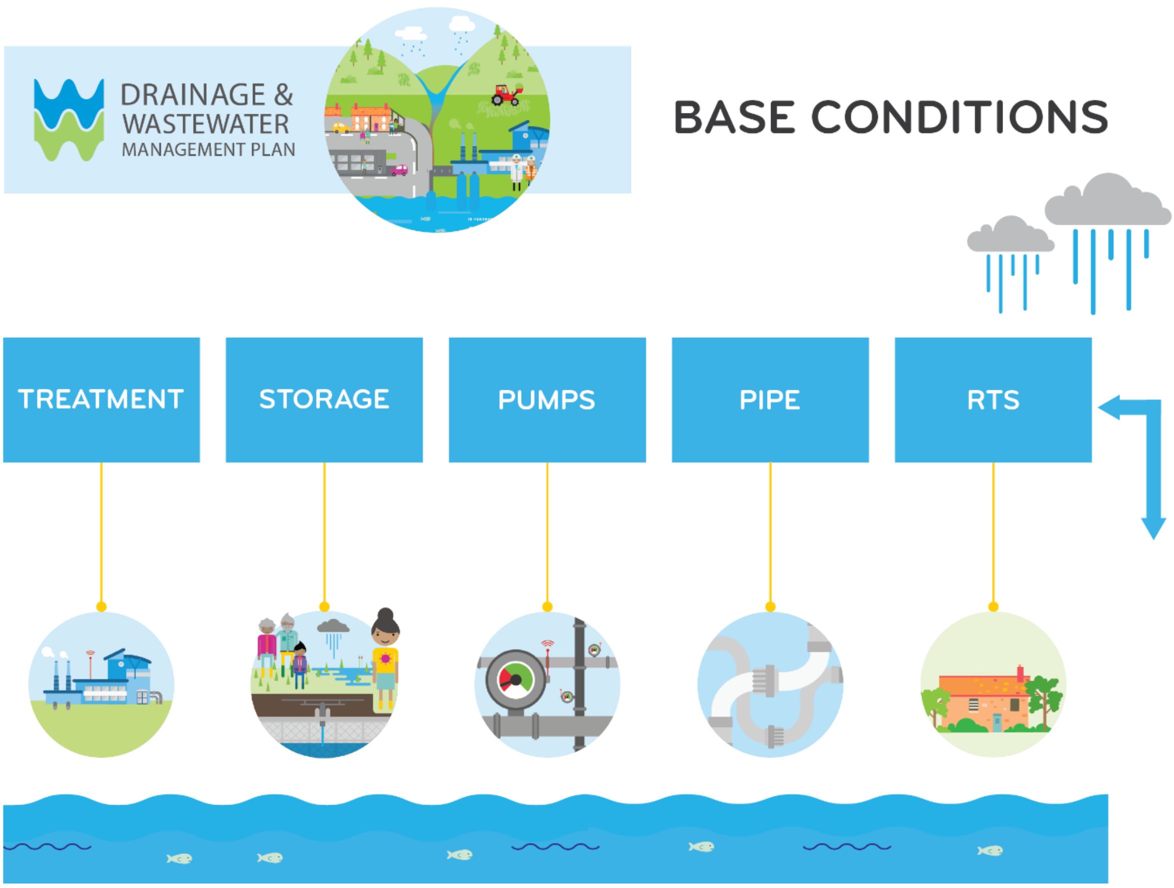


Figure 13 - Base Conditions

When the water cycle is considered as a whole, both the natural and artificial drainage systems can be assessed separately and together starting with the critical constraint which inevitably will be the ability of the river to dilute and disperse effluent and runoff. The current or baseline conditions can be assessed, and a simple relationship developed to undertake incremental change.

This evaluation enables each of the components of sewerage and drainage systems to be reviewed and their impact on network and environmental capacity to be assessed and proposals put in place to achieve a future outcome or destination. We have defined the destination, which brings together both a customer journey and an environmental journey that ends in a system fit for the 21st century. The destination is not to be thought of as something that can be achieved in a couple of decades but something to be achieved by the turn of this century. The long-term destinations for customers and the environment are:

- **Customer destination** is a time in the future when customers will no longer have flooding from sewage inside their homes that is due to the capacity of the network.
- **Environmental destination** is a time in the future when our rivers and seas receive water from our sewerage system that is fit for biodiversity and ecology.

The critical aspect of this mass balance concept to deliver against the two destinations, is ensuring that the options proposed are both affordable, deliverable, wanted and achievable, whilst delivering the needs of the catchment.

To drive this approach, the principle of Risk Management has been adopted. This enables a balance between different service priorities. The principle is based on incrementally assessing the risks to those considered a lower level of service and then taking them through the DWMP processes first. The matrix in Figure 14 combines the customer service priorities identified by the planning objectives in one direction with the environmental priorities based on the protected status of a water body in another and ensures that both priorities are addressed at each plan iteration. This is to ensure that a balanced plan is created that is always concentrating on the highest priorities.

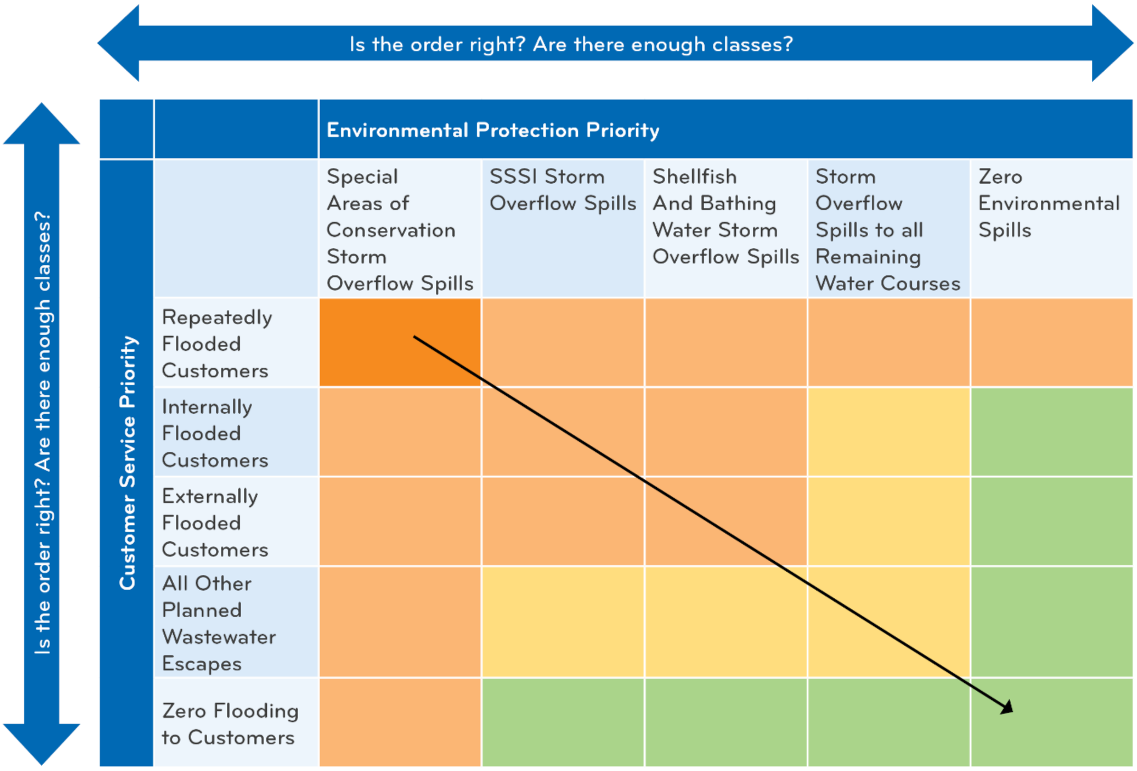


Figure 14 - Priority Matrix Principle

It should be noted that where a location has multiple designations the locations has been categorised under the highest designation and other designations within the location will also be addressed by the plan simultaneously. This will not include all designated sites in the region but the ambition for the plan is to work from highest priority to lowest through each subsequent cycle of the DWMP.

Our feedback from the consultation has highlighted that the priority matrix is complex. We will continue to refine the approach with our stakeholders. Our Plan has looked at current legislation.

The DWMP29 will provide more scenarios that look at future legislation, such as the Urban Waste Water Treatment Works Directive (UWWTD). This also applies to new guidance such as nutrient issues in the tidal parts of SAC rivers and their catchments.

2.5.1 Forecasting Demand and Understanding Capacity

After we have looked at the capacity of the **network**, the capacity of our **treatment facilities** and the capacity of the **environment** we can then come to an overall view of whether different areas can cope with changes in demand and climate that we are expecting in the future. These are combined together to show where then total from demand is higher than the treatment consented capacity.

Table 11 shows that during dry weather, and at a Level 2 scale, the level of facilities overall to treat and transport the used water and the ability of the environment to receive it would be sufficient in all areas but 1. When an additional scenario is included, that risk rises to 3. This analysis is not a typical wastewater analysis or specified within the framework; it does highlight where to look first in terms of capacity issues. The same assessment can be carried out in more and more detail and like a tree the process points to the localised areas, branches, where to look first. This is an assessment that tells us when the capacity limitations are brought together whether the system could manage dry weather flow i.e., times when there is no rainfall. This is a sewer plan as it excludes management of rainfall. And is the approach to manage our foul only systems. A more complex assessment is required to understand drainage capacity. However, this is the first building block in either system i.e., sewerage or drainage system.

What this table shows is not that the zones within the area have capacity, it just says where to look first, I.e., the greatest risks, the ones indicated red. This analysis has been carried out at level 2 below and again at level 3 which can been seen in each of the level 2 summaries showing again where to focus the next investigations. In terms of the wet weather analysis, more detail can be seen in the level 2 summaries.

Table 11 - Dry weather flow capacity issues in L2 regions

	Dry Weather	**Dry Weather with 20% allowance for resilience**
Dee		
Clwyd		
Conwy		
Llyn and Eryri		
Anglesey		
Meirionnydd		
Teifi		
Pembrokeshire		
Swansea Bay		
Tawe to Cadoxton		
SE Valleys		
Usk		
Wye		

Figure 15 - Brick Lined Sewer with the concept of Spare Capacity- Image courtesy of St John Archaeology

The capacity of a sewer pipe is illustrated in Figure 15. The use of the sewer changes during the day when there are low usage periods and high usage periods, this is dry weather flow. This illustration shows an egg-shaped sewer that was created to ensure that as flows reduce the velocity of the content is maintained. When an assessment of capacity is taken for networks, it is important to understand what makes up the section that is used and whether that assessment is made at peak usage during the day or at night time when the flows are expected to be at the lowest. The aim is to ensure that every pipe has spare capacity so that sewage is contained. An added complication for combined sewers is that on top of the fluctuating daily usage the capacity can be swallowed up by a rainfall event; the greater the volume of water in a rainstorm the more of the capacity of the sewer is used. When the capacity is full, the rain backs up, filling the sewer lengths upstream until no more can enter the sewer until downstream has passed flow onwards.

The Used element of the network needs to be understood in detail which includes what customers and businesses return to the sewer, the volume of flow that has got into the pipe through cracks and permitted traders with special requirements. These elements are used to calculate the Dry Weather flow as no rainfall is assumed during these days. These elements form the basis of all foul only networks and our sewage plan. In addition to this Dry Weather flow the used component also needs to include rainfall. This is where the combined network and drainage planning starts.

Dry Weather Flow and Why is it important.

In a typical year there are about 240 days without rainfall; this is over half of the year, during these days the sewer generally contains what we as users return to the sewer. As it doesn't include rain; This is the minimum size that the sewer system needs to be.

2.6 Emerging Trends and Challenges

2.6.1 Welsh Water 2050

The nature of the environment in which we operate presents future uncertainties 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 so that we can continue to meet our customer promises into the future. The future trends directly impacting our wastewater service are outlined in Welsh Water 2050 (DCWW, 2018), our long-term framework for our future business planning and are set out in Figure 16, below.

Change in Customer Expectations Customer expectations of their wastewater service, and the acceptability of any flooding and other issues, is likely to change.	**Protecting Essential Infrastructure** Ageing wastewater infrastructure, & physical and cyber security risks could limit our ability to maintain a reliable service in the future.
Change to the Structure of the Economy The growth of the digital knowledge-based economy could allow us to realise significant efficiencies in our wastewater business. Other changes to the economy could present challenges.	**Climate Change** More frequent and extreme weather events have the potential to adversely impact upon the rivers and catchments.
Demographic Change Changes in population and growth in the commercial sector, leads to increased service demand. More of our customers are likely to be considered vulnerable in the future.	**Policy and Regulatory Change** Policy and regulation around wastewater could change, especially following the UK's departure from the European Union.
Protecting Public Health Regulatory standards on wastewater discharges may tighten in the future.	**Environmental Change** Water quality of our coastline and rivers could come under increased pressure due to land use change in our catchments.

Figure 16 - Future trends influencing the DWMP

Through this analysis of future trends, risks and resilience, Welsh Water 2050 identified three key themes for investment planning:

- That the customer perception of risk has increased, following the recent pandemic, with greater expectation for authorities to do more to prepare for these risks.
- That protecting our service from climate change is a key priority.
- That we need to work collaboratively to ensure we make the best choices for the future of the services we deliver.

As a plan which ultimately supports the targeting of investment in our wastewater service, the DWMP will seek to tackle the challenges that are brought about by climate and demographic changes, together with the impact of CSOs, and in a way that makes the best choices for our environment, our carbon impact and affordability. In this first cycle, we set the foundations of that approach.

2.6.1.1 DCWW Strategic Responses

During the development of Welsh Water 2050, we produced a set of Strategic Responses (SRs - or business direction) to demonstrate how we intend to address the future trends and challenges outlined above.

We asked for customer and stakeholder views about these Strategic Responses, and after further refinements from feedback received, we came up with a list of 18 strategic responses that reflected the views and aspirations of our customers and stakeholders. They were grouped into three key areas: Drinking Water, Customers & Communities, and Environment (see Figure 17 below).

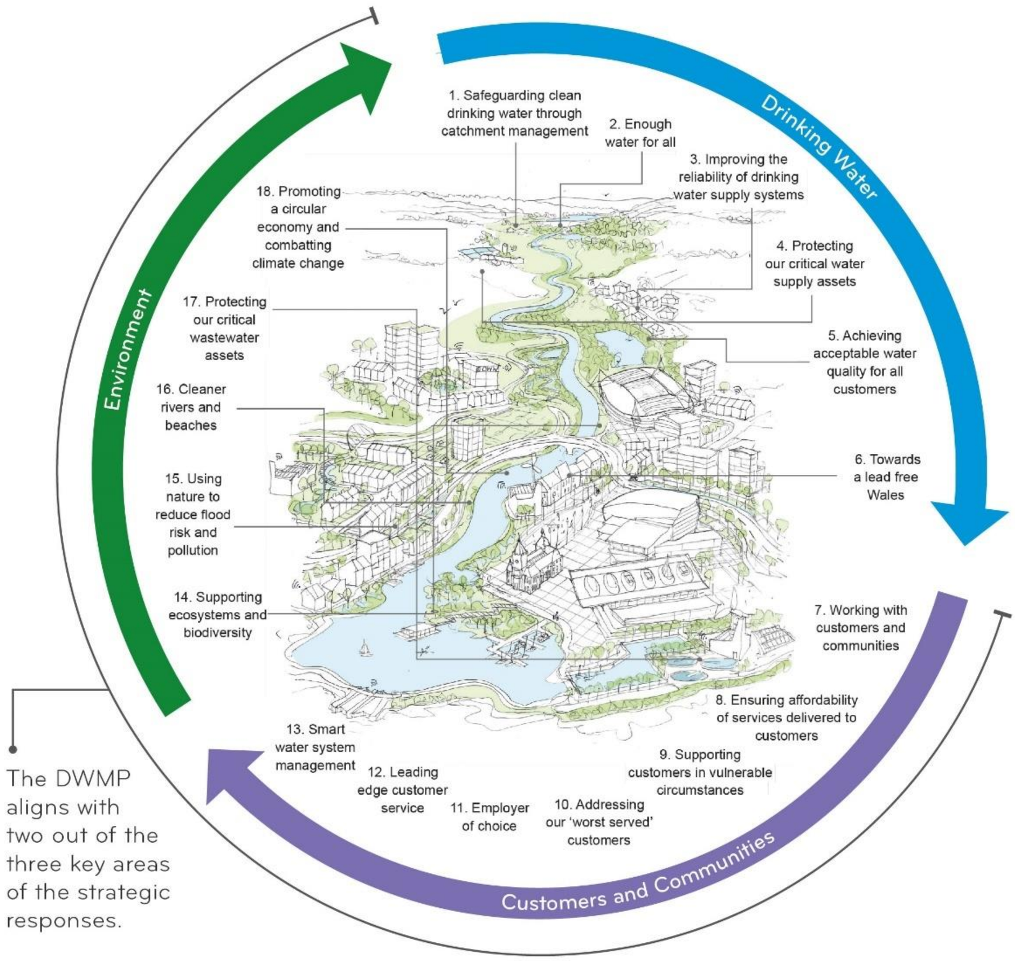


Figure 17 - Welsh Water 2050 Strategic Responses

Those grouped under the Customers & Communities, and Environment headings relate to our wastewater service and are challenges being considered by the DWMP.

- SR7 – Working with customers and communities: The DWMP will promote working with customers and communities and put customers at the heart of the plan
- SR8 – Ensuring affordability of services delivered to customers: The DWMP will not only look at ensuring the plan solutions are affordable but also that the development of the plan and its maintenance is also affordable.
- SR10 – Supporting customers in vulnerable circumstances: The DWMP will prioritise customers of today and those of the future considered to be worst served wastewater service.
- SR13 – Smart water system management: The DWMP will instigate a programme of investigation and installations to develop smart water system management over time however still in an affordable approach
- SR14 – Supporting ecosystems and biodiversity: The DWMP will incorporate ecosystems and biodiversity and promote this where opportunities present themselves
- SR15 – Using nature to reduce flood risk and pollution: The DWMP will promote the use of natural processes to manage flood risk and pollution alongside the traditional approach normally adopted
- SR16 – Cleaner rivers and beaches: The DWMP will support the delivery and on-going maintenance of cleaner rivers and beaches
- SR17 – Protecting our critical wastewater assets: The DWMP will develop opportunities to protect our critical Wastewater Assets by considering traditional and alternative approaches to resilience
- SR18 – Promoting a circular economy and combatting climate change: the DWMP will undertake evaluation of the long-term impacts of climate change on our wastewater service and promote sustainable approaches which consider managing surface water close to its source to reduce pressures on our combined sewerage systems.

As part of our latest review of Welsh Water 2050 we have also evaluated how well we expect to be able to adapt to these challenges and maintain an effective service to our customers. A summary of that exercise can be found in Table 12 below. This highlights four areas where meeting our longer-term aims, set out in Welsh Water 2050, is likely to be at risk without further focus and investment. These are:

- Ensuring affordability of services delivered to customers
- Addressing our ‘worst served’ customers
- Using nature to reduce flood risk and pollution
- Cleaner rivers and beaches

These are key themes which the DWMP will be seeking to support.

Table 12 - Progress against Welsh Water 2050 Strategic Responses

		Strategic Responses
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	Achieving net zero carbon emissions by 2040 and promoting a circular economy

Changes in climate have meant more frequent, unpredictable, and intense rainfall in Wales leading to increased flooding. When combined with growth and urban creep, the collective impact creates a surge in unpredictable peaks in the loading (demand) on our wastewater systems. This puts overwhelming pressure on sewer networks that have fixed capacity and affects the ability of our pumping stations and WwTWs to function effectively. This can also lead to more frequent overflows of rainwater diluted, untreated wastewater, into our watercourses through Combined Storm Overflows (CSOs)[5].

Climate change is also leading to more droughts and periods of low rainfall which will increase the pressure on our rivers and streams to absorb discharges. Dryer summers will result in low river flows leading to any sewage discharge being less diluted and therefore increasing the impact on the environment.

2.6.1.2 Future Trends and the need for action

The nature of the environment we operate in means that future uncertainties are likely to have a big impact on what we do and the service we provide to our customers. It is important that we consider both the challenges and opportunities these trends present so that we can continue to meet customer needs, both now and in the future.

[5] CSOs is a combined sewer system designed to overflow into a river instead of back-up into streets and homes.

The key future trends we have considered as part of the development of the plan are showing in Figure 18 below.

Changing climate patterns The increasing frequency and severity of extreme weather events such as drought and flooding	**Emerging and persistent contaminants** Continuing to find solutions to legacy contaminants such as microplastics and pharmaceutical compounds. This includes issues with recycling of biosolids/sludge recycling, micropollutants, nitrate vulnerable zone designations and potential associated changes in regulations.
Decarbonisation and sustainable business practices The resource cost and trade-offs linked to implementing the necessary move towards net zero carbon to achieve 2050 target, as well as the need for energy efficiency in operations, circular economy practices, and sustainable supply chains.	**Increasing customer and stakeholder expectations.** Keeping up with accelerating customer expectations around service levels and technology, while ensuring we retain customer and stakeholder trust against a background of increasing environmental concerns such as carbon net zero, water quality impacted by phosphate levels and CSO discharges, recycling of bioresources, and the other concerns of stakeholders and pressure groups
Price caps, affordability and potential trade-offs The constraints of balancing affordability concerns for customers, price caps imposed by regulators limiting necessary investment, and the need to invest in initiatives such as improving infrastructure and environmental protection.	**Legacy Infrastructure** Considering the set of risks posed by physical, biological and chemical degradation of infrastructure and/or lack of capacity in design of legacy infrastructure. Also considering the risks posed by ageing digital infrastructure.
Regulatory changes The UK Environment Act (2021), and several other regulatory changes which will become law in a post-Brexit Wales by 2025, are likely to bring tighter environmental standards, driving significantly increased monitoring and investment costs.	**Environmental responsibility.** Managing the impact of our activities on freshwater biodiversity and the important ecosystem services biodiversity brings. Considering the overall environmental responsibility of DCWW in their operations

Drainage and combined sewer overflows (CSOs)	Demographic and behaviour changes
Managing issues of river water quality and pollution, linked to lack of treatment capacity or functionality in drainage systems, exasperated by climate change, whilst facing increasing public pressure and expectations to resolve such issues.	The growth of homeworking and its implications and preparing for a growing and ageing population.

Figure 18 - Key Future Trends

Through longer term planning and a greater emphasis on working together with others, the DWMP will help us to respond to these future trends and challenges. We have built in uncertainty in all our investment planning.

Our 'reference option' allowed us to explore the impact of different future environmental standards and future flooding targets on the level of investment required in the plan, Consultation on the implication of these changes is carried out with our customers during each DWMP cycle to ensure that our long-term objectives continue to be appropriate and that legislative or policy changes are taken into account.

2.6.1.3 Customer promises

As shown in Figure 19, we have developed six customer promises in response to changing expectations, key priorities, and a changing environment.

Figure 19 - Showing the 'Six Customer Promises' from Welsh Water 2050

We have ensured that the DWMP reflects these customer promises and considers how the plan can help us to deliver a service that is robust and resilient to future pressures, in addition to meeting customer needs while keeping fair bills for everyone.

2.6.2 UK Climate Change Risk Assessment

The UK Government is required, under the 2008 Climate Change Act, to prepare a climate change risk assessment (CCRA) every five years, which is published on the Government website. The assessment sets out the risks and opportunities facing the UK from climate change. The first risk assessment was published in 2012, and the second in 2017. The third report was published in June 2021 (UKClimateRisk, 2021).

The Climate Change Committee (CCC) has a legal duty to advise the Government on the CCRA, and their independent advice report informs the UK Government's third CCRA (known as CCRA3).

The CCRA provides the evidence base to inform Government-led national adaptation programmes in England, Scotland, Wales, and Northern Ireland.

2.6.2.1 Summary of climate risks and opportunities for Wales

The Independent Assessment, used to help inform the third UK Climate Change Risk Assessment (CCRA3), assessed 61 risks and opportunities from climate change and their impact on Wales. This included the impact on business, infrastructure, housing, the natural environment, our health, and the wider risks from the international impacts of climate change.

Of these 61 risks and opportunities, more action is now needed in Wales to address 32 of them. The report also identified eight opportunities that could arise from climate change in Wales. 32 apply to Wales and 6 apply to Water.

In summary, risks in Wales that have a high future magnitude score and where more action is required now to address them, after considering any existing adaptation responses, include the following areas that relate to water, and the development of this plan:

- The impacts of climate change on the natural environment, including terrestrial, freshwater, coastal and marine species, forests, and agriculture.
- An increase in the range, quantities and consequences of pests, pathogens, and invasive species, negatively affecting terrestrial, freshwater and marine priority habitats species, forestry, and agriculture.
- The risk of climate change impacts, especially more frequent flooding, and coastal erosion, causing damage to our infrastructure services, including energy, transport, water and Information and Communication Technologies (ICT).
- Increased severity and frequency of flooding of homes, communities, and businesses.
- The impact on coastal businesses due to sea level rise, coastal flooding, and erosion.
- Damage to our cultural heritage assets, resulting from temperature, precipitation, groundwater, and landscape changes.

2.6.3 Climate change and net zero

Welsh Government declared a climate emergency in 2019 (Welsh Government, 2019).The Environment (Wales) Act 2016 strengthened the legislative framework to reduce greenhouse gas emissions, with a legal target of 80% carbon neutrality by 2050.

As part of the Welsh Government strategy on Climate Change, '*Prosperity for All: A Climate Conscious Wales*' was published in November 2019 (Welsh Government, 2019) with three key aims to be:

- **Aware** – Increase understanding of the risks from climate change
- **Prepare** – Improve our capacity to respond to climate change
- **Adapt** – Put changes in place to make Wales resilient.

In February 2021 Welsh Government accepted the December 2020 Climate Change Committee (CCC) recommendation (Welsh Government, 2020) to increase the emissions reduction target to 95%, and announced an ambition to bring forward a Net Zero target of No Later than 2050, considered to be possible with a 'Team Wales' effort, in a bid to limit global heating to 1.5°C.

Welsh Government's '*Pathway to Net Zero Wales and second Carbon Budget 2021-25*' (Welsh Government, 2021) contains 123 policies and proposals across all ministerial portfolios and includes the following key objectives:

- **A Decade of Action** - we need to make more progress in the next ten years.
- **Collective Action** - every business, public body, community group and citizen in Wales to embed the climate emergency in the way they think, work, play and travel.
- **A call on the UK Government** to take the action which is needed to unlock a green future in Wales.
- **Just transition** - we leave no-one behind as we move to a cleaner, stronger, fairer Wales.
- **Economic Prosperity** - that is fair and built on a wellbeing economy.

The numerous *Pathway to Net Zero Wales* policies and proposals are broadly aligned to eight areas, with the key associated proposals provided in Table 13 below.:

Table 13 - Pathway to Net Zero Policies

Area	Associated Proposal
Electricity & Heat Generation	Decarbonising electricity production from fossil fuels – gas with Carbon Capture Utilisation and Storage and fuel switching to green hydrogen. Increasing electricity from low carbon and variable renewables.
Transport	Demand reduction and modal shift – how behavioural and societal shifts could reduce or change demand for travel. The technological options available and the uptake of transport with low or zero emissions Improvements to fuel efficiency in conventional vehicles.
Residential Buildings	Energy Efficiency – Setting demanding standards for new build, and existing properties, with the social housing sector leading the way. Low Carbon Heat – Phase out fossil fuel heat sources. Behavioural shift and demand reduction – examine how behavioural and societal shifts could lead to reduced demand and the energy efficiency of appliances.
Industry & Business	Resource and energy efficiency – product replacement material substitution, waste reduction, energy efficiency – equipment, heat recovery, clustering. Fuel switching – the change to low carbon fuels including hydrogen. Carbon capture storage/utilisation and storage – carbon capture and storage, bioenergy with carbon capture and storage (BECCS), and hydrogen plants; and Commercial buildings – increase efficiency of our commercial buildings stock.
Agriculture	Low Carbon Farming Practices – increasing measures on farms which reduce emissions from soils (for example, grass leys and cover crops), livestock (for example, diets, health, and breeding) and waste and manure management. Measures to release land – Changes in consumer and farmer behaviour can release land from agriculture while maintaining a strong food production sector.
Land Use Change & Forestry	Increasing Tree Cover – policies and proposals to increase tree cover by planting new woodland and improved woodland management*. Safeguarding & increasing other carbon stores in soils – by restoration of peatland and 'blue carbon' habitats

Area	Associated Proposal
Waste Management	Landfill – Reducing the greenhouse gas emissions from landfill sites. Recycling – To achieve 70% recycling across all major waste streams. Behaviour change – To promote recycling and further reduce waste.
Public Sector	The public sector to be collectively net zero by 2030

*As one of the strategies to achieve the Forestry target, the First Minister Mark Drakeford announced the creation of a National Forest for Wales, with an ambition for a connected forest ecosystem that will extend the length of the country.

Many of these policy areas will be relevant to DCWW operations and some more specifically to the ongoing development in cycles of the DWMP and its future trends and challenges, including working towards our carbon neutral target of 2040.

The DWMP is driven by achieving the best outcomes for our customers, communities, and the environment. It is underpinned by the principles contained in the following key Acts:

- Environment (Wales) Act 2016;
- Well-being Future Generations (Wales) Act 2015;
- Planning (Wales) Act 2015;
- Water Act 2014; and
- Water Industry Act 1991.

These Acts in turn help inform the key plans that influence the direction and development of the DWMP. As seen from the illustration below, Figure 20, stakeholders such as Natural Resources Wales, Local Planning Authorities and interest groups have a critical part to play in the process. Through partnership working and information sharing, the DWMP will complement and link with our stakeholders' existing plans that manage drainage and water quality. By doing our part, we will achieve more together.

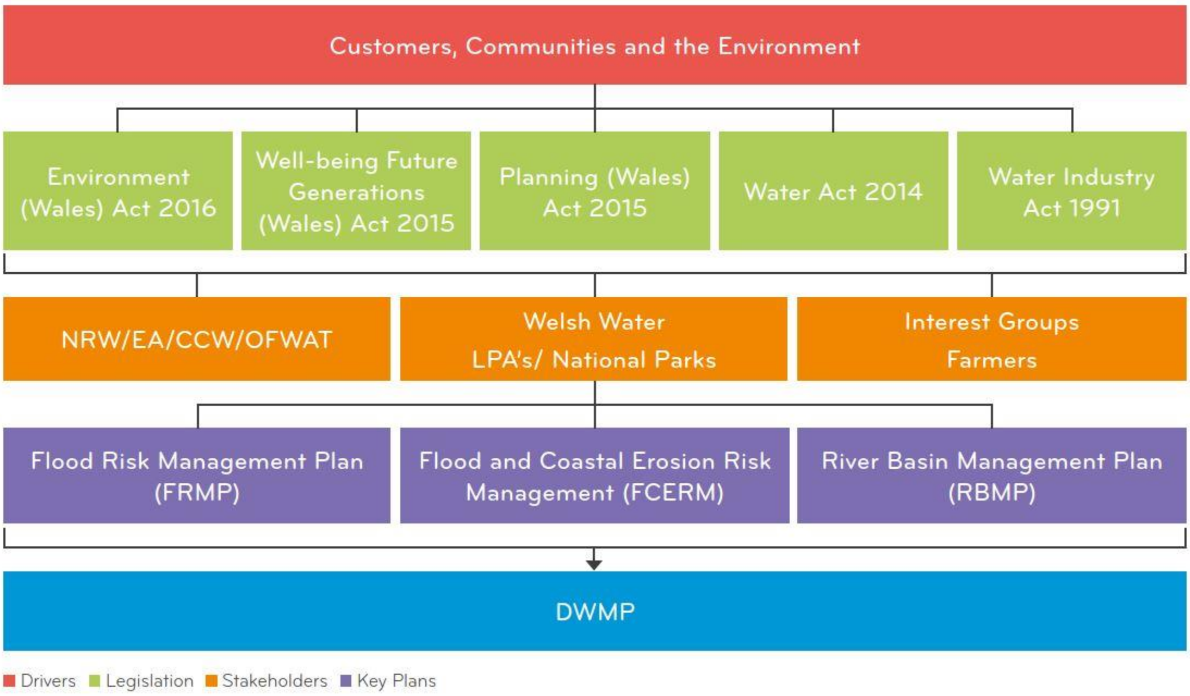


Figure 20 - DWMP and the simplified legislative context

Our long-term corporate strategy 'Welsh Water 2050' contributes to the wider goals of the Well-being of Future Generations (Wales) Act 2015. The Well-being of Future Generations Act places a duty on public bodies in Wales to consider the long-term impact of their decisions and work more cohesively with people, communities, and other public bodies to achieve outcomes.

Furthermore, the DWMP takes into consideration the principles set out in '*Cymraeg 2050: A million Welsh speakers.'*. This Welsh Ministers' action plan for 2019–20, was prepared in accordance with Section 78 of the Government of Wales Act 2006. It set out how Welsh Government will increase the number of Welsh speakers (Welsh Government, 2019), increase the use of Welsh and create favourable conditions for the language to thrive. The DWMP contributes to these wider goals by ensuring all written correspondence to stakeholders and customers are made available in Welsh.

Other key documents that have been considered, include the Water Strategy for Wales (Welsh Government, 2019) and the National Infrastructure Commission's Assessment (NIC, 2022) on the risks of drought and flooding. We have included these goals, objectives, and principles where they are applicable to a DWMP. At a UK level, we have incorporated objectives that are comparable for the industry. However, we recognise that achieving them will require ongoing collaboration with other organisations, including regulators, local councils, and customers.

2.7 Legislative Influences

2.7.1 Environment (Wales) Act 2016

The Environment (Wales) Act 2016 is the key piece of legislation in Wales controlling all aspects of environmental management, pollution prevention, and conservation. It replaces seven separate pieces of legislation that previously controlled water issues in Wales. The act also contains national targets to reduce carbon emissions. The Act is one of the first pieces of legislation in the UK to place a duty on public bodies to consider climate change, resource efficiency, and the natural environment when making policies.

The aim of the Environment Act is to enable the environment in Wales to be managed in a more 'proactive, sustainable and joined up way'. It allows Wales' natural resources to be managed at both a national and local level through a framework which aims to embed Sustainable Management of Natural Resources (SMNR) as a core consideration in public authorities' decisions throughout Wales. (This duty is placed on NRW). The different aspects of the framework are intended to support and feed into each other, as shown in Figure 21 below:

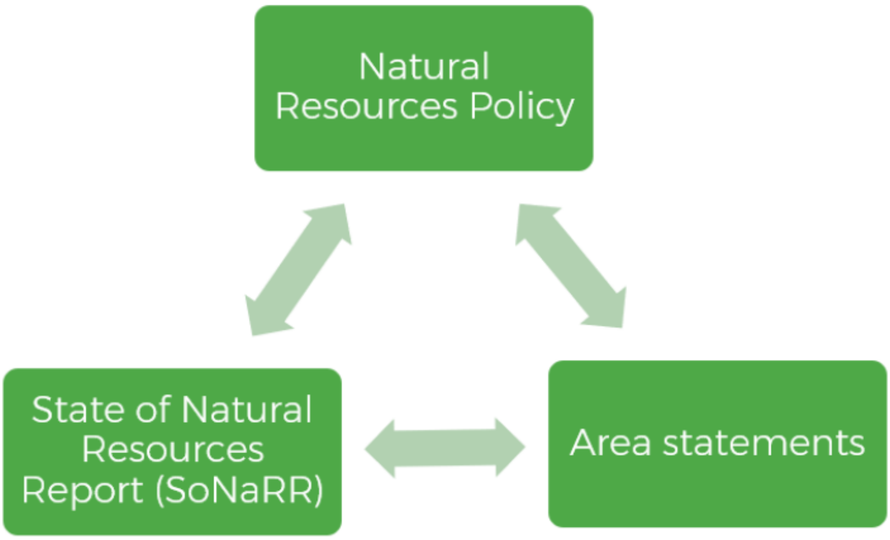


Figure 21 - Framework Aspects

The Environment Act is wide ranging and includes six other Parts; climate change, charges for carrier bags, collection and disposal of waste, fisheries for shellfish, marine licensing and a miscellaneous section that includes flooding, coastal erosion, and drainage. As well as introducing the concept of the SMNR into Welsh law.

2.7.1.1 Sustainable Management of Natural Resources

Sustainable Management of Natural Resources (SMNR) is defined in the Environment Act as:

“Using natural resources in a way and at a rate that maintains and enhances the resilience of ecosystems and the benefits they provide. In doing so, meeting the needs of present generations of people without compromising the ability of future generations to meet their needs, and contributing to the achievement of the well-being goals in the Well-being of Future Generations Act.”

In addition, Biodiversity (discussed in a following section) is defined in the Environment Act as:

“The diversity of living organisms, whether at the genetic, species or ecosystem level”

Part 1 of the Act sets out Wales’ approach to natural capital and resource planning management at both a national and regional level, in accordance with the statutory "**principles of sustainable resource management**". With respect to biodiversity the Act compels public bodies and local authorities to:

“Maintain and enhance biodiversity in the exercise of functions in relation to Wales, and in so doing promote the resilience of ecosystems, so far as consistent with the proper exercise of those functions”.

Under this framework, authorities are required to “**promote ecosystem resilience**” toward an objective of environmental sustainability.

Section five of the Environment Act amends Article 4 of the general purpose of Natural Resources body for Wales (NRW) such that: -

The body must –

a) Pursue sustainable management of natural resources in relation to Wales, and

b) Apply the principles of sustainable management of natural resources in the exercise of its functions, so far is consistent with their proper exercise. '

Principles of SMNR

Section 4 of the Environment Act introduces nine principles to help guide and underpin the way SMNR should be interpreted to ensure a consistent approach for SMNR across Wales:

- **Adaptable** – a need to plan, monitor, review and change future work considering new evidence and understanding.
- **Scale** – decisions and actions will need to be taken at national, regional, or local levels to deliver the best outcomes.
- **Working together** – everyone in Wales is a stakeholder in the natural environment and hence, to ensure best management of natural resources, all views need to be considered.
- **Engaging with the public** – ensure that the public has opportunity to give its opinion on how natural resources are managed, at all stages of the decision-making process.
- **Evidence** – an improved evidence base is needed to understand Wales' natural resources to allow for better management.
- **Understanding all the benefits received from natural resources –** the whole of Wales needs to understand the economic, social, cultural, and environmental value of natural resources, including how they can benefit future generations.
- **Long term –** impacts of decisions need to be considered not only in the short term but also in the long term.
- **Prevention** – take steps to prevent damage to Welsh ecosystems; and
- **Resilience** – to be able to deal with increased demands and pressures, such as climate change, Welsh ecosystems need to be healthy. Decisions need to be considered in terms of providing long term benefits.

Although DCWW is not covered by the same requirement as NRW in relation to SMNR, we are running pilot projects on how we can apply an SMNR approach, and these are described below.

2.7.1.2 SMNR Pilot Catchment Areas

As shown in Figure 22, DCWW has designated the Clwyd, Alyn, Teifi and Afan catchments as SMNR Pilot Catchment Areas to test different approaches, learning from the initial approach in the Clwyd has been transferred to the remaining catchment areas.

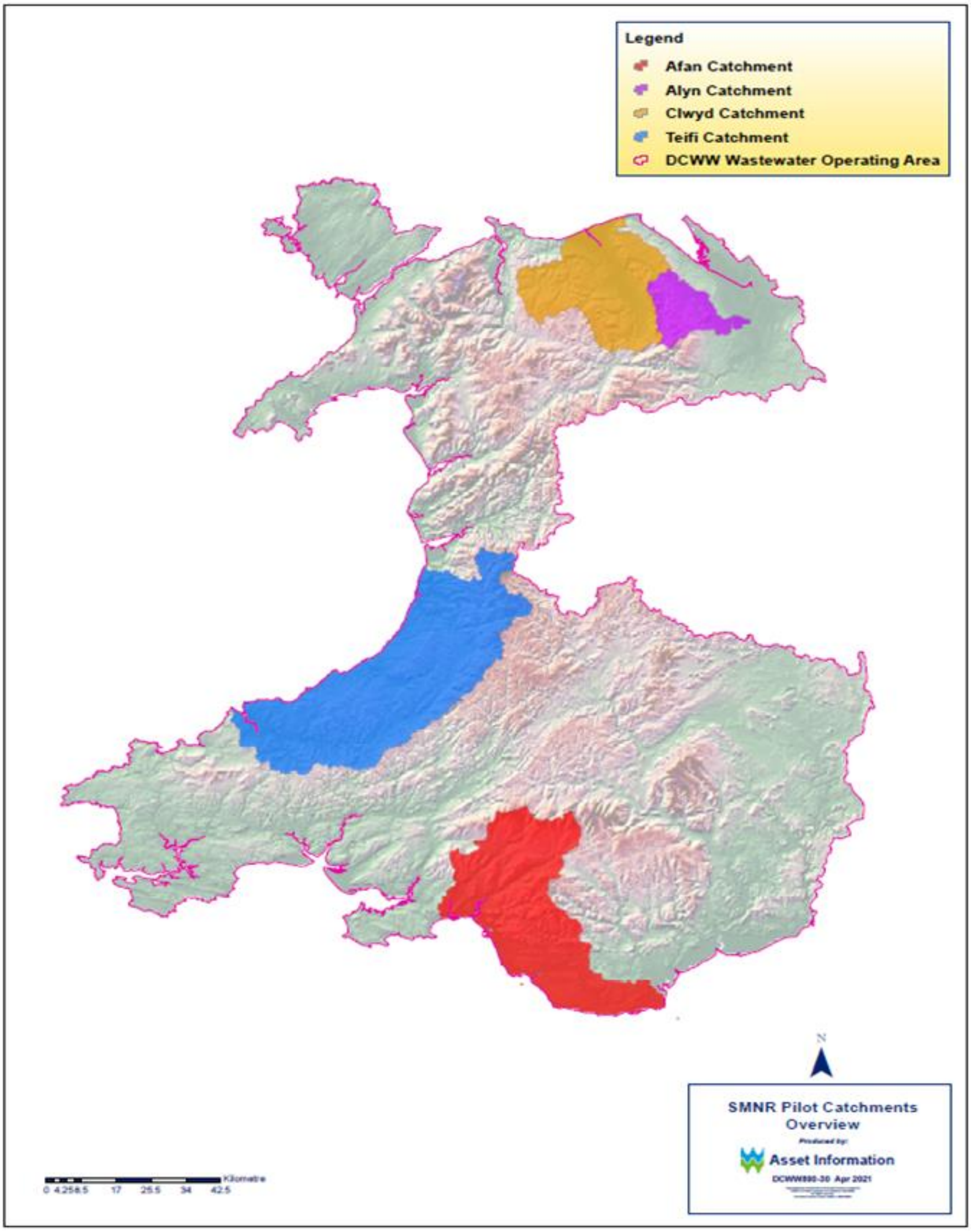


Figure 22 - DCWW SMNR Pilot Areas

A key driver has been to follow the principles of SMNR in those catchments and to aim to achieve more sustainable outcomes that provide multiple benefits with the holistic objective of contributing to a more resilient ecosystem. The outcomes in each pilot area will be based on technical work completed in these pilot catchments but also highlight future investigative work to assist SMNR development in these pilot areas. The outcomes will form part of a larger plan and it is accepted that the plan will need to adapt and change as constraints and stakeholder needs are developed. The plan will also focus on outcomes and in particular delivery of wider community participation and benefits taking into consideration the Wellbeing of Future Generations Act 2015 as well as the Environment Act 2016. Environmental outcomes delivered will need to benefit society and the wider environment and draw on co creation to achieve better outcomes for all stakeholders. These will also be aligned to DCWW's 2050 vision and be supportive of NRW with its SMNR obligations, whilst delivering our strengthened commitment to maintain and enhance Biodiversity in the exercise of our function.

SMNR directly supports much of our Welsh Water 2050 Vision and is also at the heart of NRW's regulatory purpose. Delivering SMNR also supports Welsh Governments Green and Just recovery post COVID -19. Our approach to SMNR in these pilot catchment areas will put our future customers' needs at the forefront of delivering our business objectives more sustainably

2.7.1.3 Biodiversity

The Welsh Government has recognised that we are facing not only a climate emergency, but a biodiversity crisis. Further to COP26 it is still unclear what this means in terms of support and specific actions required, however, it is a positive message that the crisis has been recognised and prioritised.

In 2020 we published our second forward-looking plan for biodiversity - '*Making time for nature*' (Water, Biodiversity Action Plan, 2020), which updated our statutory 2017 Biodiversity Action Plan (BAP) as required by Section 6(6) of the Environment (Wales) Act 2016. The plan sets out how we propose to comply with our strengthened biodiversity duty in the exercise of our functions. The Act places a strengthened biodiversity duty on us, to both maintain and enhance biodiversity, unique in the UK Water industry.

Our 2020 BAP consists of 30 overarching commitments from across the business which were as set out in the original 2017 plan. In 2019 we reported that good progress had been made against all but one commitment (delayed due to a third-party regulator database issue).

The 2020 plan demonstrates continued progress, despite the challenges from COVID-19, and the climate and biodiversity emergencies we face. It also allows us to raise awareness of our plan with the wider business, regulators, and stakeholders, as many of these are involved in co-producing and delivering solutions.

2.7.1.4 DCWW strategic commitment

In addition to the statutory Section 6 biodiversity plan, DCWW have made specific commitments to biodiversity and ecology within 'Welsh Water 2050', strategic response number 14: 'Supporting Ecosystems and Biodiversity'. The key messages from the strategic response have been captured within the BAP. Going forward, and in the context of reviewing progress against Welsh Water 2050, DCWW will be increasingly ambitious in our commitments and vision for biodiversity within the business and for our assets and estate.

DCWW is also committed to introducing multi capital accounting for use when developing its investment decisions. This approach will ensure DCWW places a value on natural and social capital benefits as well as financial. To measure enhancement within our sites we will also adopt the Defra/Natural England biodiversity metric tool v3.0. This will be in addition to the existing biodiversity net gain requirements for all capital alliance schemes.

2.7.1.5 Legislation and links to external plans

Some of the legislation under which we operate within DCWW includes but is not limited to; Environment (Wales) Act (Section 6 and Section 7), Conservation of Habitats and Species Regulations, Wildlife and Countryside Act (as amended by Countryside and Rights of Way Act), Natural Environment and Rural Communities Act and Marine and Coastal Access Act. In addition, we will be working closely with Welsh Government and regulators to ensure we understand and take account of any of the changes that the Environment Act 2021 will bring about.

To achieve multiple benefits and a strong success rate in tackling the biodiversity crisis it is essential to work collaboratively with stakeholders and regulators and to link with any relevant external plans that still help DCWW to achieve their core function, which is to provide clean drinking water and remove and treat wastewater.

During this AMP period we will also be delivering our National Environment Programme (NEP) obligations, which include a baseline study to establish priority species and habitat on our own land (including the condition of designated sites), to continue to contribute to Celtic Rain Forests project and to undertake an invasive species surveillance and pathway assessment.

2.7.1.6 Invasive Non-Native Species (INNS)

Our response to INNS is still in development as this needs to be approached from a catchment wide perspective to help control downstream sites. We are currently developing a position statement which sets out the process, roles and responsibilities and methods for control with regards to INNS. As part of our NEP output a new guidance booklet will be published in 2022 within the wider business to raise awareness of common INNS species and those to watch out for.

The Wales Resilient Ecological Network (WaREN) project is in its second year and is made up of several external stakeholders working towards the common goal of establishing a framework to tackle INNS within Wales. DCWW sits on the project board and has contributed to funding the project and will continue to do so going forward. The current focus of the project discussions is the production of a recording tool to map INNS across Wales.

2.7.2 Well-being of Future Generations (Wales) Act 2015

The Well-being of Future Generations Act 2015 is Wales' landmark piece of legislation which places a clear duty on Wales' public bodies to consider the impact their actions will have on future generations. Whilst DCWW are not a public body we act in accordance with the principles set out below in Figure 23. The legislation creates a legally binding common purpose which encourages sustainable economic growth and improves Wales' environment, with a strong emphasis on Wales' natural capital.

The act highlights the need for, and gives structure to, more effective collaboration between organizations, communities, and individuals when addressing recurring issues such as poverty, health inequities, and climate change. The Act's seven well-being goals' and 'Five Ways of Working' are intended to support and deliver public services that meet present needs without jeopardizing future generations' capability to satisfy their own.

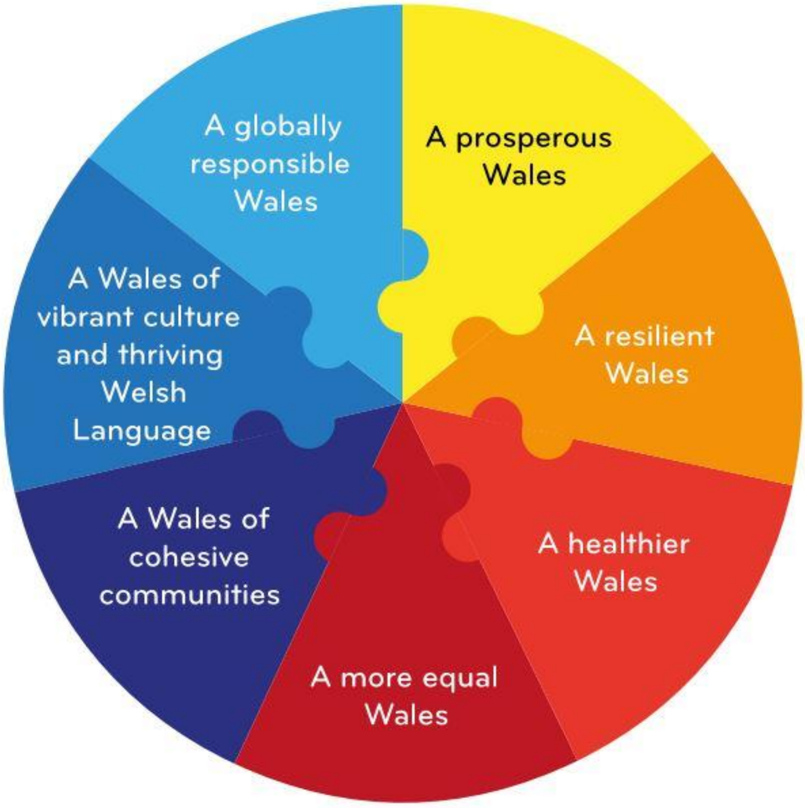


Figure 23 - The Seven Well-being goals of the Wellbeing of Future Generations Act

The sustainable development principle defined by the Act is now a required component of how public bodies and public service boards must operate. The principle, which comprises of five working methods. 'The Five Ways of Working' that public entities must consider while adhering to sustainable development, are:

Looking to the long term - meeting the needs of the present, without jeopardising the needs of future generations.

Taking an integrated approach - ensuring that public bodies consider all the well-being goals in deciding on their objectives

- Inclusivity - Involving a true representation of the individuals who will be affected by service decisions
- Collaboration - to seek shared, long-term solutions by collaborating with others
- Prevention - Recognizing the underlying causes of problems ahead of time to avoid them arising.

The Act also requires Ministerial progress reports on initiatives towards sustainable development to be published annually at the start of each, setting out the progress made over the last year.

2.7.3 Water Strategy for Wales

The Water Strategy for Wales was introduced in 2015 to help deliver a better value, more efficient and sustainable water, and wastewater service, together with a more integrated approach to the management of water, in line with the Welsh Government's Natural Resources

Policy. In support of the principles of Sustainable Management of Natural Resources (SMNR) it has sought to promote green growth, manage resources in a sustainable manner, and improve the resilience and diversity of our environment. By making joined-up investment decisions that achieve multiple outcomes, the strategy set out to ensure we deliver long-term value to our environment, economy, and society

Over the last 6-years, since its launch, we have supported Welsh Government with the delivery of several principal actions. However, only long-term planning initiatives, such as the DWMP and our internal SMNR pilots, will unlock the long-term objectives that the strategy set out to achieve.

2.7.4 Welsh Government - Natural Resources Policy (2017)

The focus of the Natural Resources Policy (NRP) (Welsh Government, 2017) is on improving the way Welsh Government manage natural resources. This is a key part of their delivery framework for the sustainable management of natural resources established by the Environment (Wales) Act. It is also vital if current and future generations are to continue to enjoy the benefits they provide. As such, it is also key to the delivery of the Well-being Goals set out within the Well-being of Future Generations Act and Wales' international contribution to the delivery of the UN's Global Goals. Through actions such as increasing resource efficiency or reducing pollution, the aim is to build greater resilience into our ecosystems.

Sections of the NRP set out the statutory principles that underpin the approach, and how the NRP supports the delivery of 'Prosperity for All - the national strategy' and Wales' international commitments. This is followed by sections on the opportunities and challenges facing our natural resources, in line with the requirements within the Environment (Wales) Act. Based on these opportunities and challenges, the NRP then identifies three national priorities to address them and illustrates how Welsh Government will implement the priorities and monitor and evaluate progress. The three National Priorities are:

2.7.5 Delivering nature-based solutions

Increasing renewable energy and resource efficiency - Developing a more resource efficient economy has a crucial role to play in green growth. Moving towards a more circular economy in Wales, where raw materials are kept in productive use for longer. Progress can significantly reduce our impact on our natural resources whilst providing opportunities for jobs and sustainable economic growth and helping address risks to long-term supply chain security.

Taking a place-based approach - enabling collaboration at the right scale, be that site, regional, catchment landscape or ecosystem. Area Statements play a key role.

The NRP is not just about the role of the Welsh Government or the public sector. The NRP is particularly important for farmers, foresters, fishermen, utility companies, communities, health professionals, the third sector and academic institutions, planners, and developers. The Welsh Government approach recognises that all society benefits from natural resources. As a first step, Welsh Government have drawn consultation responses on the NRP, and the State of Natural Resources Report (SoNaRR) published by Natural Resources Wales (NRW, 2020).

Natural resources are the foundation of the primary Welsh production industries - agriculture, forestry, fisheries, and the water industry. DCWW recognise that we are completely dependent on a sustainable environment and the resources we derive from it to deliver our service.

SoNaRR shows that the following areas deliver most in terms of both ecosystem resilience and benefits across all the well-being goals:

- Increasing green infrastructure in and around urban areas

- Coastal zone management and adaptation
- Increased canopy cover and well-located woodland, for example close to towns and cities where it will have the greatest recreational and ecosystem service value
- Maintaining, enhancing, and restoring floodplains and hydrological systems to reduce flood risk and improve water quality and supply
- Restoration of our uplands and managing them for biodiversity, carbon, water, flood risk and recreational benefits.
- Nature-based solutions include approaches to:
- Support the development of resilient ecological networks to maintain and enhance the resilience of Wales' ecosystems
- Support climate change adaptation and mitigation, and flood risk management
- Improve infrastructure - such as green infrastructure and water treatment systems, for example sustainable urban drainage, swales, and reed beds
- Improve land and water management - such as integrated coastal zone management and adaptation, integrated water resources management, natural flood management, better soil management for carbon storage and sequestration, water quality and continued productivity, for example peat bog management, streamside corridors and strategic hedge planting on farms.

2.7.6 Water and flooding

The NRP identifies opportunities to manage flooding by using natural flood risk management techniques in both upland and lowland areas. In the uplands, this means taking measures to increase water storage by reducing run off and soil sealing, and in the lowlands slowing flow through more natural floodplains. The NRP anticipates wider benefits for ecosystems and water quality, plus opportunities to prioritise management of water at a catchment scale. Welsh Government state that this approach should provide income to landowners and increase the resilience of the ecosystems, as well as providing a cost-effective approach to improving water quality. The NRP also states that Welsh Government will encourage the adoption of this approach in guidance to water regulators, and commit to the following actions on water and flood:

- Increase the role of nature-based solutions in flood and water management, including coastal risk management and adaptation. This will address problems at source and could reduce costs. Interventions should be designed to deliver a range of benefits through the way in which they manage the land.
- Support the use of innovative approaches to water quantity and drought planning which might involve new technological applications to access smaller water bodies and create a more dispersed supply network.
- Reform the abstraction licencing system to ensure that we have robust and resilient water resources.
- Increase awareness of water efficiency and support innovative approaches for encouraging reduction in water consumption. Reduction in water use will reduce energy used in the treatment and delivery of drinking water and reduce our carbon footprint.
- Improve the outdated drainage systems across Wales, with an emphasis on sustainable, nature-based drainage in our urban areas. This will include new frameworks for new development and incentivising natural interventions in areas of pressure by water, sewerage, and drainage authorities. This will both increase green areas and resilience to changes in our climate.

2.7.7 Planning (Wales) Act 2015

The Act set out a statutory foundation for planning functions in Wales, confirming the requirement to carry out sustainable development under the Well-being of Future Generations (Wales) Act 2015. It also implemented Future Wales: The National Plan 2040 (Government W. , The National Plan 2040, 2021), providing a similar function to the National Planning Policy Framework in England (Government U. , NPPF, 2021), and providing a framework for future of development in Wales, underpinned by regional Strategic Development Plans (SDPs) and local authority Local Development Plans (LDPs), which are closely aligned with the role of Local Plans in England.

2.7.7.1 Local Development Plan (LDP)

Since 2004 each local planning authority in Wales has been required to produce a Local Development Plan (or 'LDP'). The LDP sets out each local planning authority's proposals for future development and use of land in their area. Once an LDP is adopted, it forms the basis of planning decisions in the determination of planning applications for the development or use of land that the local planning authority makes. Where possible, the LDP should link in with the aims of the local Community Strategy or, in National Park areas, the National Park Management Plan.

Local planning policies are set out in the development plan for each of the 25 local planning authority areas in Wales. National planning policy is more likely to be relevant if proposals are very large, or if the development plan was adopted many years ago and is now out-of-date. The two main types of development plan are Unitary Development Plans and Local Development Plans.

2.7.8 Water Act 2014

The aim of the Act was to reform the water industry to make it more innovative and responsive to customers and to increase the resilience of water supplies to natural hazards such as droughts and floods. The Act was intended to introduce competition into the market for non-household customers and bring benefits to businesses and the economy.

The Act provided new powers to sewerage undertakers to construct drainage systems for the purpose of reducing the volume, or rate, of surface water entering public sewers. The maintenance arrangements for these systems can be subject to agreement with other risk management authorities. The legislation, which resulted in amendment to the Water Industry Act 1991 (s114a), provides a foundation for the collaborative delivery of surface water management projects which will form an integral part of this and future DWMPs.

2.7.9 Water Industry Act 1991

This act (as amended) consolidated previous legislation relating to water and wastewater and sets out the main powers and duties of the water and sewerage companies in England and Wales. It has been updated by subsequent legislation (such as the Water Act 2014 and the Environment Act 2021) to ensure that it continues to set out the core duties of the water industry in England and Wales.

2.7.10 Legislation – Water quality & quantity

2.7.10.1 Water Environment (Water Framework Directive) Regulations 2017

The Water Framework Directive is a piece of EU legislation that establishes a framework for the protection and improvement of inland and coastal water bodies. It is designed to return all surface waters, groundwater and transitional waters into good chemical, physical and biological condition by 2027.

The Water Environment (WFD) (England and Wales) Regulations, commonly known as the Water Environment regulations in Wales is the piece of legislation that implements the WFD into UK law and is still relevant and applicable post Brexit. The regulations brought about changes to wastewater standards in England and Wales to achieve ‘good’ status for bodies of freshwaters by 2027.

The implementation of wastewater regulations is an important component of the Water Framework Directive requirements, as they place restrictions on wastewater discharges which will reduce the amount of pollution entering our freshwater bodies. As implemented the regulations require that wastewater from certain sources require a permit from Natural Resources Wales before wastewater may be discharged directly to watercourses.

The WFD established a comprehensive River Basin Management Plan (RBMP) system, based on River Basin Districts (RBD) to safeguard, and improve these aquatic environments. The RBMP is a cyclical process, like the DWMP. However, it operates on a 6-yearly cycle which is closely aligned with Flood Risk Management Plans (see below).

A RBD covers an entire river system, including river, lake, groundwater, estuarine and coastal water bodies. There are eleven RBDs in England and Wales. The Environment Agency manages the seven RBDs in England. NRW manage the Western Wales RBD. NRW and the Environment Agency jointly manage the Dee and Severn RBDs.

2.7.10.2 Water Industry National Environment Programme (NEP / WI(NEP))

The NEP and WI(NEP) represent a set of outputs that NRW and the Environment Agency respectively have requested all water companies operating in Wales and England, to complete in each 5-year investment cycle (with the current running between 2020 and 2025), to contribute towards meeting their environmental obligations and agreeing the investment requirements for improving water quality to be included in the business plan for 2020-2025.

The NEP (National Environment Programme) or WINEP (Water Industry National Environment Programme) is a list of measures set out by the environmental regulator either the EA or NRW. the measures are required of the water industry to fulfil our legal obligations to the environment and is completed alongside our price review planning every five years.

2.7.10.3 Background and Context

The actions included in a water company’s WINEP reflect the company’s obligations arising from environmental legislation such as Urban Wastewater Treatment Regulations, Water Environment (Water Framework Directive) Regulations, Bathing Waters Regulations, and Conservation of Habitats and Species Regulations. The WINEP may also contain non-statutory actions.

The National Environment Programme (NEP), applicable in Wales and developed by NRW, outlines the improvements DCWW need to make to comply with new or amended environmental legislation and identifies investigations needed to inform, in an evidence-led way, potential investment requirements in subsequent AMP periods. The WINEP is currently developed by the EA and Natural England in consultation with water companies and is applicable to those areas of England served by DCWW. At the time of writing Driver papers have started to be issued by NRW and the EA for the implementation of the NEP / WINEP process in 2022.

The actions included in a water company’s NEP / WINEP reflect the company’s obligations arising from environmental legislation such as: Water Environment (Water Framework Directive) Regulations, The Habitats Directive, Urban Wastewater Treatment Regulations, Bathing Waters Regulations, and Conservation of Habitats and Species Regulations. The NEP/WINEP may also contain non-statutory actions.

Water companies include these actions in their business plans so that they can be funded through customer water bills.

The 2020 to 2025 NEP / WINEP aligns with the Ofwat 2019 price review period (PR19) and the 7th UK water industry asset management plan period (AMP7).

The WINEP is the most important and substantial programme of environmental investment in England. For 2020 to 2025 it consists of £5.2bn of asset improvements, investigations, monitoring, and catchment interventions. It sets out how the water industry will contribute to improving the natural environment.

These pressures are only likely to increase in future. Therefore, a consultation was undertaken to understand how the WINEP can be updated to help to deliver a much-needed step change in the state of the environment.

2.7.10.4 Consultation description

The water industry has taken steps over the last three decades to improve the water environment. However, there is a collective ambition for the NEP and WI(NEP) to deliver more for the environment, for customers and for communities. This reflects society's high expectations and the UK government's ambition to leave the environment in a better state for the next generation. In Wales, this ambition is focused on addressing, for example, NRWs State of Natural Resources Report (SoNaRR) and incorporating the place-based approach of Area Statements. For those parts of England which we serve our approach aligns with the ambition of Defra's 25 Year Environment Plan.

In 2020, Defra, the EA and Ofwat came together to lead a taskforce review of the WINEP ahead of the next price review (PR24) for England (EA, 2021). They have worked with representatives from water companies, Natural England, the DWI, CCW, and environmental non-governmental organisations. The aim is to ensure that the WINEP delivers greater benefits to the environment for every pound invested by water companies, and this applies to the parts of England which we serve. The proposed reforms to achieve this, in particular to meet the goal of providing clean and plentiful water, aim to contribute to:

- An improved natural environment through the protection, restoration and enhancement of the natural environment, biodiversity, and habitats;
- The government's 2050 net zero target;
- Improved water quality;
- Greater drought resilience and delivering improved flood resilience in line with the National Flood and Coastal Erosion Risk Management Strategy;
- Reduced unsustainable abstraction; and
- Clearer links between the natural environment and public wellbeing.

2.7.10.5 Identifying a way forward

The taskforce identified six objectives to guide the development of the options for updating the WINEP. The objectives were to develop a WINEP that:

- Focuses on delivering outcomes;
- Enables wider environmental outcomes to be supported;
- Allows for plans to be developed to a longer-term horizon;
- Accommodates a systems and catchment-oriented approach, including facilitating a greater use of nature-based solutions, which promotes more innovation and company collaboration;
- Allows relevant parties to co-design, co-deliver, and co-fund; and
- Makes the best use of and improves available data.

The options development process was a multi-organisational effort involving Defra, the Environment Agency, Ofwat, water companies, DWI, CCW, Natural England, and eNGOs. It was also informed by wider stakeholder engagement workshops, industry surveys, and analysis of existing guidance and documents relating to the WINEP.

Each option was scored against a set of pre-defined assessment criteria. The taskforce identified which options should be discounted, and a Roadmap for which should be implemented for PR24, and which should be considered for PR29 and beyond. Part 2 of the consultation document and the accompanying draft WINEP methodology 'Draft water industry national environment programme (WINEP) methodology' (EA, 2021) present the options that were identified as the recommended solutions for updating the WINEP.

2.7.10.6 Collaboration

As a sector, we need to support each other to meet long-term challenges through increased collaboration and partnerships. The WINEP taskforce have recognised the benefits of close working relationships between government, regulators, water companies and other environmental stakeholders.

The WINEP taskforce are committed to strong partnership working and building clear, future-focused policy frameworks, taking joint action where needed and encouraging and facilitating greater collaboration and partnerships across the sector. Not only will this generate better outcomes for the environment, but it will also stimulate innovation and new thinking.

2.7.10.7 Behaviour and culture change

The work of the WINEP taskforce has enabled a rethink of how environmental improvements are delivered through the WINEP. It has also signalled that the sector must continuously look at how it works, from developing people with the skills needed to meet future challenges, to ensuring that water companies consider the environment an integral part of their business.

2.7.10.8 Next steps

Engagement with water companies in summer 2021 via the consultation, with the aim of publishing guidance to:

'provide clarity on the Environment Agency's expectations of water companies. It will set out what evidence is needed when proposing actions for inclusion in the WINEP. The guidance will aim to provide instruction on the approaches to evaluation of costs and benefits to maximise consistency of evidence across companies and areas'.

The consultation ran from 22 July 2021 to 16 September 2021, the results of which are yet to be published. The NEP is expected to place requirements on DCWW for the delivery of specific water quality schemes, identified through the DWMP.

2.7.11 Water Resources Act 1991

This act (as amended), which applies in England and Wales, set out the functions of the National Rivers Authority (now Natural Resources Wales, the Environment Agency in England) and introduced water quality classifications and objectives for the first time.

Part II of the Act deals with management of water resources. This includes the licences required to abstract and impound controlled water. These licences can be obtained from the regulator (NRW/EA). Note that the water abstraction and impounding provisions have been significantly amended by the Water Act 2003. Part II also includes provisions dealing with drought orders.

Part III of the Act deals with control of water pollution. This includes the discharge consent system. Any business that wishes to discharge anything other than clean, uncontaminated water into controlled waters must have a discharge consent from the regulator. Part III also details water pollution offences. The main offence is causing or knowingly permitting any poisonous, noxious, or polluting matter or any solid matter to enter controlled waters.

Part IV deals with flood defence. Part VII deals with anti-pollution works and works notices. A works notice can be served on anyone that causes or knowingly permits a pollutant to enter controlled waters.

2.7.12 Flood Risk Regulations 2009

The Flood Risk Regulations 2009 make the Floods Directive (Directive 2007/60/EC of the European Parliament and of the European Council on the assessment and management of flood risks) part of UK law. It requires the following to be repeated on a 6-yearly cycle:

- Preliminary Flood Risk Assessment (PFRA) map and report, from which Flood Risk Areas should be identified;
- Flood hazard and risk maps; and
- Flood Risk Management Plans (FRMPs), each covering a RBD.

2.7.13 Flood and Water Management Act 2010

The Flood & Water Management Act 2010 applies to England & Wales and aims to create a simpler and more effective means of managing the risk of flood and coastal erosion. The Act also seeks to support the sustainability of water resources and minimise the risk of potential droughts.

Through the creation of new management roles, the Act gives local authorities the duty and ability to manage flood risk and allows water companies to restrict consumption during shortages. It promotes sustainable drainage systems, calls for a risk-based approach to reservoir safety, introduces new measures for vegetation management, and requires that flood risks be addressed in a manner that encourages more ecologically beneficial options whenever feasible (such as natural flood management elements). Flood management is targeted at the local level through the formation of new Local Flood Risk Management Groups (LFRMGs). These groups must consist of stakeholders from public, private and non-governmental sectors, including representatives from the communities at risk of flooding or coastal erosion. Local Authorities are required to actively engage these stakeholders to determine how best to manage flood risk within their area.

The act also introduced Flood Risk Management Plans (FRMPs) which became mandatory in 2015. These plans, which must be updated every six years, identify flood risk and how it will be managed in a particular area. Flood defence improvements are prioritised based on their contribution to risk reduction and affordability, environmental objectives, and potential for future development.

Section 13 of the Act also placed commitments on risk management authorities to work together in the exercise of their functions, something that will be critical for the successful delivery of the DWMP:

> *(1) A relevant authority must co-operate with other relevant authorities in the exercise of their flood and coastal erosion risk management functions.*
>
> *(2) A relevant authority may share information with another relevant authority for the purpose of discharging its duty under subsection (1).*

Schedule 3 provides the primary legislation to enforce sustainable urban drainage. The SuDS hierarchy is introduced through the supporting regulations and guidance beneath this schedule. Including the statutory national standards for sustainable drainage systems (2018).

2.7.14 Environment Act 2021

The Newly enacted Environment Act sets out the requirements that will make the Drainage and Sewerage Management Plan (DWMP in the non-statutory phase) a statutory requirement. This act states where the enactment is to be addressed which is within the Water Industry Act 1991.

2.7.15 Welsh Government - National Strategy for Flood and Coastal Erosion Risk Management

The Flood and Water Management Act 2010 places a duty on Government in England and Wales to develop a national flood and coastal erosion risk management strategy.

During 2020 government released update versions of their national strategies for England and Wales:

- National Strategy for Flood and Coastal Erosion Risk Management in Wales (Government W. , National Strategy for FCERM, 2021) sets out the long-term Welsh Government policy and is supported by 24 measures which set out actions for the Flood and Coastal Erosion Committee for Wales, Welsh Government and for Risk Management Authorities (RMAs) to deliver over the next 10-years.
- National Flood and Coastal Erosion Risk Management Strategy for England (Government U. , National Strategy for FCERM, 2021), sets out the UK government direction for managing flood and coastal risks to the year 2100. It is supported by the Flood and Coastal Erosion Risk Management Strategy Action Plan (Government U. , National Strategy Action Plan, 2021), which is managed by the Environment Agency.

Welsh Government agency Natural Resources Wales (NRW) in Wales, and the Environment Agency (EA) in England, manages flood risk from major rivers and the sea. NRW the EA can also carry out certain actions on minor waterways to reduce hazard, such as changing water levels and constructing new works. Both organisations are primarily responsible for advising Government, as well as informing RMAs and the public through their prediction, warning, and mapping work.

There are 22 Lead Local Flood Authorities (LLFA) in Wales and a further 6 within the English areas operated by Welsh Water, who oversee flood risk from surface water, groundwater, and lesser streams known as ordinary watercourses. They oversee drainage on local roads under the Highways Act. Their responsibilities include drafting Local Flood Risk Management Strategies (LFRMS) or FRMPs, investigating all significant flooding, and keeping asset registers on defences in their jurisdiction.

Under the Highways Act, the Welsh Government, as the highway authority for trunk roads, is responsible for drainage on trunk roads in Wales. In England, National Highways deliver an equivalent role.

2.8 Regulatory Influences

The privatised water sector in England and Wales is regulated by four separate and independent bodies that work on behalf of Government. These are:

- Ofwat;
- Natural Resources Wales;

- Environment Agency; and
- Drinking Water Inspectorate (not directly linked to drainage and wastewater).

The statutory status of these bodies means that they will have a primary role in regulating future cycles of the DWMP. However, government is also advised by several Non-Governmental Organisations (NGOs), and we expect these to be considered as non-statutory consultees to future cycles of the DWMP.

2.8.1 Economic Regulator

Ofwat was established to set appropriate service levels and ensure economic fairness for the consumer. Ofwat is a non-ministerial government department primarily responsible for the economic regulation of the water and sewerage industry in England and Wales and applies price limits to promote equality.

In addition to economic regulation, Ofwat has several other responsibilities, such as protecting customers from poor service levels, promoting sustainable development within services, and making sure that companies are run efficiently.

The Water Industry Act 1991 (WIA91), as amended, assigns duties to Ofwat as the economic regulator of the water sector, in sections 2 and 3 of the Act.

Ofwat seeks to apply the principles of best regulatory practice, which includes ensuring that activities are transparent, accountable, proportionate, consistent, and targeted.

To ensure fairness of pricing and economic performance, Ofwat reviews service provision and applies a price cap system to WaSC's revenue. The price cap mechanism is expressed by the formula RPI + K, where RPI represents the Retail Price Index and K represents the expected efficiency gain the regulator believes the operator would have achieved in an unregulated competitive market. The first price review occurred in 1994 and was repeated following a five-year cycle. These periods are described as the Asset Management Plans (AMPs).

2.8.2 Environmental Regulators

The below sections describe who our environmental regulators are.

2.8.2.1 Natural Resources Wales

Natural Resources Wales (NRW) was established in in 2013 and is a Welsh Government sponsored body that was created from a merger of the Countryside Council for Wales, Environment Agency Wales, and the Forestry Commission Wales. The core duty of NRW is to "pursue sustainable management of natural resources" and "apply the principles of sustainable management of natural resources" as stated in the Environment (Wales) Act 2016.

On 1 April 2015 the functions, assets, and staff of previously independent Internal Drainage Boards (IDBs) (for specific low-lying areas such as Powysland, Lower Wye and Caldicot and Wentlooge Levels) were transferred to NRW. NRW management of Internal Drainage Districts in Wales joins up water level, conservation, and flood risk management in key areas.

NRW acts as environmental regulator and regulates our activities in Wales, which forms most of our wastewater operating area.

Discharges to the environment from industrial activity is licenced by the EA through a permitting framework. The regulations enforced by the EA are typically implementations of EU directives. Directives such as the Water Framework Directive place additional burden on wastewater companies by tightening the discharge consent limits (European Parliament, 2000).

NRW have responsibility for the preparation and consultation of River Basin Management Plans (RBMP) in Wales, and for driving the subsequent National Environment Programme (NEP) which aims to address unacceptable risks to the aquatic environment. They also play an oversight role in flood risk management and the deliver some regional FRMPs.

Following the same methodology as the EA (their counterpart in England) NRW regulates waste discharges to the natural environment via a permitting mechanism.

2.8.2.2 Environment Agency

The Environment Agency (EA) was established in 1996 and is an executive non-departmental public body, sponsored by DEFRA to protect and improve the environment, and acts as environmental regulator to the water sector in England. The EA regulate our activities in England only, a relatively small component of the area which we serve.

Discharge to the environment from industrial activity is licenced by the EA through a permitting framework. The regulations enforced by the EA are typically implementations of EU directives. Directives such as the Water Framework Directive place additional burden on wastewater companies by tightening the discharge consent limits (European Parliament, 2000).

The EA is responsible for updating and consulting on the River Basin Management Plans (RBMPs) for England and for developing the subsequent Water Industry National Environment Programme (WINEP) which aims to address risks identified and specifies a series of outputs or outcomes that the water industry must deliver to meet the necessary environmental improvements. These outcomes may range from investigations and monitoring to capital investment projects aimed at making improvements to the aquatic environment from our wastewater systems. As such, the DWMP may provide a valuable data on where our assets are likely to put the environment at risk and the estimated timelines for those risks to arise.

2.8.3 Other Regulators

The below sections describe who our other regulators are.

2.8.3.1 Natural England

Natural England, established in 2006 as an executive non-departmental public body sponsored DEFRA, is the government’s adviser for the natural environment, and their primary responsibility includes providing advice on matters concerning land and aquatic habitats. They work to secure England's landscapes from degradation or destruction through designation of protected areas and enforcing related regulations. This role is undertaken by NRW in Wales since the Countryside Council for Wales was incorporated.

2.8.3.2 Lead Local Flood Authorities

County Councils and Unitary Authorities are defined as Lead Local Flood Authorities (LLFA) under the Flood and Water Management Act (FWM). They become responsible for managing local flood risks, such as those arising from surface water, groundwater, and minor waterways. This involves promoting communication among the Risk Management Authorities within their region. The LLFA is required by the FWM and Flood Risk Regulations to produce a Preliminary Flood Risk Assessment (PFRA). The PFRA highlights areas of potentially significant flood risk. This assessment provides a high-level summary of significant flood risk, based on historic information and regional data

2.8.3.3 Risk Management Authorities

WaSCs, and local councils (District and Borough) are assigned the role of Risk Management Authorities (RMA) by the FWM and are responsible for flood and coastal erosion risk management, flood warning and flood forecasting services on a catchment or sub-catchment basis. As key stakeholders in planning local flood risk management they ensure risks and vulnerabilities facing the area will be addressed through collaborative efforts with LLFAs and other Risk Management Authorities, and seek to guarantee that risks are effectively managed, including in terms of policy development. Furthermore, they are responsible for undertaking flood risk management activities on minor watercourses within the region.

2.8.3.4 Local Authority Highways

Highways - Under the Highways Act 1980, highway authorities (Highways Agency and unitary/county councils) have primary responsibility for providing and managing highway drainage and roadside ditches. The Flood and Water Management Act 2010 introduced a new duty on local flood authorities (i.e., NRW) to work with relevant local bodies such as transport agencies and the emergency services when managing flood risk from land adjacent to major roads. In practice, Highways Authorities need to liaise closely with both other Risk Management Authorities and Local Authorities as part of an all-hazards approach to flood risk.

2.8.4 Other stakeholders

2.8.4.1 Consumer Council for Water

The Consumer Council for Water is an independent advocate for water consumers in England and Wales. The CCW provides free advice to resolve complaints against water service suppliers and retailers. CCW's mission is to Secure a fair deal for water consumers, now and in the future. five key objectives underpin this goal:

- Affordability – creating a system that provides access at an affordable price;
- Climate resilience - ensuring consumers have access to water services now and in the future;
- Consumer engagement/ participation– to ensure services are influenced by consumers views and opinions;
- The needs of all consumers are met; and
- Effective complaint processes—responding quickly and appropriately when individuals have concerns.

To further support these objectives and core mission the CCW has 4 special campaign areas

- End water poverty;
- A voice for your complaint;
- End sewer flooding misery; and
- Be in the know.

2.8.4.2 Riparian Owners

Under common law, a riparian owner possesses rights over and responsibilities for the stretch of a watercourse that forms the boundary of their property. A riparian owner is anyone who owns a property where there is a watercourse within or adjacent to the boundaries of their property and a watercourse includes a river, stream, or ditch. A riparian owner is also responsible for watercourses or culverted watercourses passing through their land. Riparian responsibility can also lie with the tenant of the property, depending on the agreement. A watercourse in this context is any natural or artificial channel above or below the ground through which water flows such as a river, brook, beck, ditch, mill, stream, culvert, drains, cuts, dykes, passages, pipes and sewers (other than public sewers).

2.8.4.3 Coastal Authorities

Harbour authority – generally an independent self-governing body that is responsible for safely managing and efficiently running a harbour. Most harbours are administered by statutory harbour authorities (SHAs), empowered, and governed by local legislation which is generally tailored to the requirements of the harbour in question. These requirements may include operation and maintenance of harbour systems, plus environmental management including, for example, maintaining water quality and monitoring of groundwater and surface waters.

The Crown Estate - The Crown Estate manages a significant proportion of the Welsh foreshore, the land between mean high and mean low water mark, including numerous stretches of coastline, beaches, bays, estuaries (Crown Estate, 2022). In this capacity, The Crown Estate lease and licence tidal land and seabed for port and harbours infrastructure, moorings and marinas, and cables, pipelines, and outfalls. The Crown Estate also lease land for aquaculture and other coastal development projects.

Maritime Local Authorities – involved in Coastal Groups (whose members include NRW, government bodies and other stakeholders with a responsibility or interest in managing the coast) in the production of Shoreline Management Plans (SMP). SMPs are not statutory documents, but Welsh Government want to see them considered both in local decision-making and strategic planning, such as Local Development Plans and Local Flood Risk Management Strategies.

2.8.4.4 Interest groups

There are several other key environmental non-government organisations and local interest groups that have a voice or role in the DWMP. Organisations, such as the Rivers Trust, Afonydd Cymru, National Farmers Union, Farmers' Union of Wales, professional institutes, academia, and others who can make a valuable contribution to the development of the DWMP, as well as responding to the formal consultation process. Consultation with this sector, in the absence of the Catchment Based Approach (CaBA) structure in Wales has been constrained in this first cycle of our plan but further details can be found in the Engagement section of this report (Section 3).

3 Engagement

3.1 Introduction

This section sets out how engagement has been undertaken and how Customer Research has been utilised to develop the Plan. It also sets out the meaning of formal consultation and how these separate actions knit together to drive plan development and inform the next cycle.

> The framework (WaterUK, 2018) states that: 'through their DWMP's, companies will provide the basis for effective engagement with customers and stakeholders on levels of service, environmental performance and resilience, now and for the future and on the choices and costs to customers in providing that service. Early engagement in the DWMP process is fundamental to ensure alignment of objectives and plans, to identify issues, risks and potential opportunities, and to reduce the risk of issues being identified at a later stage in the process or being overlooked completely.' We have broken this statement down to form our approach.

As part of this work, we reviewed where the company were already carrying out engagement activity and, as suggested in the framework, to identify any opportunities to merge with existing approaches. It was established quite quickly that any engagement activity was not consistently being carried out. One of the reasons for this is that the company straddles the Welsh / English border, with differing regulatory requirements and policy drivers on either side of the border. This difference needed to be incorporated into the engagement strategy. Another reason related to the north / south divide of Wales, with Welsh as a first language in parts of north Wales, and English as a first language in much of south Wales. This was not seen as a barrier to communication but an opportunity to pro-actively incorporate and consider the use of language.

It should be highlighted that, as one of only two water and sewerage companies operating "wholly or mainly in Wales", we have had to take the Welsh Government policy and context into consideration throughout the development of the Plan. Therefore, the approach to engagement and the outcomes of engagement activities will not necessarily be consistent with other water and sewerage companies across the UK.

In addition, there is a significant difference between England and Wales regarding the existence of the Catchment Based Approach (CaBA) in England, which provides an existing platform for dialogue between organisations involved in the water environment. We held a workshop with our stakeholders to evaluate the appetite to set up a catchment-based approach in Wales. The outcome of that work being that stakeholders would prefer us to consider an alternative approach.

These differences were not seen as draw backs, or barriers, but a way to trial differing approaches to suit the needs and dynamics of the location.

3.2 Shared Vision

Engagement with stakeholders and customers is central to achieving our shared vision for the future improvement of environmental water quality and the management of drainage and wastewater.

We have worked hard to ensure that engagement with both customers and stakeholders is meaningful and collaborative, and we have used the outcome of our engagement work to shape this first cycle of the Plan.

Early work with customers involved research groups to determine awareness, expectations, and support around the DWMP management options and of wastewater services in general. Findings from that work suggested that the DWMP objectives align with our customers' expectations of what Welsh Water should strive towards in the long term, to achieve the best outcome for the communities we serve and the environment we operate in.

We have undertaken ongoing collaboration with stakeholders at a company level, covering the whole of Welsh Water's operating area; working with stakeholders across our 13 'Level 2' Strategic Planning Unit areas and at our 'Level 3' Tactical Planning Unit areas.

3.3 The Purpose of DWMP engagement?

The aim of stakeholder engagement is to collaborate and find solutions that align with the needs of society while informing the decision-making process and enhancing the development of the DWMP.

Engaging with regulators helps ensure compliance with best practices while also fostering innovation in DWMP approaches.

Engaging with the government is crucial to ensuring that the DWMP can deliver the intended benefits and that legislation and policies are in place to support these outcomes.

We work well with our stakeholders, although there is a lack of consistency across our operating area. In those areas where engagement is strong, we have worked together with stakeholders to identify many areas of opportunity. Our latest innovative collaboration relates to the development of a wetland owned by a regional management authority, which is fed solely from the effluence of our WWTW's. We need more of these opportunities. If we were to do this in every river we would need to replicate the activities and the driver and find a common reason to work in a location. Our engagement with stakeholders offers the opportunity to enhance what we as Welsh Water already do, i.e. offers an additional dimension. Within this chapter we will discuss how we intend to enhance the activities that we already have. The DWMP engagement strategy sets out to achieve the development of a consistent approach that works well at every location. The approach relies on predetermined processes and methodologies, with buy in and roles from Government, RMA's and eNGO's agreed and established from the outset. Contributions will need to go far beyond participation at meetings, with the vision being that the project group becomes the hub of programmes for future National Environment, drainage and infrastructure programmes.

In the areas where we are working with other organisations, we are already 'Planning Together' and 'Acting Together' and in some areas have empowered community-directed solutions as laid out in Figure 24. We will continue to describe the enhancement activities required via the consistent approach through these stages of engagement.

3.4 Engagement Objectives

What is engagement?

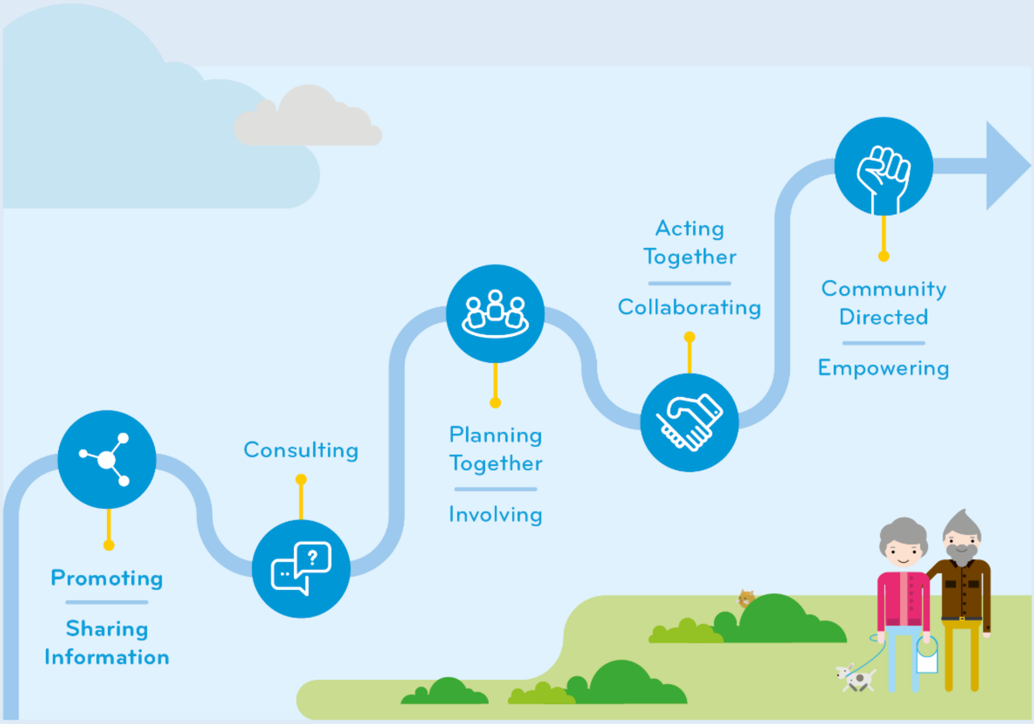


Figure 24 - Community Engagement Model (MFSH, 2008)

By engagement, we mean a broad and ongoing process of sharing information and updates with all our stakeholders, getting their feedback and acting together. Stakeholders are anyone who has an interest in what we are doing; everyone from our customers to the government, regulators, and other water companies.

Figure 24 shows the stages of engagement that we are aspiring to achieve using the DWMP principles to gain community involvement in decisions.

Our aim with the DWMP engagement framework is to progress from simply sharing information to a more collaborative, community-directed approach where stakeholders and customers play an active role in decision-making. This will move our communication activities to a collaborative/acting together level of engagement. We recognize the need to adapt to newer engagement models, but our model is based on a 2008 framework that still provides a useful roadmap for our journey towards full community-directed, project-based schemes. We noted at the start of the DWMP process that we were in the 'sharing information' stage. Our programme of work over the next 25 years will move us from 'sharing information' to 'acting together' and 'community directed', where stakeholders and customers will make decisions on the solutions which are right for them.

As part of the first cycle of our plan, we set realistic engagement objectives based on past engagement experiences, identifying opportunities for improvement and the best approach going forward. Our focus is to work closely with stakeholders to develop plans and identify the benefits of the DWMP to them.

Our engagement objectives:

- We aim to engage all stakeholders in a proactive manner that meets their different needs and expectations, while building a broad public awareness of the challenges involved in delivering the DWMP;
- We prioritize early, consistent, and meaningful engagement with key stakeholders to ensure their views are properly considered at every stage of the development process;
- We aim to create greater public awareness of the magnitude and intricacy of the task of executing the DWMP by presenting comprehensive information about the challenge in a manner that is easily understandable;
- We aim to maintain consistent messaging to avoid mixed communication by ensuring that all DWMP communications are consistent in terms of style, tone and content; and
- We aim to identify risks early and proactively implement effective actions to minimise or neutralise reputational or program damage.

Early engagement with stakeholders has been essential to enable all parties to understand their roles in relation to the DWMP. This helped to support early identification of capacity or capability constraints and assisted in identifying how we wanted to work with stakeholders and how they wanted to work with us to manage DWMP activities.

3.5 Engagement with Regulators

Engagement with Regulators throughout the process has been via the Water UK steering group and the Welsh Government DWMP Steering group. These sessions have occurred either quarterly or on an ad hoc basic. Looking ahead, we plan to introduce more formalised sessions to demonstrate the methodology being undertaken, with an opportunity for us to gather immediate feedback from our regulators.

3.6 The difference between engagement and consultation

There is a misunderstanding regarding the differences between engagement and consultation and it is important that we draw the distinction between these activities.

- Engagement is carried out continuously. It is used as a mechanism to nurture collaboration and co-creation. This is carried out informally and occurs while the Plan is being developed and often without site of the Plan documentation; and
- Consultation is a formal activity that includes all our stakeholders and customers. This formal activity has a clear objective which is to comment on the draft Plan once it is written so that there is a formal steer in order to create a final Plan.

3.7 Our Milestones and objectives

We undertook an assessment of our engagement maturity using the principles from the International Association of Public Participation and concluded that in terms of the starting position before the DWMP we were at the informing/sharing information stage. Our milestone programme was built to improve our position.

We worked together with our stakeholders to develop the DWMP and ensure that the needs of our different stakeholder groups, including our customers, are reflected in the Plan. We had three milestones and five objectives to achieve during our 2024 Plan as outlined in Table 14.

Collaborating with our stakeholders, we developed the DWMP to ensure that the plan aligns with the needs of our diverse stakeholder groups, including our valuable customers. Our 2024 plan was designed to meet three major milestones and five key objectives.

Table 14 - 2024 Plan Milestones, Objectives and Aims

Milestones	1. Create the right environment for engagement to take place. 2. Align our objectives with stakeholder feedback. 3. Jointly agree the approach and methodology with our stakeholders.
Objectives	1. Engage with stakeholders in good time and in a way that meets everyone's needs and expectations. 2. Engage in a clear, consistent, and meaningful way to ensure everyone's views are properly understood and considered. 3. Build a broad public awareness of the DWMP by providing clear and easily accessible material suitable for the audience. 4. Ensure that all materials and communications have the same style, tone of voice and messaging. 5. Make sure that all stakeholders are given enough information on the DWMP and have an opportunity to feed into the development of the Plan.
Aims	Following on from the consultation of our Draft Plan, we have introduced two additional aims for engagement: 1. To inform, engage and consult with stakeholders and customers throughout the development of the DWMP. This includes engaging with all stakeholders at the end of every stage of the DWMP. 2. To engage directly with stakeholders to develop specific opportunities and turn them into opportunities for delivery.

A summary of what we have done to meet each of our three key milestones has been included below.

3.7.1 Milestone One – Create the engagement environment.

We followed the following steps to create the right environment for engagement to take place:

1. Mapped out key stakeholders, how they fit with the DWMP, how they currently work and their current links with Welsh Water.
2. Identified what was already in place in terms of forums or other methods key stakeholders had to speak with us regarding flooding, pollution, drainage, and other issues.
3. Decided on an approach for how we can best work with these stakeholders and get their input.
4. Identified the main regulatory bodies and their interest areas in the DWMP.
5. Carried out engagement with customers to better understand:
    - Awareness and understanding of drainage and wastewater.
    - Expectations of drainage and wastewater service.
    - Views on our 25-year plan for drainage and wastewater.

The key outcomes of this Milestone were:

- A list of key stakeholders, their links with Welsh Water and why they have an interest in the development of the DWMP.
- An overview of what's already in place to engage with these stakeholders.
- An outline of best approach for working with these stakeholders.
- An understanding of customer awareness, views, and expectations of the DWMP, their drainage and wastewater services and our 25-year plan.
- An agreement to contact stakeholders by email

Overall, this stage helped us to find out how stakeholders would prefer to work with us and what they want from engagement and the DWMP. This helped us to develop our Plan objectives.

Creating the Engagement Environment

Through our engagement with stakeholders, we established there were several forums dealing with flooding across England and Wales, including:

- The Welsh Flood and Coastal Erosion Risk Management strategy (FCERM): sets out how the FCERM will help reduce risks to communities and businesses across Wales and adapt to our changing climate;
- Lead Local Flood Authorities (LLFA): sit within county councils and unitary authorities and lead in managing local flood risk within their areas;
- The Water Industry National Environment Programme (WINEP) and Welsh National Environment Programme (NEP): set out the water industry's contribution to delivering the wider national objectives for the natural environment as set out in the River Basin Management Plan and other statutory plans;
- Nutrient Boards: identify and deliver actions relating to phosphorous in rivers;
- National Flood Forum: supports individuals and communities at risk of flooding throughout England and Wales;
- Public service boards: improve joint working across all public services in each local authority area in Wales;
- Area Statements: provide a local evidence base;
- Better River Quality Taskforce: brings regulators, government and water companies together to improve river quality;
- Upon examining the existing joint working forums, we determined that there was no forum in Wales that addressed both flooding and pollution within a specific geographical area; and
- To establish an engagement environment, we consulted with stakeholders on their current approaches to engagement, identified potential opportunities and obstacles to collaboration, and determined that establishing a forum to address this issue is necessary.

3.7.2 Milestone Two – Aligning Objectives with Stakeholders

During Cycle 1, we faced difficulties in meeting with stakeholders due to the lack of developed forums for engagement, which hindered the efficient collection of opportunities. We tried to reach out to approximately 185 stakeholders via email to understand and confirm any organizational objectives or initiatives that could align with the DWMP works to include them in the strategic context of the first plan. However, we received very few responses, less than 30, and even fewer asked us to incorporate an objective.

We had planned to visit councils and key stakeholders face to face to discuss the plan. We aimed to meet with a minimum of 26 councils and national parks and join those sessions with e-NGOs. However, we were only able to complete the first two visits when the Covid pandemic halted our programme. In response, we reviewed other organizations' plans, such as Area Statements, River Basin Management Plans, Flood Risk Management Plans, and others. Some organizations faced challenges in transitioning to online work, so we had to do this ourselves. Our online sessions resumed in late 2020, and we used these sessions to check the breadth of planning required by each organization.

Despite the impact of Covid-19 on physical engagement, the key messages and objectives of other organisations have indirectly influenced how the Plan has developed. We concluded that there are many overlaps in the plans required by each organisation and recommended considering creating a joint plan for drainage and water quality in the future.

Subsequently, we met with all councils and national parks to carry out an opportunities mapping session, and we are continuing to undertake more sessions. After considering how to create the engagement environment, we discussed our approach to engagement with stakeholders, talked about the opportunities and barriers, and found that there was a need to create an engagement forum to feed into the development of the DWMP. We engaged with key stakeholder organizations through email or face-to-face meetings, met with local councils and stakeholders face-to-face and online, met with small local community interest groups, and reviewed key stakeholder organisations' plans and documents to understand how these could align with the DWMP.

These steps allowed us to identify the need to create a new engagement forum to feed into the DWMP as no forums discussed both Quality and Quantity at the same time. They also helped us understand how stakeholders' own plans and aims align with the DWMP, which allowed us to agree on an overall approach and method for carrying out our engagement.

The key outcomes of this Milestone were:

- We identified the need to create a new engagement forum to feed into DWMP as there were not any forums that discussed both Quality and Quantity at the same time.
- We gained more understanding of how stakeholders' own plans and aims align with the DWMP.

This allowed us to agree on an overall approach and method for carrying out our engagement.

3.7.3 Milestone Three - Jointly Agree the Approach And Methodology

Our aim is to create a joint working arrangement through the set-up and repurposing of programme and project boards to agree on resource plans to deliver solutions. But we also want to create a community ownership approach to the choices that provide the solutions of their choice.

The joint working groups would consist of:

Strategic Management forums, to make decisions that manage joint funds and agree programmes of work.

Programme/Project Boards, to act as enablers between Strategic Management Forums and Community Projects to plan and agree resources and build business cases to put forward to the Strategic Management Forums for funding.

Community Project Boards, which work with Project Boards to endorse and put forward suggestions, develop and work with those who implement solutions for their own community and act as the community liaison for local flooding and pollution issues in Figure 25 below.

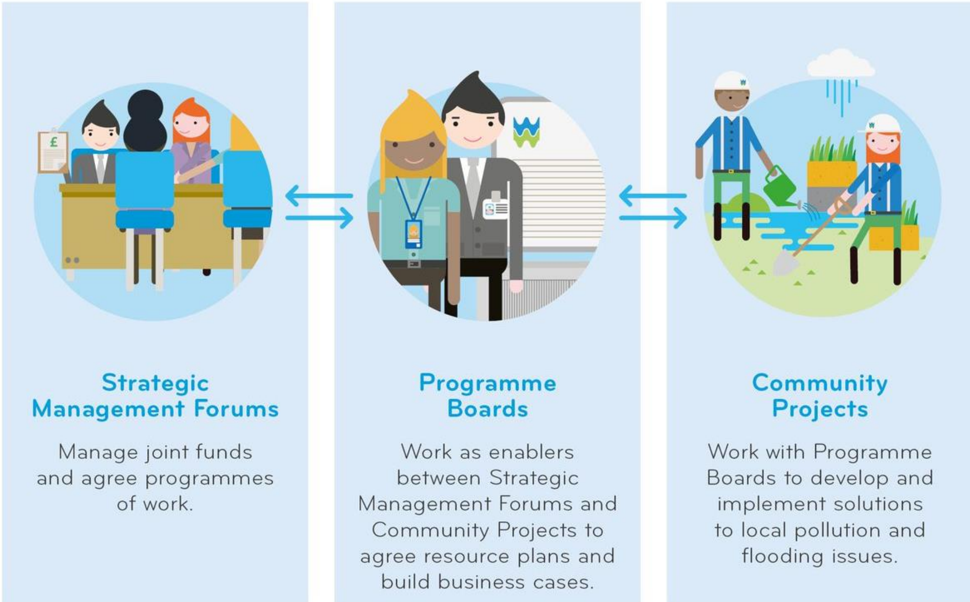


Figure 25 - Represents the setup of functioning groups with skills for each group to facilitate opportunities

Workshops with local Councils and Local Planning Authorities took place in mid-2021 to explore how stakeholders would like to engage with Welsh Water in the future, as part of a Joint Working Group throughout the development of the DWMP. The workshops emphasised the setup of project boards as an enabler between the Strategic Management board and community projects.

The outcome of these workshops indicated that, whilst stakeholders strongly agreed that a joint working group would benefit their organisations and they could bring a range of expertise such as planning; modelling; design; natural flood management and local knowledge to support such a group, there were constraints which would impact their participation in a joint working group project board. This shows there is a willingness and appetite to have strong relationships to nurture joint working opportunities, however the constraints are holding us back.

The primary constraints indicated were lack of funds (for resource; to deliver schemes and to engage with the community); technical constraints; alignment of priorities and availability of time to participate.

It was concluded that what was needed was a mixture of the boards rather than three individual boards. It is the combination of skills of each board that are required. Where it is necessary, we will set up the appropriate number of boards rather than automatically setting up three separate groups that is effective for that area. This means that in a local area where a few people together can cover the skills there is not a need for three meetings. But in the remainder of this section, we will continue to reflect on the three separate tasks to highlight where changes are going to be required going forward.

We were asked by Welsh Government to trial the approach alongside other approaches being trialled for Sustainable Management of Natural Resources (SMNR) (see Figure 26) so as a company we have set up five locations, of which Anglesey was chosen for the DWMP approach.

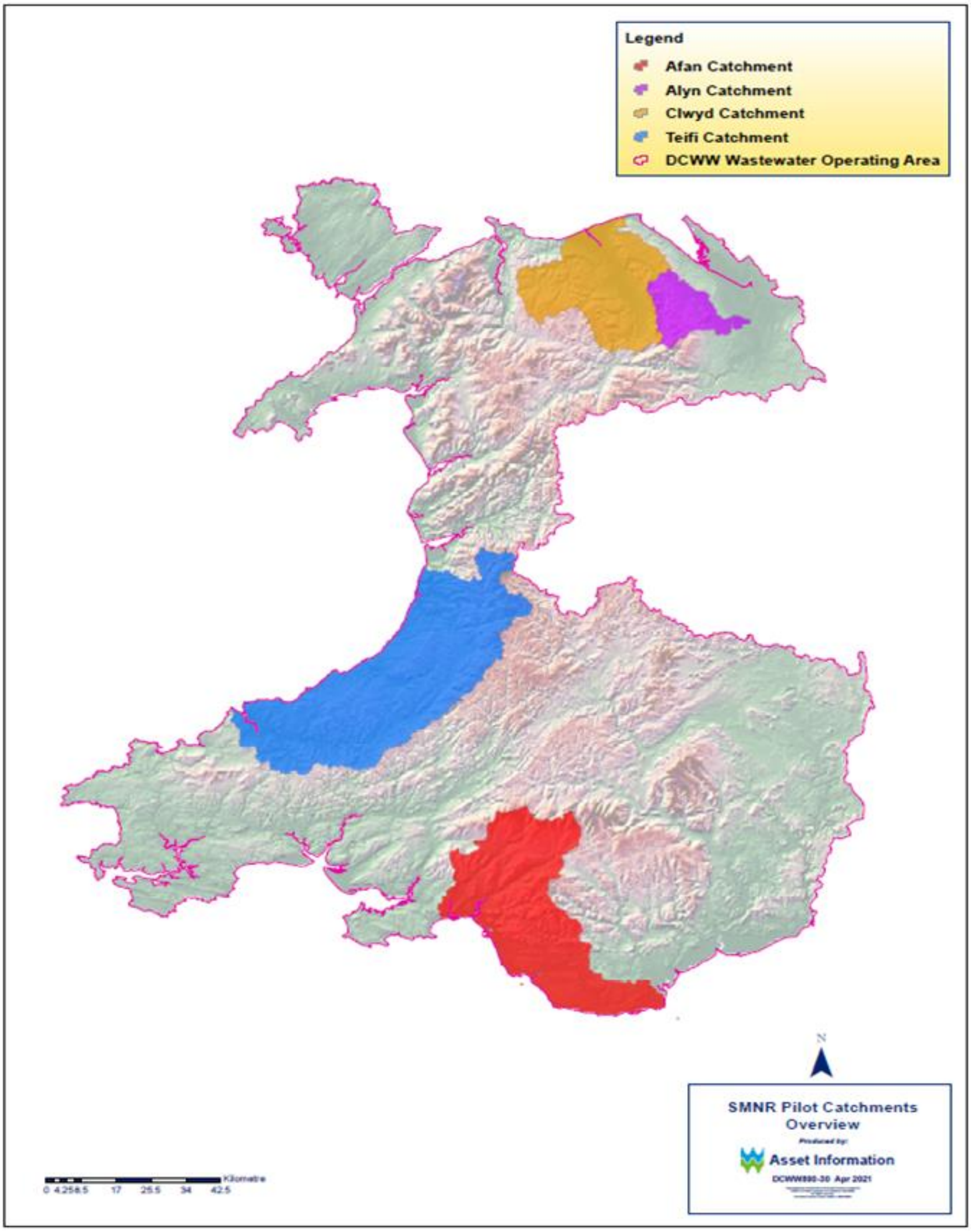


Figure 26 - DCWW SMNR Pilot Areas

The Anglesey trial started in June 2021 and was aimed at the Project level board. It is still running now. The membership is DCWW and the Isle of Anglesey council. NRW joined the group at relevant stages, for example at locations where NRW were proposing solutions. The meetings highlighted that it was difficult to find overlaps when considering only the remit of the organisation. It was when the flexibility of the Team Wales approach was considered (i.e., what is the best outcome for the community to manage drainage and pollution, as a whole) that opportunities started to be highlighted. However, delivery of joint investigations also became a barrier when health and safety of staff attending site while work was being undertaken by the co-creator organisation. Also, it was difficult to maintain momentum through investigation stage while current risks that emerged while the process was underway took time from the staff resourcing and the funds allocated to forward planning. Then eventually the high turnover of staff on both sides also impacted progress. It is clear that in the area of drainage there is a limited number of experts in the field and there is high turnover of staff finding new positions in consultancy and other more lucrative posts.

Our aim is to have a joint working approach with stakeholders and local communities to feed into development of the Plan and deliver options. We want local communities to be involved in the process and feel that their voice is being heard.

The steps we have followed as part of this stage included:

- Discussions with our stakeholders to bring out the benefits from the groups already underway; and
- Discussions to understand the barriers to engagement.

We have agreed that we need a separately managed group so that opportunities to manage drainage collectively can be discussed and then together application for funds can be made.

A barrier to joint working was identified where each organisation could not obtain joint funds easily and many previous joint opportunities have been difficult to deliver even at the initial stages to obtain funds for the project to start.

As part of planning the joint working groups, we have held workshops with local councils and planning authorities to look at how stakeholders would like to engage with Welsh Water in the future. These workshops have taken place throughout the development of the DWMP.

Joint working Trial

We have been trialling our joint working approach with Isle of Anglesey County Council. We have been getting to know each other better, getting to know where our current risks are, building models that include both organisations pipework, but we are learning that there is some give and take, and alteration of standpoint required. We both need to think about the community and not about the organisation and funding. Now we need to find a scheme to support. Then learn how to fund it.

The key feedback and outcomes from this milestone were:

- A joint working group is a good idea, but a different approach may be needed which is more tailored to different areas and stakeholders.
- There are some issues holding back the idea of a joint working group which include lack of money, resources and time, and differing priorities.
- Local councils and planning authorities want to work with us on the DWMP and identify opportunities to work better together.
- We need a mixture of boards (rather than just the three boards identified) and we may need more (or less) boards based on what will work best in different areas.

3.8 How Mature Is Our Engagement Locally?

We are at the 'informing' stage with two out of the 13 areas; at the 'consulting' stage with 10 areas, and we are moving between the 'consulting' and 'collaboration' stages in one area (Anglesey). We are building relationships first in order to gain trust, with the aim of moving to 'collaboration' with stakeholders in all areas.

We need to identify the right contacts in an organisation to carry out actions and who are also in a position to agree to support the opportunities, not only with funds to carry out the scheme on the ground but to support the development of a cocreated pipeline of schemes, already worked up.

To achieve this, our aim is to put together joint working groups which are made up of people with the skills of the Strategic Management Forum, but predominantly carrying out the tasks we would associate with a Project Board.

We are proposing going forward to support the development of drainage plans in Wales. We work together with council and key stakeholder to create the remaining 12 Programme Boards in the same way as the Isle of Anglesey County Council trial.

We started the introduction of the Boards at the end of 2022 but immediately found that the councils were not ready to move to a standard forum just yet. We then set about working with individual councils instead. This seemed to work much better but is very labour intensive as there are 26 councils and national parks, six areas in NRW, plus Water Resources West. However, the aim is still to achieve the 13 Boards when the stakeholder's area ready to move to that formal set up.

We will consider Strategic Management Boards and community boards while we develop our next Plan.

3.9 Engaging with our External Advisory Panel Stakeholders

We met regularly with the independent environmental advisory panel (IEAP) throughout this process. The panel is made up of representatives of organisations such as Afonydd Cymru, Wales Environment Link and many more who are there to challenge and advise.

3.10 Engaging with our customers

We are committed to bringing the voice of customers into the heart of our business and the DWMP. We want to understand the views of our customers on key parts of the plan, particularly in terms of how quickly we make improvements as this will impact on their bills.

We have particularly ensured early research and ongoing engagement to provide opportunities for customers to help shape the development and speed of changes of the Plan.

We have also met with the Customer Challenge Group who are an independent group of organisations that supply scrutiny of our plans from a customer point of view include this group includes CCW.

Working with our customers

Throughout the development of the plan, we have worked closely with our customers through a series of research sessions. These sessions have informed us of customer awareness, expectations, and support for different options.

This has fed into the development of the Plan, ensuring that the outcomes are in the best interests of both existing customers and future generations who will benefit from it.

Our findings show a strong link between customer priorities and our objectives for the Plan; these include planning for the long term, acting in an environmentally friendly way and providing good value for money.

3.11 Customer research sessions at outset

We carried out research with a broad range of customers including hard to reach groups over three phases during 2020. We engaged with 117 customers during this time, including 15 hard to reach and 30 vulnerable customers. Figure 27 shows the phases and customer coverage undertaken for the first plan.

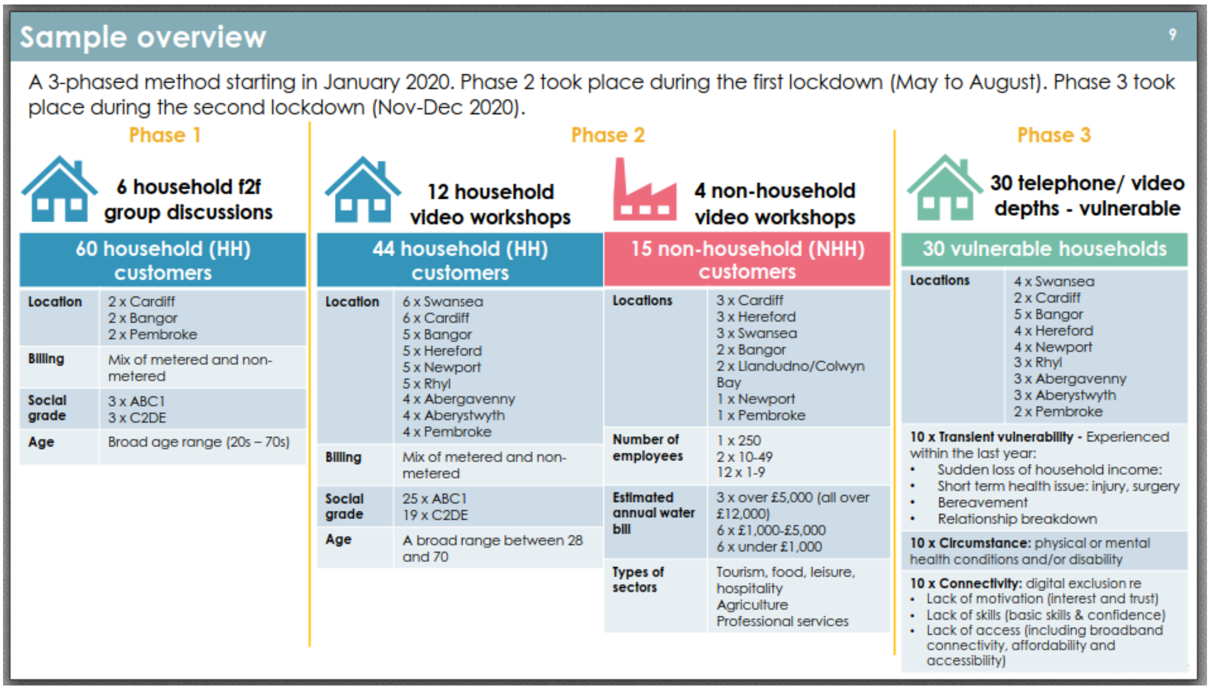


Figure 27 - The extent of customer research

During this customer research, we wanted to find out:

- What do customers know about drainage and wastewater services?
- What level of service do customers want in terms of drainage and wastewater?
- What options for drainage and wastewater management do customers want us to focus on?
- What do customer's think about different investment options?

Our key findings were:

- Customers generally have a low level of knowledge about drainage and wastewater services, and the role of surface water;
- Despite limited knowledge, customers understand that collecting and treating wastewater is a vital part of everyday life;
- Customers are generally aware of future challenges around a bigger population and climate change, but they are less aware of other issues such as growing urban areas

(urban creep). Customers don't fully understand how these issues will impact drainage and wastewater; and
- Customers were positive about efforts being made to plan for the future, having a longer-term view and working closely with others to achieve change.

Drawn conclusion
During a research session, a customer said that *they pay the water company, they pay their tax, and they pay their council tax, so can we just be efficient with the money*. What this means is each of these funds contribute to manage drainage. It doesn't matter where it comes from and how much each contribute, we need to make our plans together and be efficient in how the money is spent.

3.11.1 Learning from the willingness to support research.
We identified a requirement to consult with customers on the Drainage and Wastewater Management Plan (DWMP) ahead of its publication. Market research agency, Relish, was commissioned to conduct independent customer research to help us to understand customer views. The sample size used for household customers was 500, and for non-household customers, 100.

The research objectives were:

- *Overall thoughts on the DWMP*: How do customers feel about what is being proposed in the DWMP consultation? What approach would they like Welsh Water to take to future planning?
- *Detail of the DWMP; importance of areas*: - Do customers agree with proposals in the consultation? Are there certain areas that should be focused on more than others?
- *Updates to the DWMP:* - How do customers want to be engaged with updates as the DWMP evolves over the next 5 years?

We employed two methods to conduct customer research:

- A two-week online exercise, followed by two online focus groups (90 minutes each)
- An online survey involving household and non-household customers

Through this research, we have learned that customers have a high level of interest in the areas covered by the DWMP, particularly in environmental and flooding issues in their local areas.

To meet our customers' demand for more detailed information on the progress of activities in the plan, the use of area-specific summaries has been suggested. These summaries will provide a localized overview of the progress made in a particular area and will be continually updated as work with area-specific stakeholders and communities progresses. We will make these summaries available to customers and address confusion over references to water quality and the term 'stakeholders' being too broad.

Customers prefer a proactive, long-term approach to addressing wastewater and drainage issues in Wales. They support the incremental improvement with targeted small zones approach where appropriate, acknowledging that there cannot be a universal approach, and show flexibility by applying small zone approach in some higher-risk areas. Customers prefer an approach that benefits a wide number of communities more quickly and is more proactive, providing value.

There is a compromise between customers' preference for zero spills from storm overflows and the cost implications of achieving a zero-spill target. Most household customers, specifically younger customers, are willing to accept a level of 10 spills per year during serious storms only. There is a smaller level of acceptance for spills during continuous downpours, and very little tolerance during days of drizzle and dry weather. Customers are in favour of removing surface water from sewers, and we will continue to work with local authorities, Natural Resources Wales (NRW) and the Environment Agency (EA) to agree on ways to provide support in this initiative.

Customers expect to see zero spills within an average of 50 years, and improvements must be evidenced sooner than that. We acknowledge that consideration of affordability has influenced the development approaches in our Plan, and bills need to remain stable. The pace at which we deliver improvements will be influenced by our five-yearly price review submission, balancing the aspirations set out in the DWMP with bills, customer affordability, and Ofwat's expectations. We will continue to work with local authorities to identify areas where we can work together to improve drainage issues locally and use Program Boards to work with communities to develop and implement solutions to local pollution and flooding issues.

3.12 Communication with wider stakeholders to produce programmes of work

As an example of our engagement with wider stakeholders, we have carried out a survey looking into wild swimming groups. We have identified locations where a higher level of public health protection could be provided. We will then incorporate the locations on a priority basis similar to the government process around designation of bathing waters. As this work is just finalising now, the outcome from it will form one of the “what if…..” scenarios in cycle 2.

3.13 Methodology

The following sections outline how we have engaged with stakeholders over time and how the development of the engagement alongside the plan development has evolved too.

We have had to be flexible to work reactively to our stakeholders needs, as well as providing updates when required.

We also had to develop the first plan and gain agreement and direction from stakeholders on topics within the plan. Engagement was carried out to introduce new topics using a presentation of “What is a DWMP”. We then asked stakeholders for their opinion to support the plan development while at the same time developing our understanding of the engagement destination.

3.13.1 Informing the content of the Plan (Information and Promotion).

The programme of engagement aligns with the technical DWMP programme of works, and the key outputs obtained from each development stage which is shown in Figure 28 below. The programme sets out the work required to finalise the initial DWMP cycle by 2024, ready to feed into the next investment plan for Welsh Water. Table 15 presents an overview of engagement at each stage of the Plan.

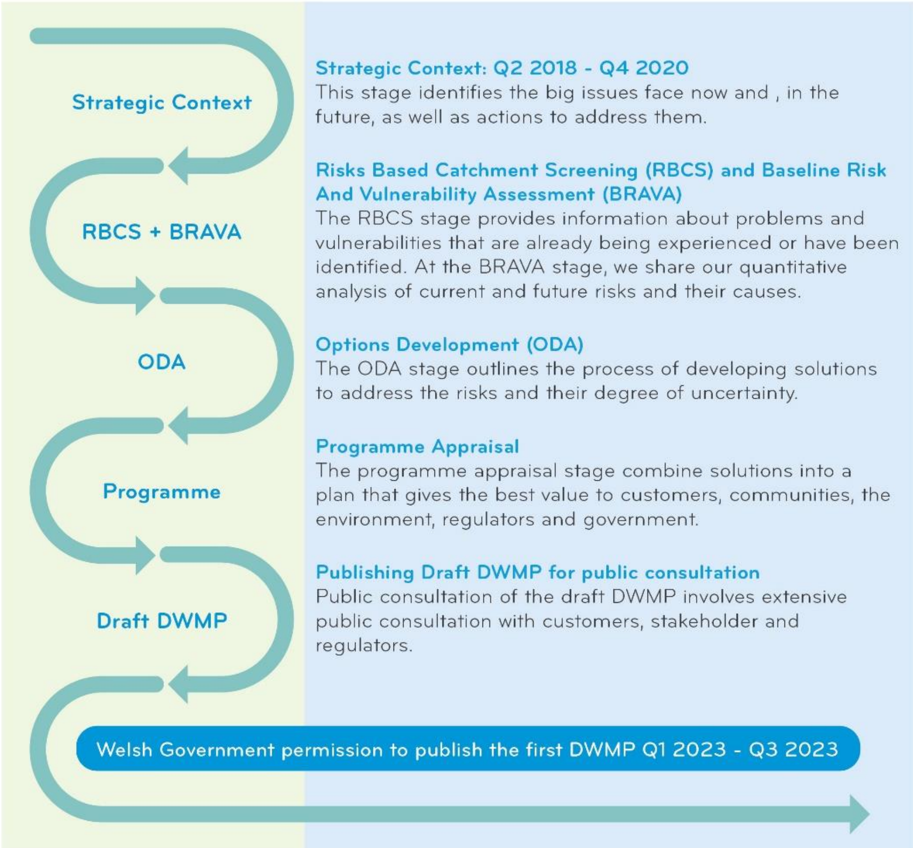


Figure 28 - DWMP Engagement Stages

Table 15 - Overview of engagement at each stage

Programme	Activities	Engagement purpose	Engagement outcomes
Strategic context	Customer Research	To gain and understanding of customers' awareness and understanding of drainage and wastewater; the level of service that customers expect, and customers' views on DCWW's 25-year plan for drainage and wastewater	Awareness raising regarding the DWMP. An understanding of customer knowledge of drainage and wastewater and its future challenges. An understanding of customers' expectations for their drainage and wastewater service for the next 25 years
	Emails to L1 and L2 stakeholders	Setting the direction and explaining the purpose of the DWMP and wastewater	Awareness raising regarding the DWMP. Confirmation of specific stakeholder contacts

Programme	Activities	Engagement purpose	Engagement outcomes
	Meetings with L1 and L2 stakeholders Presentations to L1 and L2 stakeholders Website	management, and the important role which stakeholders can play in its development. This will also be an opportunity to begin to understand and identify future trends such as population growth, economy, and climate change.	within each organisation. Initial understanding of the most engaged stakeholders. Production of Strategic Context Customer Overview document
Risk and issues (Baseline Risk and Vulnerability Assessment – BRAVA)	Joint working meetings and workshops with L1 and L2 stakeholders Presentations to L1 and L2 stakeholders Website	Discussing outputs from the Baseline Risk and Vulnerability Assessment and understanding if/where this aligns with stakeholder plans and policies.	Agreed areas of drainage and wastewater risk, now and in the future. Initial understanding of where and how Welsh Water and stakeholders may be able to work together to solve shared problems. Production of 'Where and How we want to work with you document.
Options	Meetings and workshops with L1 and L2 stakeholders Presentations to L1 and L2 stakeholders	Discussing and characterising the risks and problems previously identified in more detail and defining potential solutions to those problems. Environmental Assessment on the preferred options	Mapping of different drainage and wastewater options. Managing expectations as to the realistic timescales of potential solutions. Understanding of opportunities which will require collaboration and/or co-funding.
Action Plan: (Optimised Plan and Investment)	Presentations to L1 and L2 stakeholders	Review of previous risk and options work undertaken, and how this is to be reflected in the DWMP. Review of DWMP investment solutions and priorities across different DWMP cycles.	Early understanding of overall feedback on the DWMP and progress made. Consensus on investment priorities and how this will be implemented through the DWMP.

Programme	Activities	Engagement purpose	Engagement outcomes
Draft DWMP Strategic Environmental Assessment and Habitat Regulations Assessment and Consultation	A 12-week public consultation on the draft DWMP. Open to all stakeholders and the public.	An opportunity to provide formal comment on the plans, including assessment work undertaken and identification of options.	Collation and analysis of formal responses received to the DWMP consultation from all stakeholders. Understanding and reiteration of key issues and concerns from stakeholders regarding drainage and wastewater management.
Final DWMP Strategic Environmental Assessment Habitats Regulations Assessment Post Adoption Statement	Emails to stakeholders to advise of publication of final Plan. Update and publication of Website	Conclude the Cycle	Plan to reference over the next 5 years as progress is made.

3.13.2 Our approach to plan engagement

DWMPs will only fully realise their potential in delivering a robust and resilient drainage and wastewater service by working in partnership with key stakeholders, both at strategic and local levels.

By working in synergy with our key stakeholders, interest groups and customers, the DWMP will complement and integrate with other existing plans and strategies that manage drainage and environmental quality.

To achieve this, our stakeholder engagement process had to be effective and informative to ensure the views of stakeholders, business and local communities were taken into consideration.

We carefully planned our approach to understand the views of stakeholders, where they may have an interest in the plan, and what they needed to know to provide an informed view.

Our approach to engagement with stakeholders in Wales has been to identify the organisations we want to work with, and those that want to work with us, but also to identify the role within that organisation at each of the stakeholder levels. For example, a company can appear in all three levels but the messaging to the role holder will be different for the level in which they are associated.

We have structured our engagement activities to suit each category of stakeholder.

As previously highlighted, we do not have catchment-based groups in Wales as they do in England, so we are engaging separately with groups of stakeholders and working with Welsh Government to bring people together to develop these partnerships.

3.13.3 Engagement activities

We have created a programme of events and a mode to capture other organisations' opportunities. We have created presentations where we would like to nurture an opportunity and the outcome of this will inform Cycle 2.

We have aligned our engagement with requirements set out in the Water UK DWMP Framework as follows:

The Water UK DWMP Framework states:

> *'Level 1 DWMP – engagement and challenge provided through the existing customer challenge group (CCG) process and to support strategic discussions with regulators and other key stakeholders.'*

In response to this, we engaged with CCG, IEAP, the Drainage Policy Group and the Welsh Government Steering Group. This was carried out at a country level as Welsh Water's region covers most of Wales.

The Water UK DWMP Framework states:

> *'L2 SPA – cross stakeholder and customer engagement processes will be more formalised at this level (compared to current practice). For each L2 SPA, a stakeholder engagement strategic planning group (SPG) led by the water company should be established. This could be in the form of a formal management Board / steering group or a more flexible engagement structure.'*

In response to this we asked stakeholders what they wanted. During this period of engagement, barriers were identified which meant we were not able to achieve this. We have developed relationships with councils and although we are working slowly at the pace our stakeholders are able to, we are still working with each to remove the barrier. However, funding of staff resources with skills to be able to deliver a pipeline of project is the highest barrier and this cannot be solved without funds. In the short term we will have to support the group by providing consultancy support to show the benefit of joint working.

The Water UK DWMP Framework states:

> *'L3 TPU – engagement with local interested parties to understand risk and inform the development of options to mitigate identified risk. Companies should use existing processes for establishing such relationships as and when needed.'*

We established, through our engagement with stakeholders, that existing processes are not uniform across the company. Welsh Water has agreed to pilot the implementation of an SMNR approach. These are being trialled and will form part of L3 and L2 engagement. The requirement for a nutrient management board for the SAC rivers has also become apparent and is being trialled and set up. The most appropriate form will be taken forward and rolled out over time.

3.13.4 Stakeholder groups using the hierarchy of the plan

The stakeholder engagement process had to be effective and informative, to ensure the views of stakeholders, business and local communities were taken into consideration. To do this we needed to understand the views of stakeholders, where they may have an interest in the plan, and what they needed to know to provide an informed view.

In alignment with the engagement approach set out in the DWMP framework, and to make sure engagement was targeted and effective, stakeholders were grouped into four categories depending on the level of DWMP detail which they may have an interest in. Figure 3 and Figure 4 in Chapter 3 (Engagement) explains the four DWMP stakeholder categories. Note that some stakeholders may overlap across the different levels.

In addition to these stakeholders, as the Plan has progressed the distinction between NRW, EA, and Ofwat compared to other stakeholders has become more apparent. These organisations are Regulators. But NRW and EA also own assets, which also make them strategic stakeholders. Ofwat, however, is not a strategic stakeholder as they do not own assets.

Our approach to engagement in Wales during Cycle 1 has been to identify the organisations within Level 1 and Level 2 that we want to work, those that want to work with us, and the roles within that organisation at each of those stakeholder levels.

3.13.4.1 Level 1 stakeholders – Company Operational Level

These are stakeholders who will have a vested interest in the Level 1 DWMP, and therefore at a strategic level about what is happening across Welsh Water. Level 1 stakeholders, including regulators, customer challenge groups and Welsh Government will be most interested in the strategic value and benefit of the programme of DWMP.

3.13.4.2 Level 2 Stakeholders – Strategic Planning Level

These are stakeholders who have an interest and direct input into the development of the Level 2 DWMP works and therefore will have an interest in river drainage catchment-level matters. They will provide challenge where needed as well as support for solutions that meet the criteria for development.

Level 2 stakeholders can be divided into the sectors below and include, but are not limited to:

- Risk Management Authorities;
- Specific departments of Local councils – including Lead Local Flood Authorities and development planners;
- National Parks authority;
- Regulators;
- Natural Resources Wales;
- Environment Agency;
- Environmental –Non-Governmental Organisations;
- RSPB;
- Water interest groups and wild swimmers;
- Environmental interest groups;
- Farming and agricultural organisations;
- Rivers Trusts;
- Wildlife Trusts;
- National Flood Forum;
- Industry; and
- WASC's.

If we are to deliver resilient wastewater and drainage systems, we must work together with others and consider different planning areas from national to local.

3.14 Engagement with Stakeholders

We launched our programme of stakeholder engagement to feed into the DWMP in early 2019.

The key to a DWMP success relies on meaningful collaboration and partnership working with other Risk Management Authorities such as Local Authorities, Highway Authorities, Local Planning Authorities, Natural Resource Wales, and the Environment Agency. Equally, the support and participation from within the business plays a critical role in shaping and influencing the direction of the DWMP.

Therefore, the planning stages included a stakeholder mapping exercise to identify stakeholders in the DWMP, with a focus on Level 1 (Company operational area) and Level 2 (river basin district) interests. Engagement planning considered the DWMP Framework and its key technical outputs, as well as Welsh Water's 2050 vision, to develop a bespoke approach to engaging stakeholders which can be flexible to stakeholder requirements whilst meeting programme demands.

3.14.1 Launch of the DWMP process

Welsh Water's DWMP process was launched in the public domain through a variety of communications:

Welsh Water website: This included information on the purpose of the DWMP and the importance of effectively managing drainage and wastewater. It also included information on the different operational, regional, and local boundaries which Welsh Water is using as a basis to undertake assessments and planning work, with links to all stakeholder and customer-facing documents produced for the DWMP.

Letters and leaflets: These were issued in May 2019 to over 180 stakeholders with a potential strategic and/or operational interest in the DWMP (and interest at the Level 1 basis). The purpose of the letter was to introduce the DWMP and ask stakeholders to confirm any organisational objectives or initiatives which might be aligned with the DWMP works. A follow up letter was issued to the same stakeholders in September 2019 to enquire about any relevant regional or departmental contacts which may help in progressing the DWMP. Responses were received from around 20 stakeholders to confirm interests and / or contacts to be used as points of communication.

3.14.2 Strategic Context Engagement Pilot

Work on Welsh Water's DWMP was piloted in the Clwyd region of Wales. As such, engagement at a regional level was also piloted in this region. As the Baseline Risk and Vulnerability Assessment (BRAVA) developed, the outputs of these catchment risk assessments were used as an introduction to the DWMP for stakeholders, and as an opportunity for stakeholders to provide their own risks or objectives which might align with the DWMP.

An introductory letter and leaflet were issued in October 2019 to over 40 stakeholders with an interest in the Clwyd region. The purpose of the letter was to introduce the DWMP, the works undertaken so far in Clwyd, and to ask stakeholders to confirm any objectives or initiatives which might align with the DWMP. This was also an initial opportunity to establish contact and develop relationships at the regional level.

Following the issue of the letter, two stakeholder meetings were held. Welsh Water met with Denbighshire County Council and North Wales Wildlife Trust (both on 3 December 2019) to present details of the DWMP and the BRAVA outputs to date to demonstrate key areas of risk being identified across the Clwyd region, and to explain the opportunities for input from stakeholders. The meetings also included a session where stakeholders could highlight specific areas on a map (Figure 29) which is of focus to them and which they felt might align with the DWMP works (i.e., growth, flood management or water quality).

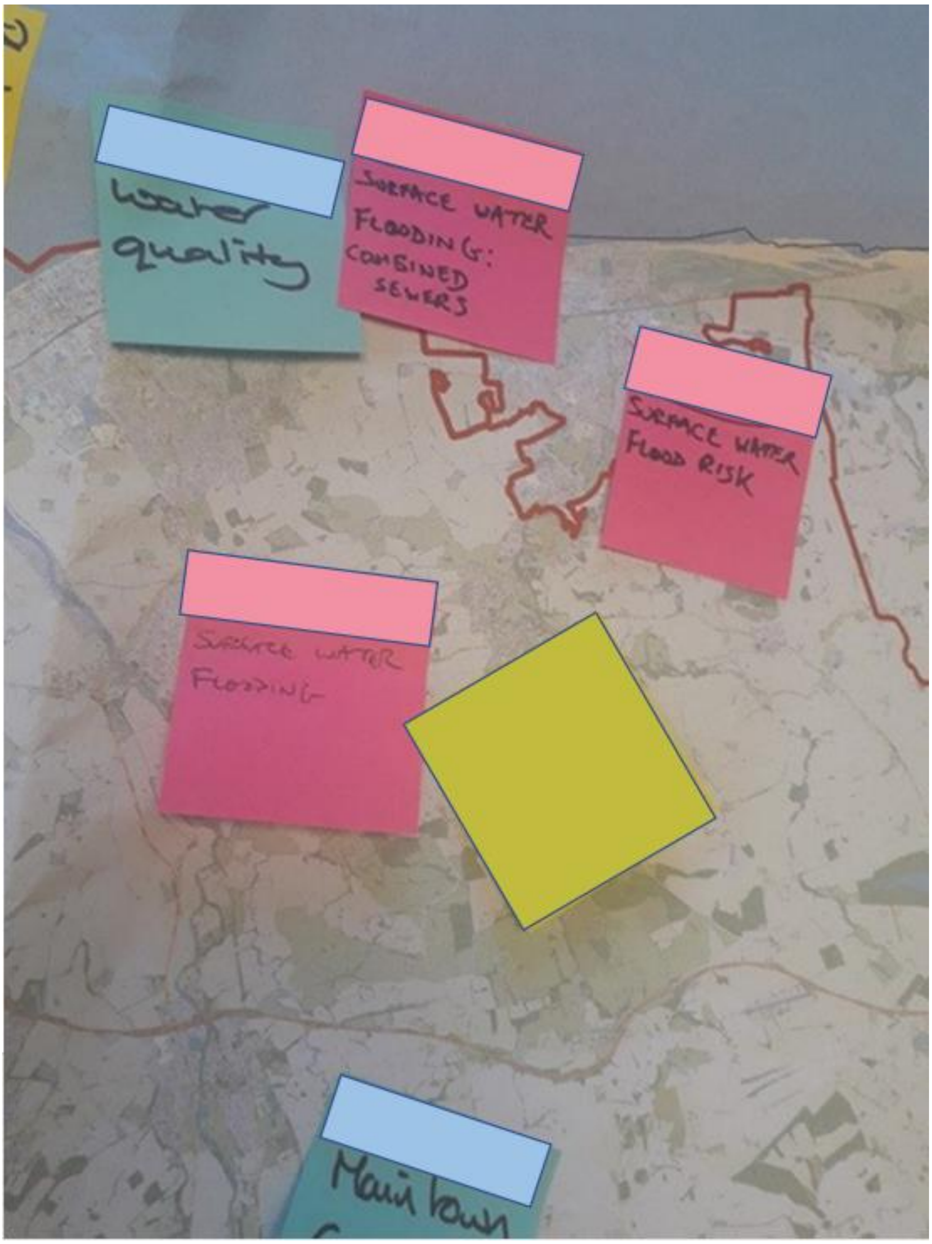


Figure 29 - Example engagement output

The approach to engagement undertaken in Clwyd was to be rolled out across all other regions in Wales, providing regional and more localised stakeholders with the opportunity to view and understand the risks currently coming out of the DWMP work, as well as to provide their own risks and objectives which could lead to collaborative solutions to common issues.

DWMP launches were held in Llyn and Eryri, Meirionnydd, Ynys Mon and Conwy and meetings took place with Gwynedd Council on 14 January 2021 and Conwy County Borough Council, Isle of Anglesey County Council all North Wales Flood Risk Management Group members on 18 February 2021.

The outcomes from these pilot early engagement sessions indicated a willingness by the stakeholders to work with Welsh Water and along with the email's stages were used to inform the development of a Strategic Context document for stakeholders, which is summarised in the 'Outcomes of Stakeholder Engagement' section below.

In March 2020, social distancing policies were enforced in response to the spread of the COVID-19 virus.

The DWMP Engagement Plan was reviewed to comply with Government guidelines and prioritise the safety of staff, stakeholders, and the communities in which we operate. The activities and timings for engagement with key stakeholders was adapted so that the programme could continue to be delivered remotely, without any face-to-face contact.

Meetings re-commenced in an online format in late 2020 and workshops were held in October 2020 to introduce Welsh Water's DWMP and establish foundations for partnership working with stakeholders.

Attendees at these meetings included officers from county and city councils throughout Wales and some parts of England and officers from National Park Authorities.

The meetings sought to understand how stakeholders currently worked with Welsh Water and aimed to agree a preferred approach for ongoing collaboration to co-create the DWMP.

In general, a joint working approach was welcomed by most stakeholders, with the need for an approach which is flexible and allows stakeholders to meet separately if group meetings are not available

Area statements were not favoured as an approach as there is no consistency across how each area statement operates. It was noted that catchments do not line up with the local authority boundaries, so it may be difficult to assign to just one area statement, and there was a request to understand the cross-boundary impacts of the DWMP and how it can be clearly reported.

3.14.3 Strategic Context document

Our DWMP Strategic Context document was produced following early engagement with stakeholders and was launched in August 2020 to partners and organisations external to Welsh Water that plan and manage infrastructure, flood risk and the water environment across Welsh Water's 13 operational areas.

The document provides a contextual overview of:

- The principles of the DWMP;
- The benefits of working together;
- The key drivers of change; and
- The strategic planning objectives.

The document sets out the legal requirements of what we are doing, looking at the challenges of managing growth, creep and climate change and the additional benefits of working together with other stakeholders. It brings together the requirements of the Environment (Wales) Act with the goals of the Well-being of Future Generations Act, the Water Act, and the Water Industry Act, and highlights how customers are at the heart of the Plan.

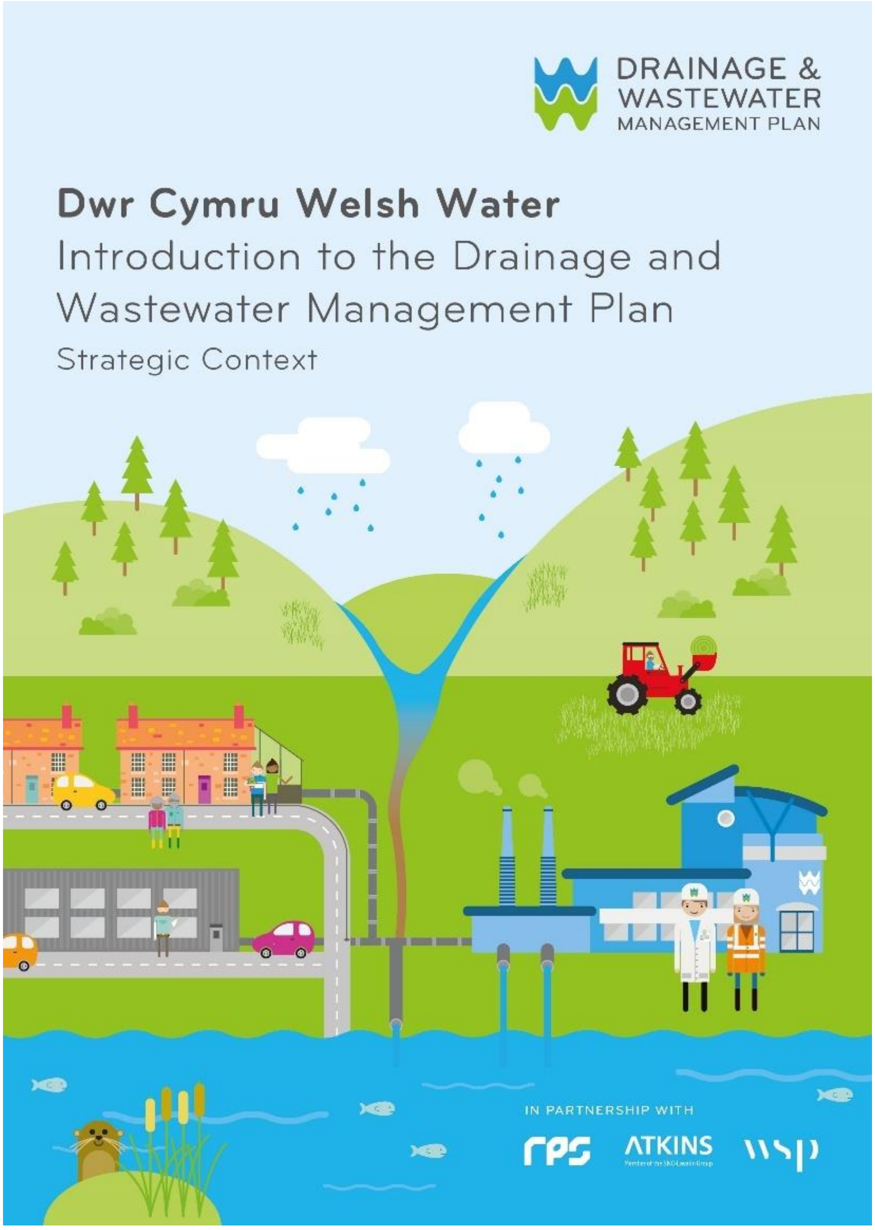


Figure 30 - DWMP Strategic Context

The Strategic Context Document was used by the DWMP Planning Team as a pilot to check the governance and assurance process so that it meets stakeholder needs in terms of expectations, resourcing capacities and timing requirements. The specific objectives of the engagement were to:

- Introduce the first output of the DWMP (i.e., the Strategic Context) and the subsequent outputs to follow.
- Trial the governance and assurance process with targeted stakeholders in preparation for the Plan at statutory consultation.
- Develop an early understanding among key stakeholders about their role in the review process and the time and resource commitments required to undertake the review.

The feedback received from key stakeholders throughout the pilot was used to improve:

- How we ask for feedback.
- Who to include in the process?

- How long stakeholders need to respond (review period).
- What stakeholders need to respond to (scope of feedback).
- Commitments of next steps.

Feedback on the Strategic Context Document from targeted stakeholders was used to develop the process and outline what forms the governance for the delivery of the Final DWMP for Cycle 1.

In July 2019, oversight group members that would form the DWMP governance process were presented to the DPG where approval was sought. In July 2020, this process was re-visited, and the Strategic Context document was introduced as a pilot to trial the following governance and assurance process with members of the Oversight Groups.

Each oversight group has a nominated coordinator appointed by Welsh Water to manage and execute administrative duties. These coordinators acted as a critical conduit between the DWMP team and the members of the oversight groups. The DWMP team worked together with them to tailor communications for respective members and respond to questions or suggestions that were raised.

3.14.4 Engagement on Joint Working (Risk stage)

Further workshops with Local Councils and Local Planning Authorities took place in mid-2021 to discuss outputs from BRAVA and understand where those aligned with stakeholder plans and policies. We explored how stakeholders would like to engage with Welsh Water in the future, as part of a Joint Working Group throughout the development of the DWMP. The workshops emphasised the setup of a project board as an enabler between the programme board and community projects.

Outcome of these workshops indicated that, whilst stakeholders strongly agreed that a joint working group would benefit their organisations and they could bring a range of expertise such as planning; modelling; design; natural flood management and local knowledge to support such a group, there were constraints which would impact their participation in a joint working group project board.

These constraints included, amongst others, lack of funds for resource, to deliver schemes and to engage with the community; technical constraints; alignment of priorities and availability of time to participate.

Welsh Government requested that we explore joint working at level 2. This triggered the development of the Anglesey DWMP stakeholder group. We have been meeting with Anglesey Council regularly and have been inviting others to the group, such as NRW, depending on the location being discussed. Simultaneously, the company has been developing three/four SMNR working groups and SAC management boards, all of which is informing the company approach.

The outcome of the BRAVA phase was the development of the 'How and where we want to work with you' document, which is summarised in the 'Outcomes of Stakeholder Engagement' section below.

3.14.5 How and Where we Want to Work with you document

The 'How and where we want to work with you' document was produced following engagement with stakeholders at the BRAVA stage.

The document highlights the areas and risk themes identified from the baseline risk and vulnerability assessment to enable stakeholders to identify areas they may be able to work together with DCWW to start addressing future risks and reducing the effects of climate change in Figure 31 below.

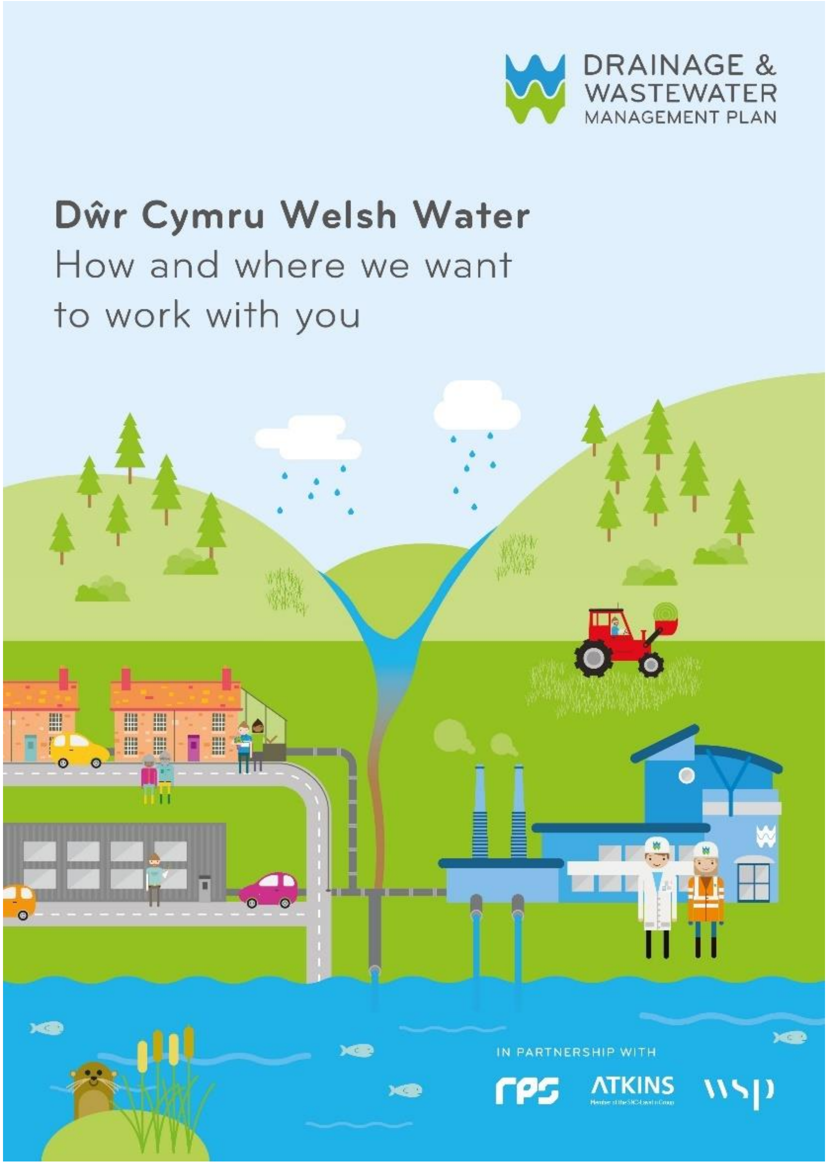


Figure 31 - 'How and Where we want to work with you' document

It also highlights DCWW's vision for reducing flooding and improving water quality and underlines three major themes for wastewater management planning:

- Water Quantity (reducing the risk of flooding to local communities);
- Water Quality (management of water quality and the environment); and
- Resilience (adaptiveness to change while maintaining critical services and protecting the environment).

The map inFigure 32, taken from the 'How and where we want to work with you' document (Figure 31), shows the forecast of risk in 2025 after we carried out risk assessments for both flooding and pollution.

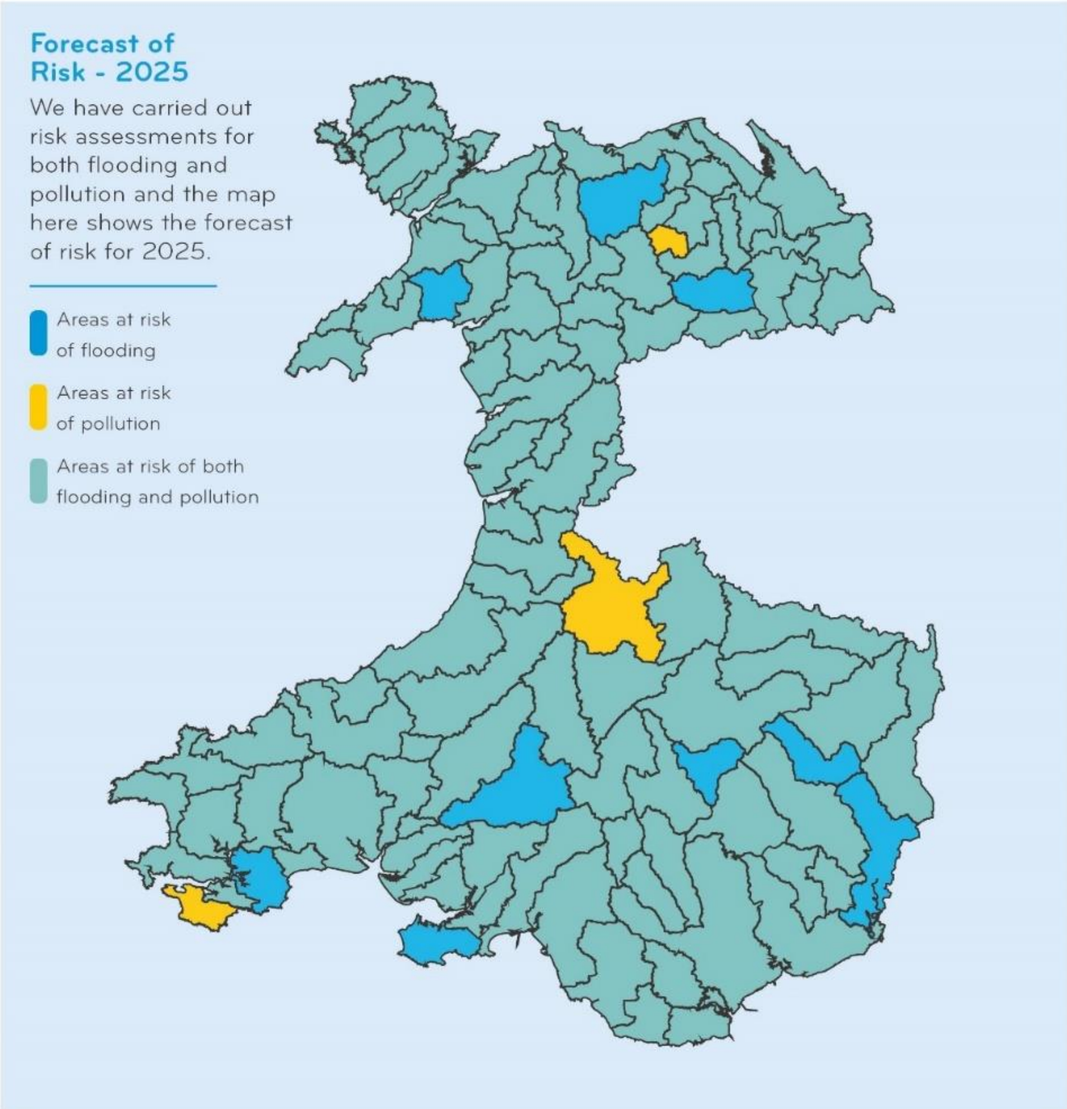


Figure 32 - Summary of BRAVA 2025 L2 & L3 Flooding & Pollution Results (2021)

3.14.6 Engagement on Options Development

Three stakeholder workshops took place in February 2022 to introduce the Options Development Process. The meetings also discussed drainage planning and further explored how to develop joint opportunities. These meetings were attended by council officers and representatives of National Parks Authorities and ENGO's.

Stakeholders strongly agreed that a summarised joint plan is required to coordinate actions.

It was recognised that Lead Local Flood Authorities are currently leading joint plans, but Natural Resources Wales and Water and Sewage companies should lead a joint flood and pollution plan.

Most stakeholders agreed that a typical average storm should be the first target to achieving sewage planning. The worst case 1-in-30 return period storm should represent the target between drainage planning and emergency planning.

Stakeholders indicated their preferred approach for cycle 2 was combination of Level 3 by Level 3 and Worst Risk Approach, and their preference for speed of delivery was for a forward planning 'off the shelf' approach.

Stakeholders suggested various ideas to help create opportunities that turn into real schemes, including integrating with Green Infrastructure plans; partnering holistically with RMA's to address multiple issues across different asset/ownership groups; combining data sets from different organisations to identify joint opportunities on a risk based approach; collaborative top-down strategic ideas delivered through NRW, EA, LA's, DCWW, then community education projects to provide greater awareness and ownership.

3.14.7 Progressing with Opportunity mapping

We have invited all councils and national parks to carry out an 'opportunities mapping session' with us, to help identify areas where we can work together on shared opportunities to improve drainage and water quality in their areas. We want to co-create solutions to support one another's plans to bring about long-term benefits to communities and the environment.

These workshops have proved very successful, and at the time of producing this Plan we have met with councils and national parks in 11 out of the 13 areas. Using an interactive portal, we have worked with our stakeholders to identify opportunities for co-working throughout each area.

3.14.8 Engagement with the Customer Challenge Group

To ensure the voice of Welsh Water's customers are kept at the heart of the DWMP process, the DWMP team works with a Customer Challenge Group (CCG), which is an approving body made up of Welsh Water staff and representatives from external organisations that plan/manage infrastructure, flood risk and the water environment.

Representatives from the following organisations sit within the CCG:

- Welsh Water;
- Cardiff University;
- Citizen's Advice Bureau;
- Welsh Government;
- DEFRA;
- Gwalia;
- Environment Agency;
- Warm Wales;
- Co-production Network Wales;
- PDP Partnership;
- Cynnal Cymru;
- Natural Resource Wales;
- Consumer Council for Water;
- Business in the Community; and
- National Farmers Union.

The group has a nominated coordinator appointed by Welsh Water to manage and provide executive administrative duties. This coordinator acts as a critical conduit between the DWMP team and the CCG.

All stakeholder and customer-facing documents are formally issued by email to the group via the coordinator, and the DWMP team works with them to tailor communications for respective members and respond to questions or suggestions that are raised. The coordinator also helps to collate feedback and ensure all comments are contained within one spreadsheet before issuing the completed tracker to the DWMP team for further consideration.

The group is asked to provide feedback on documents at a strategic level, for example: messaging, objectives and alignment with key policies or documents. The group also makes suggestions on clarity, tone, use of Plain English and accessibility to ensure documents are accessible to all.

Welsh Water also works separately with the Consumer Council for Water, as a voice for the customer when producing DWMP customer-facing documents.

An example of this is the production of an e-learning tool, which was produced to help customers learn more about the DWMP in an interactive and easy-to-understand way so that they can contribute and make an informed decision for shaping the Plan.

CCW is consulted at all stages of the production, from the early storyboard, which gives an overview of the messaging, through the design with relevant graphics and animations, production and finally testing to ensure it is relevant and accessible to all.

Working closely with CCG and CCW has resulted in advocacy from the groups, and an opportunity to work in collaboration to develop key customer-facing documents.

3.14.9 Engagement with the Independent Environment Advisory Panel

To ensure the voice of Welsh Water's Environment sector and are kept at the heart of the DWMP process, the DWMP team works with an Independent Environment Advisory Panel (IEAP) who are a body made up of Welsh Water staff and representatives from external organisations that plan/manage infrastructure, flood risk and the water environment. This panel provides the environment challenge on content, direction, and pace.

3.14.10 Engagement with Public Service Boards

A session was held between Welsh Water and the Public Service Boards across Wales in February 2022 to explore how the DWMP can be driven by the PSB. The meeting investigated how the PSBs could host the forum for unified solutions, as they have the Wellbeing of Future Generations principles at their heart.

However, as the DWMP is a relatively new development and still at a non-statutory stage, we concluded that the DWMP will need to become a statutory requirement for the PSBs to integrate it into their plans. As the DWMP is not a statutory voice on the Boards, it puts us at a disadvantage when integrating planning objectives.

Additionally, it was concluded that in our current state of maturing plans and their current stage of council elections, it would be difficult to say with wide agreement that a PSB could lead the facilitation of flood and pollution plans. However, offers were made for the DWMP to be promoted at future PSBs and for us to work with PSB officers in future to explore the opportunity further.

3.14.11 Consultation with stakeholders on specific opportunities

We are engaging directly with regulators (NRW and EA) and risk management authorities (local authorities, national parks) to identify areas where we can work together to efficiently co-create solutions to address drainage and water quality issues.

To address stakeholders who have requested direct engagement with specific opportunities, we have altered our approach so that we will have more direct conversations. We have taken this action to reach a collaborative stage earlier, while we are still aiming to move to a community-led approach over time. Our plan is now to work at a more localised level, then to summarise this work in our Plan. It is important that we target the right stakeholders, to ensure we are engaging with those people who are involved at a community level.

We will work with stakeholders in the roll-out of community campaigns. This collaboration with our stakeholders will enable us to deliver efficiencies and value for money across our operating area.

3.14.12 What we learned during our Engagement with stakeholders

The pace of our engagement and collaboration with stakeholders is contingent on their ability and willingness to progress. Following our initial introductory meetings, we aimed to establish joint working groups via Strategic Management Forums and Programme Boards. However, after several joint working meetings and workshops, we realized the importance of meeting with each stakeholder individually to determine their positioning and level of engagement.

Although this has delayed the establishment of Programme Boards, it will establish a stronger foundation for collaboration. We are currently holding productive meetings with stakeholders and generating useful outputs that will inform our Plan. This approach will enable each stakeholder to understand their role within the Programme Boards and contribute towards solutions that benefit their communities.

3.15 Engagement with Customers

3.15.1 Customer Research

DCWW carried out research with a broad spectrum of customers including hard to reach groups: non-household customers (NHH) and Vulnerable customers.

This was a three-phased method, starting with Phase 1 in January 2020; phase 2 took place during the first COVID-19 lockdown (May to August 2020) and Phase 3 took place during the second lockdown (November – December 2020).

117 customers were included in this customer research, including 15 NHH customers and 30 vulnerable customers. An overview is presented in Figure 33.

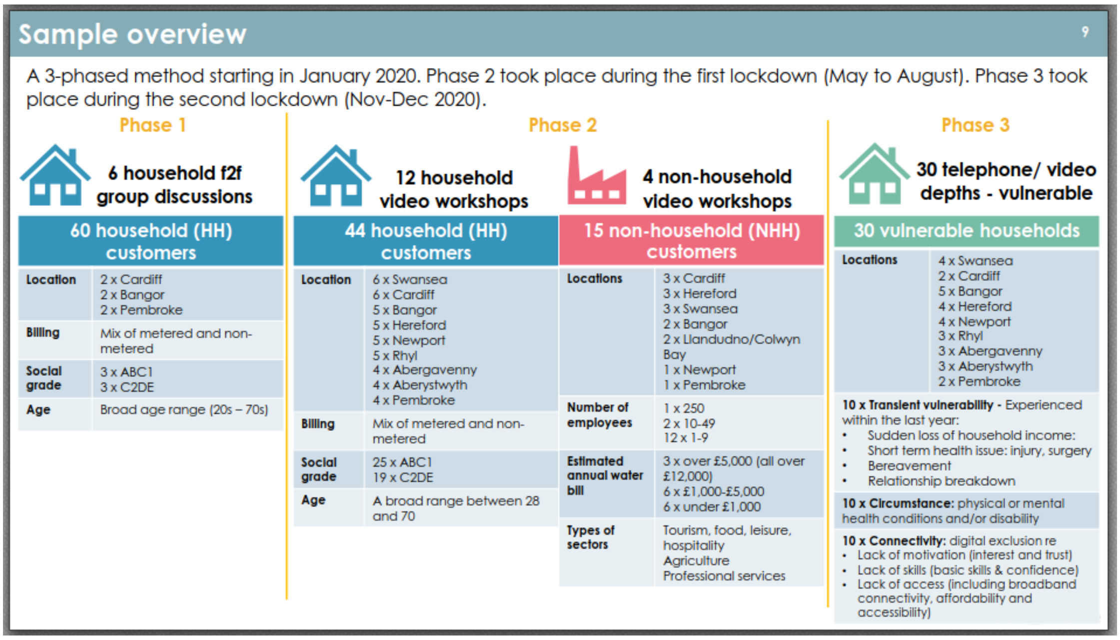


Figure 33 - Customer Research Sample Overview

Objectives of the customer research were:

- Customer awareness and understanding of drainage and wastewater
- What do customers know about drainage and wastewater services?
- Customer expectations of their drainage and wastewater service
- What level of service do customers want in terms of drainage and wastewater?
- Customer views on DCWW's 25-year plan for drainage and wastewater
- What options available to DCWW in terms of drainage & wastewater management do customers want DCWW to prioritise?

As a foundation stage project, we intentionally excluded references to cost from all stimulus materials and encouraged respondents to consider the solutions irrespective of cost.

Results from this customer research concluded:

- Customers have a very low pre-existing knowledge about drainage and wastewater services.
    - Understanding of surface water contribution to drainage and wastewater is particularly limited.
    - When they start to think about it, customers consider wastewater a vital part of everyday life.
- While customers are aware of population growth and climate change as major future challenges, they are less aware of urban creep. And for all three challenges, customers are rarely knowledgeable about the implications for drainage and wastewater.
- When asked about their views on DCWWs 25-year plan for drainage and wastewater, customers were positive about the fact that DCWW is planning for the future of wastewater and drainage. They were reassured that DCWW is adopting a long -term view and expected DCWW to work with other organisations to achieve change.

Options favoured by customers are:

- Creating more permeable places for rainwater to soak into the ground.
- Using technology to control flow through sewers.
- Customer incentives to split foul water drains from roof drains.
- Building new treatment works where an area is at capacity.
- Education on blockages.
- Customer incentives to change behaviour.
- Separating sewer pipes so foul water and rainwater carried in separate pipes.
- Creating natural wetlands to store flood water during peak rainfall seasons once foul water is separated.

3.15.1.1 Outcome of engagement with customers

DCWW tested 16 investment options with customers during the customer research. Reference to cost were intentionally excluded from the stimulus materials, however cost-effectiveness repeatedly emerged as a key priority for customers.

The DWMP framework does not take account of affordability for customers and does not allow the company to manage this aspect. Therefore, the three options to manage affordability are:

- Worst served customers and environment;
- Whole catchment approach, based on priorities; and
- A blend of the above two approaches.

Deliverability of a scheme in practical terms is also a constraint to the production of the plan and to the long-term achievement of the plan. This can be highlighted using the affordability challenge given by customers. To explore this limitation further using an example where a catchment requires multiple schemes to work together to obtain the desired outcome of reducing flooding to customers or to improving water quality for the environment. The concentration of or widespread nature of the schemes can cause a limitation to what can really be achieved in practical terms.

3.15.1.2 Keeping customers at the heart of what we do

Customers are a priority of the DWMP. Their voices drive the process, so it is vital they are involved in its development to ensure we create a long-term plan that benefits everyone and the environment we live in.

3.15.2 The DWMP Customer Research Journey

Figure 34 presents an illustration of or customer research journey.

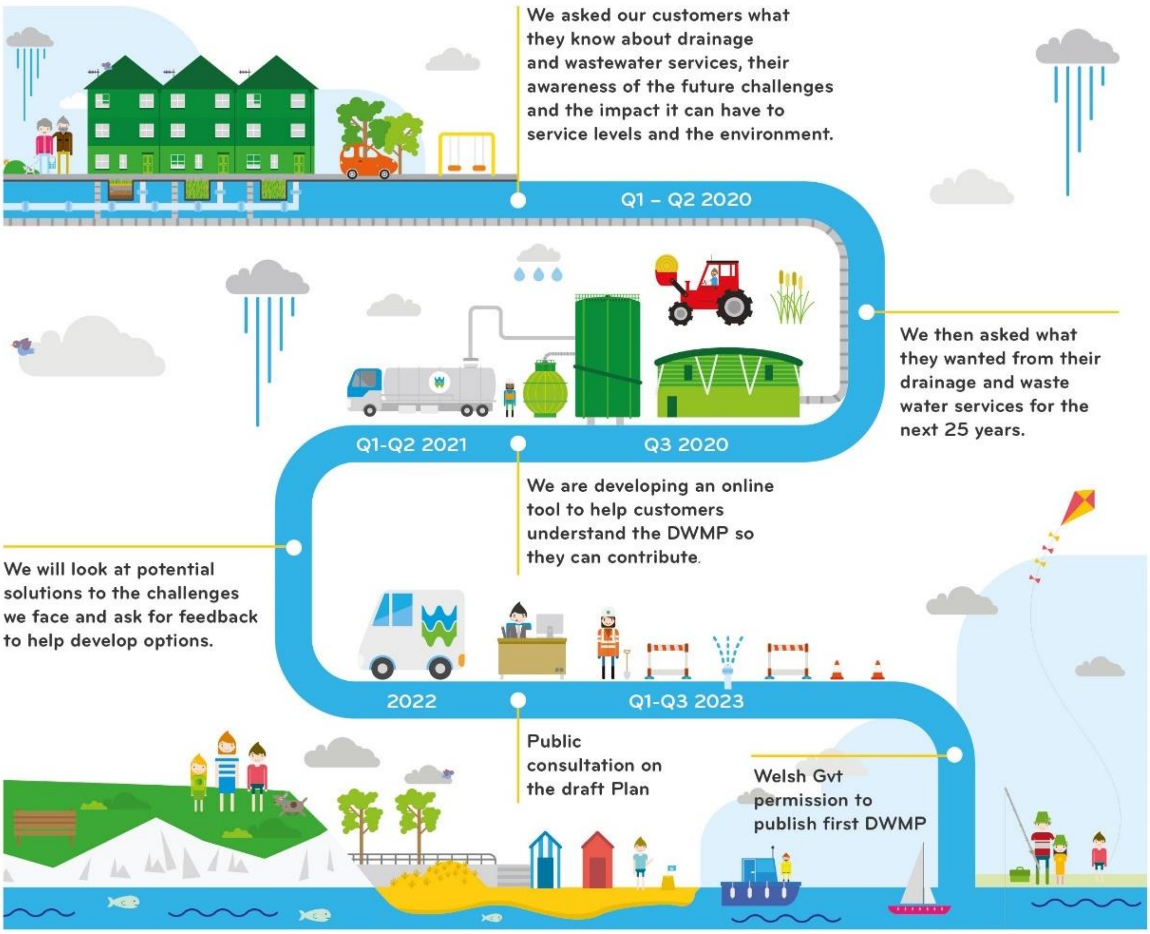


Figure 34 - DWMP Customer Research Journey

3.15.3 Website

We have a dedicated DWMP website aimed at customers and stakeholders, which sets out what a DWMP is; why we need a DWMP now to mitigate against future implications and how we have worked towards producing our first DWMP.

The website is set out in a clean, clear format and is kept fully up to date as work on the Plan progresses. All DCWW's DWMP customer-facing documents are available to download off the website.

3.15.4 E-learning

We launched an e-learning tool in the spring of 2022, with the aim of helping customers learn more about the DWMP in an interactive and easy-to-understand way so they can contribute to and make an informed decision for shaping the draft Plan.

The tool will be developed in modules over time and through the DWMP cycles and will cover various topics relating to the DWMP (Figure 35).

This e-learning tool is specifically aimed at DCWW customers and the public but may also be used by an internal DCWW audience.

The tool is hosted on DCWW's website in both Welsh and English.

Figure 35 - E-Learning Tool

3.16 Engagement and the Use of Language

All our documents and meeting invitations are produced in English and Welsh, as is the DWMP website.

This is a requirement of the Welsh Language Act 1993, but also gives us an opportunity to engage stakeholders and customers for whom English is not their first language.

Furthermore, we are investigating the possibility of using translation systems during the second cycle to enable those who speak languages other than Welsh and English to participate and will consider producing the Plan in additional languages if the response to the consultation indicates this will be useful to customers and stakeholders.

The recent consultation regarding the promotion and use of Welsh Language for Water companies will conclude during 2023. This consultation indicates that if proposals are supported, the engagement plan to support the Welsh Language will become a requirement. Our intention is in line with the proposals.

We have met and exceeded Welsh language requirements for the translation of documents, including as many technical documents as possible. Non-framework documents produced at the specific request of our financial regulator have not been translated.

3.17 Consultation

So far in this chapter we have discussed how we have engaged with stakeholders and customers to inform them of what a DWMP is, to inform them of progress and to understand their views and perspectives to inform the development of this Plan in terms of Process and strategy. So, during the early development of the Plan, engagement has been informative.

A key part of any management plan is the formal consultation process, and this is described below.

The process starts with a pre consultation formal stage which can be considered as notification of some kind. In our case this was e-mails to approximately 150 stakeholders to inform them that we were in the early stages of a Plan development and that we were interested in understanding their objectives. At that time, we also asked the organisation if they wanted to remain informed during the process, and what level of information they were interested in.

The consultation section of the Plan is defined for this Plan as a mimic of the WRMP process and this is defined as:

- Stage 1: the production of the Draft Plan and any supporting appendices published on the company website with additional guidance on how to complete the consultation.
- Stage 2: A 12-week consultation period providing enough time to produce a substantive response to the content. The responses will be returned to the Water Company during the Non statutory phase of Plan Development.
- Stage 3: Once the 12-week consultation has ended the comments are collated and a Statement of Response is prepared. This summarises the comments and states how the comments and actions arising from the comments have revised the plan.
- Stage 4: The Statement of Response and the revised plan is published on the company website and sent to Welsh Government for confirmation to turn the Draft Plan to a final Plan

The consultation is a formal, recorded process. Each response is documented and a response to that consultation response is also reported. The response influences the current Plan and/or the timeframes in which the action will be taken.

The consultation on our draft Plan ran for a period of 10 weeks from 27 July 2022 to 7 October 2022.

3.17.1 Consultation materials

A range of materials were developed for stakeholders and customers to support the draft Main Plan, Foreword, Non-technical summary, Technical Summary and L2 area summaries in Table 16 below:

Table 16 – Consultation Materials

Customer Brochure and Questionnaire	The Customer Brochure explained the need for the DWMP as a tool to support investment to increase the capacity and performance of the drainage system. It explained the area covered by the DCWW's DWMP, and the high number of areas at risk of both pollution and flooding. The questionnaire sought consultees' views on the topics raised by the Brochure, such as plans for handling increasing volumes of wastewater, and priorities for investment.
Online Questionnaire	The online questionnaire is the same as the customer questionnaire, but in an interactive online format.
e-Learning	An e-learning tool was developed to help stakeholders and customers learn more about the DWMP in a fun and interactive way. A link to the e-learning site can be found online at https://docs.learningnexus.co.uk/courses/dwrcymru/wws06/en/story.html
Virtual Room	An interactive virtual room was created to display the consultation materials and provide access to the consultation questionnaire.
SEA and HRA	The consultation also included questionnaires relating to the Habitats Regulations Assessment (HRA) and Strategic Environmental Assessment (SEA) and the following documents were available on both the website and via the virtual room: Strategic Environmental Assessment; and Habitats Regulations Assessment.

3.17.2 DWMP documents to keep our stakeholders and customers informed

In collaboration with our stakeholders, we have produced the following documents at the completion of each stage of the DWMP:

Stage 1, Strategic Context: 'Introduction to the Drainage and Wastewater Management Plan'. We produced a Strategic Context document with details of the six national planning objectives and the DWMP action plan. In addition, we produced a customer overview of the 'Introduction to the Drainage and Wastewater Management Plan', which summarises what is included in the DWMP and why and how we created it.

Stage 2, Risk Assessment: 'Where we want to work with you', which details our vision for future joint working on current and future risks

Stage 3, Options Development: An Options Development document is currently being developed with stakeholders and will be published later in 2023. This document will communicate how we have developed options that apply across all areas.

Stage 4, Programme Appraisal: We are developing a 'Programme Appraisal' document in conjunction with our Options Development document, which will be published in 2023 and will outline how we take preferred solutions from the Options Development process and develop a programme of work and timescales to implement them.

Stage 5, Consultation: We produced this DWMP Plan, along with supporting documents to help stakeholders and customers make informed decisions at the consultation stage. Supporting documents to the DWMP include:

- A Customer Version DWMP;
- A DWMP brochure and questionnaire
- A non-technical document. These were all published for the public consultation between July and October 2022.

Following on from the consultation, we have produced:

A Statement of Response and a customer version Statement of Response to provide our stakeholders and customers with our responses to the items raised as part of the consultation.

3.18 Future Recommendations

The feedback received from stakeholders has been used to improve the governance and assurance process, which will be used at each stage of the DWMP process in cycle 2 (i.e., Risk Based Screening, Plan Development and Draft DWMP).

The following key improvements were recommended:

- To undertake the DPG review ahead of IEAP and CCG review, so that any sensitive information or data can be reviewed internally before being shared with external stakeholders. This is particularly relevant for the subsequent stages of the DWMP process, where we share the analysis of current and future risks to drainage and wastewater management across the 13 catchment areas.
- Include a review of Welsh messaging by nominated Welsh Water personnel.
- Liaise with Welsh Water's Security Manager to complete security and confidentiality checks to meet the Government's security and emergency directive.
- Extend the overall review period for Oversight Groups from 6 weeks to 8 weeks
- Implementation of governance 'gateways' – high-level activities that need to take place at key points (or gateways) throughout the governance process, including an internal programme for review of documents by different audience groups and key stakeholders.

Now that Cycle 1 is complete we can reassess our engagement destination and re-set our milestones for Cycle 2.

The aim during Cycle 2 is to continue providing stakeholders and customers with information and relevant updates as the DWMP progresses, but to also focus on a more involved and collaborative approach. We want to work directly with our customers and in partnership with our stakeholders to identify and develop preferred solutions which benefit all.

The aim of the DWMP is to empower stakeholders and customers by 2050 to be leading planning and implementation of activities to benefit the environment for their communities and for the whole of Wales.

3.19 Post consultation Engagement Strategy and Milestones for Cycle 2

In response to feedback from the consultation, we have updated our Milestones for Cycle 2 in line with the following:

- We have changed our approach from a ‘top down’ approach to one of engaging more directly with RMA’s and their communities. Our approach now is to work at a more localised community level, then summarise this into our Plan.
- It is important that we target the right stakeholders with this approach, to ensure we are engaging with those people who are involved at a community level.
- We aim to progress from ‘sharing information’ to ‘planning together’ and ‘acting together’ with RMAs and their communities during our next cycle and this is well underway. We have already started engaging with RMA’s to identify areas of opportunity to work together to improve drainage and water quality in their communities and our level of engagement with these stakeholders is now at a ‘consulting’ stage.
- During the first cycle of the DWMP, we engaged primarily with economic and environmental regulators, Lead Local Flood Authorities; Risk Management Authorities; consumer councils and interest groups to understand their objectives and how they can align with the DWMP. These stakeholders provided invaluable guidance and advice and these relationships will be ongoing to ensure consultation is continued. In the next cycle of the Plan we will expand our engagement with Natural Resources Wales and will set up ongoing engagement with Environmental Non-Governmental Organisations. This will enable us to work together with relevant parties to identify and develop environmental solutions as part of the DWMP.
- We will also work more closely with local communities to understand their priorities and ensure they are heard. This is an important element of our engagement as the Plan is essentially customer-led for the benefit of the communities we serve.
- We will engage with all stakeholders at the end of every stage of the Plan to gain their input and to agree next steps.
- Where there are local flood management groups, we will explore joining those groups.

The following milestones are recommended to enable further refinement of the engagement activity in cycle 2.

3.19.1 Milestone 1, Cycle 2: Research

- Review our customers’ views on our progress to date, and aspirations for future cycles.
- Develop stakeholder research in line with customers’ aspirations.
- Engage with other water industry to discuss approaches to develop innovation and best practice.

3.19.2 Milestone2, Cycle 2: Innovation

- Investigate new approaches to engage with stakeholders.
- We will take a hybrid approach to engagement in Cycle 2, combining traditional face to face interactions where possible to build and strengthen relationships, with online meetings, using interactive platforms such as Mentimeter and Miro.
- We would also like to explore the use of translation systems to enable engagement in various languages. This will enable us to continue to engage in both English and Welsh, but to also include other languages which our customers and stakeholders speak. We have experienced meetings using translations systems, with varying degrees of success. We are considering learning from these to be able to provide this service.
- Learning from other companies’ delivery and ENGO approaches

3.19.3 Milestone 3, Cycle 2: Engagement through the five stages of development of the DWMP

We will produce documents for stakeholders at the following stages:

- An updated 'Strategic Context' Document which sets the direction, produced during the Strategic Context phase of Cycle 2 (year 1).
- An updated 'How and Where we want to work with you' document, produced during the BRAVA phase of Cycle 2 (year 2).
- A document that details areas of opportunity, produced during the BRAVA phase of Cycle 2 (year 3). This document will highlight catchment or drainage options which have been developed through collaborative work with stakeholders.
- A document detailing 'Options', detailing what we have developed. This will be produced in the Options phase of Cycle 2 (year 4) and will indicate what we intend to do, and where.
- A Programme outlining when we plan on delivering options and solutions will be produced during year 5, Cycle 2.
- The Cycle 2 Draft Plan, public consultation, Statement of Response, and the Final Plan will be produced during year 5 of Cycle 2.

In the second cycle, we will also ask customers in which order they would like us to address the issues, based on:

- Worst served customers and environment
- Whole catchment approach, based on priorities
- A blend of the above two approaches

Changes will need to be driven by customers and based on customers' ability to pay (rather than willingness to pay).

3.19.4 Milestone 4, Cycle 2: Other engagement activity

The following outlines the additional activities necessary for the completion of our engagement programme during Cycle 1 and other initiatives being developed in the early stages of Cycle 2.

Set up/continue UK and National Steering groups at country level

- Water UK and WASC;
- DWMP WSG – annual; and
- Regulators.

Set up/continue Steering groups at L1

- Welsh Water QEC – annual;
- IEAP – annual;
- CCG – annual; and
- DPG – annual.

Build collaboration forums at L2 and L3

Set up steering groups at L2: Programme Boards

Set up joint working groups: 13 areas x 1 per month. Programme of 13 meetings every year as shown in Table 17.

Table 17 - L2 Meeting Programme

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
L2	1	2	1	-	2	2	-	-	1	2	2	-

These will take the form of meetings and workshops with stakeholders to identify areas of local opportunity, align plans and set up joint working groups.

Set up steering groups at L3: Community involvement and delivery plans

To review the previous risk and options work and to identify areas of local opportunity, align plans and set up joint working groups we will undertake further stakeholder meetings during cycle 2

Develop actions for Cycle 2 with stakeholders.

Promotion of the DWMP

Produce plans for promotion of the DWMP and undertake marketing campaigns to assist in the DWMP achieving its aims, to include:

- Promotion with stakeholders through ongoing engagement;
- Linking with stakeholder campaigns; and
- Marketing campaigns for the public, at national and local level: TV, Radio, print; display marketing and roadshows to highlight fats, oils, and greases; preventing blockages (wet wipes); general water use on rainy days.

Annual conference

We propose holding an annual two-day 'Drainage and Pollution conference', supported by CIWEM, ICE, IWO WLGA. This would provide a joint forum for WASCs, consultants, NRW/EA, LLFAs and ENGOs to come together to discuss opportunities and to jointly develop solutions. It would provide an opportunity for organisations to display and discuss what they are doing, to enable others to collaborate, share and join up. Focus on: RBMP, SWMP, CRMP, FRMP and DWMPs.

Royal Welsh Show

We propose taking a stand at the Royal Welsh Show to promote the function of the DWMP and highlight the benefits of community involvement.

Provide updates on the Plan via:

- Social media;
- Forums, webinars, and progress updates;
- DWMP website; and
- DWMP Portal (GIS platform enabling stakeholders and customers to pinpoint areas on a map).
- Local promotional opportunities
- Marketing opportunities within communities (talks, stands and give-aways at community events);

- Linking with ENGO events and campaigns; and
- Roadshows within communities to highlight 'fats, oils & greases', wet wipes and promote the work of the DWMP.

3.20 E-learning

We will update the online e-learning with new modules and interactive activities.

3.21 STEM events

We propose carrying out STEM events at schools to promote the work of the DWMP and the importance of planning ahead to protect Wales's rivers and natural environment.

3.22 Annual Review of the Previously Published Plan

This will provide an update on:

- The delivery of the Plan; and
- Progress of engagement, detailing the type of engagement which has taken place; the number of sessions which have taken place and which groups of stakeholders have been engaged.

3.23 Endorsement from Consultees, Regulators and Customers

A number of consultees commended us as part of their feedback to the consultation on the first draft DWMP.

In particular, respondents commented on the extent and level of detail of the information we provided and the accessibility and range of formats in which the detail was presented. We received positive comments regarding our engagement with customers and the provision of a customer version of the Plan, along with the use of a virtual room, videos and an e-learning platform.

Stakeholders commended us on our willingness to engage with stakeholders and raise awareness of the DWMP and indicated their wish for engagement and consultation to continue in the future to ensure development of the Plan with others.

Regulators recognised the level of engagement which has taken place throughout the early phases of this planning cycle and our objective to seek input on areas that could be impacted by growth, flood or water quality risks.

3.24 How has engagement with stakeholders and customers influenced The Plan?

A flexible joint working approach was welcomed by most stakeholders, although area statements were not favoured as there is no consistency across how each area statement operates.

Stakeholders strongly agree that a summarised joint plan is required to coordinate actions.

It was recognised that Lead Local Flood Authorities are currently leading joint plans, but Natural Resources Wales and Water and Sewage companies should lead a joint flood and pollution plan.

Most stakeholders agreed that a typical average storm should be the first target to achieving sewage planning. The worst case 1-in-30 return period storm should represent the target between drainage planning and emergency planning.

Stakeholders indicated their preferred approach for cycle 2 was combination of Level 3 by Level 3 and Worst Risk Approach, and their preference for speed of delivery was for a forward planning 'off the shelf' approach.

Stakeholders suggested various ideas to help create opportunities that turn into real schemes, including integrating with green infrastructure plans; partnering holistically with RMA's to address multiple issues across different asset/ownership groups; combining data sets from different organisations to identify joint opportunities on a risk based approach; collaborative top-down strategic ideas delivered through NRW, EA, LA's, DCWW, and community education projects to provide greater awareness and ownership.

DCWW tested 16 investment options with customers during the customer research. Reference to cost were intentionally excluded from the stimulus materials, however cost-effectiveness repeatedly emerged as a key priority for customers.

The DWMP framework does not take account of affordability for customers and does not allow the company to manage this aspect. Therefore, the three options to manage affordability are:

- Worst served customers and environment;
- Whole catchment approach, based on priorities; and
- A blend of the above two approaches.

Deliverability of a scheme in practical terms is also a constraint to the production of the plan and to the long-term achievement of the plan. This can be highlighted using the affordability challenge given by customers. To explore this limitation further using an example where a catchment requires multiple schemes to work together to obtain the desired outcome of reducing flooding to customers or to improving water quality for the environment. The concentration of or widespread nature of the schemes can cause a limitation to what can really be achieved in practical terms.

3.25 Next Steps

We understand that DWMPs will only fully realise their potential in delivering a robust and resilient drainage and wastewater service by working in partnership with key stakeholders, both at strategic and local levels.

We will continue to work in consultation with our key stakeholders, interest groups and customers to ensure we understand and take consideration of their perspectives and views and provide them with what they need to know to enable them to deliver informed feedback. It is important that the DWMP complements and integrates with other existing plans and strategies that manage drainage and environmental quality.

Our approach to engagement with stakeholders in Wales has been to identify the organisations we want to work with, and those that want to work with us. We also needed to identify stakeholders within each organisation that held roles at each of the stakeholder levels. For example, an organisation can appear in all four levels but the messaging to the role holders will vary according to the level in which they are associated.

We will be carrying out engagement after every stage of the Plan.

Our focus during the first cycle of the DWMP was to engage and work with stakeholders to ensure the DWMP was aligned to their plans for their communities. Our aim during the next cycle of the DWMP is to work more closely and directly with customers through both information and educational campaigns and via community projects. We are currently working with local authorities to identify areas we can work together to improve the drainage issues locally. Once these areas have been identified we plan to set up Programme Boards to work with communities to develop and implement solutions to local pollution and flooding issues.

Results of our customer research showed that customers who have read the Plan have strong feelings towards the importance of what it sets out to address, which highlights the need for a long-term plan to address these issues.

We will carry out a review with customers in Cycle 2 and collaborate with them to understand their aspirations for the future of wastewater and the environment.

4 Risk Assessment

4.1 Introduction

This section sets out how risk assessment has been undertaken in line with the DWMP framework. It sets out the key steps we have taken to understand the risk picture, to focus the plan development in the areas which are in greatest need of investment.

4.2 Alignment to Welsh Government and Ofwat Strategies

We need to ensure that, at the outset, our plan reflects the strategic direction from government and our regulators. Before we discuss assessment of risk, it is important to ensure that our assessments align with the key strategies. This is discussed in this chapter.

4.2.1 Welsh Government Water Strategy for Wales

The key action relating to this plan from the Water Strategy for Wales is quoted below.

> *"We will establish a framework to identify any evidence, data or regulatory gaps and consider how these might be addressed to ensure that the sewerage undertakers, regulators and other key stakeholders have the correct tools to assist them in the management of our sewerage and drainage systems."*

We have been undertaking trials to provide information to Welsh Government in support of this action. We have mentioned in our engagement strategy that we need to create additional forums at a catchment basis but have multi skills. These need to cover the whole water cycle and how it links to the environment and communities. Until we have these joint forums with goals that work towards a cohesive planning direction, we will find it difficult in terms of resources, funds, legal responsibilities, and capability to make the aspirational changes being expected of us by society.

The plan trials need to continue. The support from councils and our environmental regulator will be a necessity and should be the first milestone to achieve in setting up these forums, project boards and community boards. The fundamentals of these boards are laid out in the principles of SMNR however there needs to be an interim stage of development that creates teams from each organisation to produce the applications for change from the opportunities we suggest. We have evidenced through plan creation that the aspirations of stakeholders are not affordable within a 25-year period, and that there is a need for further balance between customer and environmental destinations to drive uniform improvements across our operating area so that delivery of aspirations do not disproportionately improve one community versus another.

We have also converted the WRMP approach of Annual Average, critical period, and extreme weather planning as 3 separate planning levels, along with the review of consents programme which makes 4 scenarios. This is a very important learning from Cycle 1 as the annual average Sewage plan sets the policy for all future containment volumes for both foul only and combined networks to meet the current permits, ensuring that sewage capacity is always planned prior to the addition of rainfall.

The critical period, or drainage plan, sets the policy point where SuDS and nature based solutions should be the first consideration in a hierarchy of options, as long term sustainability becomes paramount to deliver, but also allows the construction of tanks and storage if the benefit is required within the short term, as a trade-off between what is needed and the time to realise the benefits from a blue/green infrastructure or SuDS solution. This also includes a consideration of 'what if' scenarios that bring in permits to meet future conditions, policies that could become enacted, new expectations of our customers and stakeholders, trying to define scenarios, the Extreme weather plan (which is directly opposite to the Drought Plan), and the extreme flood plan where, on the exception days of named storms and out of bank flooding, the additional consideration of returning to service once an event has occurred, and how to manage that event, is considered.

These recommendations are not currently part of the DWMP Framework or Ofwat methodology but have benefits with regards to long term delivery strategies and making sure that the utilisation and the life span of a solution is considered at its inception.

4.2.2 Ofwat Priorities for the Welsh sector through PR24

Ofwat's summary of WG strategic objectives are reproduced below:

- Adopt an outcomes focused approach that promotes an appropriate focus on addressing long-term risks, safeguarding long-term resilience and performance and ensuring that the timing of investment results in intergenerational equity;
- Pursue a preventative approach by encouraging companies to understand and consider how problems could be addressed at source;
- Deliver value for money for customers, communities and the environment and challenge companies to provide sustainable and effective support to vulnerable customers and customers who are struggling to pay;
- Challenge companies to deliver best value solutions by encouraging investment that responds to multiple drivers or has multiple benefits and that takes account of outcomes and the wider environmental and social value of solutions;
- Encourage companies to meaningfully involve, engage with and take account of the views of customers and stakeholders on long term outcomes, priorities and pace of delivery, and use effective collaboration to maximise the impact and effectiveness of regulation;
- Deliver a cohesive and transparent regulatory framework that, taken as a whole, is proportionate, effective, transparent and efficient and challenges companies to provide clear and compelling evidence to underpin their investment plans; and
- Challenge companies to seek new ways of working to deliver for customers and the environment more efficiently.

They reference the five strategic priorities listed in section 1.15.

Specifically relating to WRMP and DWMP, the following expectations have been bulleted.

Through WRMPs and DWMPs we expect companies to:

- Consider a wide range of options that mitigate the risks identified, including nature-based solutions, catchment-scale schemes and traditional grey infrastructure interventions.
- Demonstrate that adjustments to operational and maintenance regimes have been implemented before exploring enhancement options;
- Fully consider interdependencies with other stakeholders' strategic and opportunities for partnership working, including co-funding and co-delivery; and
- Make efficient use of current technology such as smart metering, and investigate the use of emerging technology including smart data and networks.

Within the development of our plan, we have addressed the following expectations:

While complying with the DWMP Framework, which allows us to funnel down to the highest priorities to produce risks proportionately, we have developed an approach that takes account of outcomes considering both current and long-term risk, along with costs for the customers of today and the future. We have produced solutions that provide value for money but recognise that benefits and aspirations cannot be achieved uniformly across the company. We need to rethink as an industry how to provide value for money uniformly for all customers and the environment without some communities being disproportionately disadvantaged.

We have created a process that includes not just a direct cost versus volumetric benefit but one that also considers the carbon, environmental and societal benefit. This comparison clearly highlights where decisions have been made and why. Our approach also takes this further as it calculates the same solutions, but with an early or a later delivery date, which alters the length of time the benefits realisation is achieved; when these are also compared against least cost, best value today and best value due to earlier benefit, we can demonstrate in more evidence why a decision has been made.

We have put customers at the heart of our plan and gained customer input not only at the end of planning, but also at the very beginning. The plan reflects their direction, and their reflection of what they are paying for. We have worked with our challenge groups, made up of different stakeholders, to continually inform and incorporate comments into our plan through the process. The methodologies and approach have been created jointly with these organisations and those of each council. This has included the highest priorities and destinations discussed in this plan.

The DWMP has informed the company in terms of aspirational direction; the pace of change linked to affordability and finance ability and discussed the deliverability of the distribution of aspirations required. It has explained that, to afford the long-term aspirations while delivering a fast-paced CSO programme, there is a need for increased bills to customers not only in AMP8, but each AMP after that.

Our plan has delivered the following that meets the DWMP expectations set out by Ofwat:

We have implemented the DWMP framework list of solutions as expected. We also explored more detailed solutions. We have now included just over 80 interventions or options that could work in differing situations. Our approach for every catchment includes a methodology to short list from the 80+ sub options to those that will, in full or in part, provide a solution to a catchment. We have learnt from this application that we need to convert the methodology, which is like the WRMP approach, to apply at a much more granular level. This level has been created within the DWMP first cycle and is classed as Level 7 hydraulically connected areas. The assessment needs to be carried out at that level to ensure that the right sub options are listed, and that the lists are shortened down to the specific location requiring intervention.

As a company, we have teams that consider the operational and maintenance regimes reviewing the effectively of the current operational set up to make efficiencies. In the DWMP, we have explored with our customers whether they would agree to paying a little more for the added resilience that an additional allowance would provide in our networks and at our treatment works. Customers are supportive of this additional resilience approach (headroom). This provides the added time required to repeat when something goes wrong. We will continue to include this approach in our planning activities to evidence the need for increased maintenance from the current level of planning.

The industry reflects maintenance as an allowance for siltation or tree root ingress often reflecting on models that are clean and have no allowance. We have included a risk assessment for this to help direct where maintenance, such as siltation removal, could reduce capacity and drive a need for solutions where the increased removal of siltation may be a more appropriate strategy.

Through our trials with councils and NRW, we have delved deeply into methodologies not only to produce solutions but the added efficiency of jointly planning investigations and providing joint materials to communities. We are still building on our approach but will need support from Welsh Government to extend these outcomes to a uniform methodology for Wales.

We have investigated and produced a programme that will progress smart metering in every catchment. The added information provided by this installation will not only provide day to day information but provide the trends that are needed to produce accurate long term projections.

However, affordability impacts this ultimate goal, and a strategy has been created to incrementally improve the permanent metering locations required to support robust long-term planning in a similar way used in water supply. We have also investigated the development of new tools once the data is available.

4.3 How we considered risk

We have looked at a range of different areas as part of an overall assessment of risk (Table 18):

- **Risk Based catchment screening (RBCS) and Catchment Vulnerability Assessment** - A 'risk screening' process to identify areas most at risk and where we need to focus most of our efforts. In this plan all Level 3 areas were carried forward to the next assessment stage.

- **Baseline Risk and Vulnerability Assessment (BRAVA)** - A method to bring together different elements and help us consider what the key problems are both now and in the future. This has highlighted the differing levels of information behind the assessments and the need for greater focus going forward on planned development, such as creating more models.

- **Problem Characterisation** - Characterising problems which we need to solve in terms of how complex they are. We have concluded that there are 24 level 3 localised areas that need to be investigated in greater detail and, within these areas, 44 Level 4 catchments.

Table 18 - Overall Assessment of Risk

Risk-based catchment screening (RBCS) Where are we today and where do we need to focus our efforts?	• This is a screening exercise to see which areas need to progress to more detailed analysis. • This process is important as the outputs will allow us to focus our efforts on the most in need areas. • All 106 Level 3 areas were triggered not allowing us to focus on any areas. This is a result of the amalgamation of areas into river reaches.
Baseline Risk and Vulnerability Assessment (BRAVA) Where will we be in the future if we only maintain the standards of today?	• This is an assessment of zonal performance against planning objectives. This is only for zones that triggered the RBCS. However, our conservative approach at RBCS, our coverage of models, and our approach to zone creation, meant that all our zones were assessed. • However, many zones in the assessment were identified as requiring further investigation to understand risk. This means we need to increase our understanding of the whole catchment and how it interacts. We will need to increase the types of models, and the model coverage, to feed into this additional investigation as part of plan development for DWMP29.
Problem characterisation How big and complex are the problems we'll need to solve?	• We look at problems we'll need to solve and how big and complex they are. • We categorise each area as standard, extended or complex. This categorisation shows where there are multiple risks in a geographical location and indicates if growth could be a big problem in the future. • From this information, we can produce a 'risk matrix' which gives each problem a category based on how complex they are. • This helps us to predict the level of effort we'll need to put into developing options for each of these problems. Options for more complex problems will take more time to develop. • Our results showed that most areas would require a standard assessment. • Through the delivery of this plan, we have learnt that even standard catchments may require many individual solutions to resolve each localised risk zone within a catchment, even if the risk is not big or complex.

4.4 Plan Development Risk - Catchment Vulnerability Assessment

4.4.1 Introduction

In their price review methodology consultation, initially published in July 2017, Ofwat created a new requirement for annual reporting (Ofwat, PR19 Framework and Methodology, 2017), to provide a measure of the resilience of sewerage undertaker's drainage systems to extreme wet weather. Atkins were subsequently commissioned by Water UK to produce a common industry methodology for assessing resilience. They produced "Developing and Trialling Wastewater Resilience Metrics Final Report" in 2017 (Atkins, 2017). This provided an outline of how water and sewerage companies might assess how resilient their wastewater networks are to extreme wet weather and specifically to generate an estimate of the proportion of the population served which would be at risk of sewer flooding from a 1 in 50-year return period storm.

As part of 2019 price review submissions, water and sewerage companies produced resilience estimates using a variety of different approaches, which were variations on the principles outlined in the Atkins report. DCWW opted to run 1 in 50-year storms on all wastewater hydraulic models that had been verified as part of the development of our sustainable drainage plans (SDPs), and to produce exceedance flood routing using various pseudo 2D flood routing methods. These flood paths were then overlaid against background mapping to provide an estimate of the percentage of the population which would be at risk from sewer flooding. The results from these simulations were then extrapolated across the whole DCWW region, for those catchments where current hydraulic models were not available.

The variation in the application of the Atkins methodology across the sector made it difficult to establish industry baseline figures for the resilience metric. As a result, Water UK held a meeting on 'Consistency of Reporting for the Common Performance Measure (resilience metric)' on 6 of February 2019 and it was agreed that all water companies should follow an approach which more closely aligned with the Atkins report, particularly where suitable models were not available. As a result of this decision, it was necessary for DCWW to carry out a catchment vulnerability assessment.

Because the Atkins document is not sufficiently prescriptive to act as a detailed methodology for an assessment, it was necessary to agree an approach which would be appropriate for DCWW given the datasets and capabilities that are available. RPS were commissioned to produce a methodology for the assessment, and pass/fail criteria were agreed with the DWMP leads. It was agreed that RPS would produce a technical note detailing that methodology and the process followed when assessing the catchment vulnerability to allow the assessment to be repeated in future reporting of the resilience metric.

4.4.2 Methodology

To mitigate some of the subjectivity associated with the application of the Atkins guidance, DCWW have devised a set of parameters for assessing the resilience metric, drawing on several data inputs, GIS layers, incident datasets and telemetry data. The DCWW methodology for Assessing Catchment Vulnerability was developed following the guidance outlined within the Atkins document 'Developing and Trialling Wastewater Resilience Metrics' (Atkins, 2017). This metric forms the basis for estimating percentage of population at risk of sewer flooding in a 1 in 50-year storm, where suitable hydraulic models are not available to provide a more detailed estimate.

In addition, this metric forms part of the Risk Based Catchment Screening (RBCS) as a Tier 2 metric for determining which Level 3 catchments should be progressed to Baseline Risk and Vulnerability Assessment (BRAVA).

The 16 vulnerability criteria (or metrics/ assessment parameters), labelled A to P, are provided in Table 19.

Table 19 - Catchment Vulnerability Criteria

Assessment Metric / Parameter	Vulnerability Description
A	General catchment geographic topography funnelling all flows into one area
B	Catchments with a rapid response
C	Unknown asset data
D	Only drainage system in catchment / high proportion of combined sewers
E	Sewer flooding risk from historic reported incidents
F	Repeated blockage risk from historic reported incidents
G	Urban density (high population concentration)
H	Proximity to sea / river level
I	Large complex networks with many dependencies
J	Dependence on pumping
K	Proximity to water table
L	Growth potential (unplanned)
M	Consequence of flood risk management by others
N	Growth potential (planned)
O	Catchments with a slow response - flat sewers and septicity
P	Where no key issues identified

Each of the 16 vulnerability criteria derived for the assessment were subject to the following technical methodology steps:

- Detailed description of each vulnerability provided to aid assessment;
- Criteria for Assessing Metric - Each metric is assigned a vulnerability grade (5 being the highest vulnerability) based on the extent to which it meets specific Criteria;
- Process for undertaking assessment – specific steps in GIS for each of the Criteria (this may include creation of area boundary layers, calculation of areas, creation of x, y, and z (elevation) co-ordinates for export into specific excel calculation sheets; and
- Recommendations for refining the process for each metric during future iterations were given where appropriate.

The Technical Methodology document provides detail on how the Atkins guidance has been interpreted to be applicable specifically to DCWW, and how the assessment against each metric is carried out. A section has been completed for each vulnerability criteria, detailing the vulnerability description, the vulnerability grade assigned for each criterion, and the detailed description provided. Following this is the agreed methodology and criteria for scoring and a step-by-step guide on how the assessment has been carried out.

This enabled consistency in application and assessment of each of the vulnerability metrics to produce catchment vulnerability scores for each of the 16 criteria, and an overall vulnerability grade for a given catchment.

4.4.3 Outputs

The primary output of the assessment is the Catchment Vulnerability Assessment (CVA) report spreadsheet. The calculation sheet compiles the results into the agreed format for reporting as of April 2019.

The first sheet, ‘CVA Results’ compiles the results of all the vulnerability criteria, with a column for each criterion.

This spreadsheet summarises the results of the assessments of each catchment against each metric and includes the assessed vulnerability grade for each catchment. The assigned vulnerability grade is based on the maximum vulnerability grade assigned through the assessment of each of the 16 metrics for each catchment.

The results have then been used as part of the resilience metric reporting and as part of the DWMP Risk-based Catchment Screening process.

Table 20 provides an example of the output for a metric, in this case ‘A - General catchment geographic topography funnelling all flows into one area’.

Table 20 - CVA output example for an individual criterion

CATCHMENT	FLID	AREA	NRW_PROPAR	EA_PROPAR	HIGHPOINT	LOWPOINT	Highpoint_x	Highpoint_y	Lowpoint_x	Lowpoint_y	X distance	y distance	total distance from high point to low point	gradient	Percentage of area within surface water flood zones	5 or null
BETWS-Y-COED	466	49.8411067	2.807759718	0	58.6988599	10.8471981	277828.733	356834.366	279515.582	357020.683	1686.84881	186.316667	1697.107184	2.82%	5.63%	5
CAPEL CURIG	467	17.4443872	1.217212136	0	209.252211	147.262032	271987.313	358395.26	273619.151	356839.235	1631.83776	1556.02459	2254.796443	2.75%	6.98%	5
CAPEL GARMON	468	2.25737846	0.043201151	0	231.243344	217.403071	281631.908	355466.398	281537.213	355288.609	94.6945267	177.789108	201.4349038	6.87%	1.91%	
TALYBONT-DOLGARROG	469	82.2583898	3.544242641	0	151.537863	2.88687618	275448.087	369796.696	277813.109	366805.922	2365.02157	2990.7739	3812.880217	3.90%	4.31%	
EGLWYSBACH	470	19.5567707	0.302687	0	53.0251468	25.7271492	280554.633	370955.254	280178.254	370873.218	376.378794	82.0365173	385.2155071	7.09%	1.55%	
HENRYD	471	5.49665996	0.060201895	0	37.4501338	28.2509935	276990.73	374857.817	276848.032	374678.989	142.697272	178.828811	228.7842983	4.02%	1.10%	
LLANFAIRFECHAN	473	176.064918	9.5970547	0	156.300898	3.04934457	269204.836	374430.45	264860.579	373614.683	4344.25673	815.766489	4420.18569	3.47%	5.45%	5
LLANRWST	474	133.470948	11.50197996	0	168.347201	3.80292224	280813.387	363591.482	279794.496	361545.808	1018.89167	2045.67443	2285.371768	7.20%	8.62%	5
ROWEN	477	14.6182471	0.510045762	0	97.2746525	48.2431227	275457.124	372116.072	276033.264	371849.548	576.140135	266.523708	634.8010253	7.72%	3.49%	
TRELAWNYD	478	57.0383767	1.059403322	0	191.814151	138.1086	307552.409	381511.833	308758.942	379283.221	1206.53277	2228.61207	2534.251975	2.12%	1.86%	
TYNYGROES	479	26.4702111	0.318362537	0	79.9042658	2.92640279	277249.418	371783.237	278400.47	371413.633	1151.05176	369.604202	1208.936478	6.37%	1.20%	
YSBYTY IFAN	480	4.99526683	0.404898567	0	230.301525	211.950462	284306.218	348631.515	284211.424	348843.374	94.7934675	211.859356	232.0995221	7.91%	8.11%	5
BETWS YN RHOS	481	16.7643961	0.321541787	0	134.820814	91.6662572	290478.231	373364.555	290758.324	373684.223	280.092971	319.668496	425.0176696	10.15%	1.92%	5

Table 21 provides an example of overall Catchment vulnerability grading.

Table 21 - CVA output example of combined catchment vulnerability grading.

Catchment ID	Catchment Name	Total PE	Residential PE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Assessed vulnerability grade	Model available	Assessment
53022	MILFORD HAVEN	14,483.13	14,174.00					4		2					3		2			4	Yes	Option 1B assessment
53032	TENBY	15,939.56	9,545.00					4		2	3		3		3		2			4	Yes	Option 1B assessment
53100	SWANSEA BAY	185,873.15	165,383.00					4		2			3		3	2	2			4	Yes	Option 1B assessment
53118	LLANTWIT MAJOR WWTW	9,544.05	9,265.00		5			4		2	3		3		3		2			5	Yes	Option 1B assessment
53154	AFAN	139,432.60	121,296.00					4		2	3		3		3	2	2			4	Yes	Option 1B assessment
53174	ABERAERON STW	3,013.89	2,605.00					4		2	3		3							4	Yes	Option 1B assessment
70011	PENMAENMAWR	4,572.60	3,978.00	5				4		2	3				3		2			5	Yes	Option 1B assessment
70042	ALWEN	15.00	14.00	5			5			2										5	No	Option 1a assessment
71123	NEWPORT (DYFED)	1,296.96	898.00					4		2	3		3		3		2			4	No	Option 1a assessment
71128	DOLWYDDELAN	371.00	326.00	5			5	4		2	3		3		3		2			5	No	Option 1a assessment
71132	HEREFORD RIVER VIEW	58.00	58.00				5			2								2		5	No	Option 1a assessment

4.5 Plan Development Risk - Risk Based Screening

4.5.1 Introduction

Following the process of setting out the Strategic Context and understanding the key drivers of the DWMP, the first stage of the risk assessment process, or ‘Understanding the problem’ for development of the DWMP, is a high-level Risk Based Catchment Screening (RBCS). RBCS identifies which sewerage catchments are likely to be most vulnerable to future changes, such as climate change or population growth, so that effort on the remaining steps of the DWMP can be focused accordingly. The RBCS process is set out in Appendix B of the Water UK DWMP Framework (WaterUK, DWMP Framework, 2018).

The purpose of the RBCS process is to provide an initial screening of all DCWW catchments using existing quantitative and qualitative data to determine the level of assessment required at the next stage of the DWMP process. It highlights which L3 Tactical Planning Unit (TPU) catchments should be progressed to a more detailed Baseline Risk and Vulnerability Assessment (BRAVA).

The results of the screening and any subsequent, more detailed, risk assessment directly informs planning for the aggregated Level 2 Strategic Planning Areas (13 DCWW ‘Drainage

Basin Areas') that ultimately form a single Level 1 Area (where planning at L2 and L3 are brought together within the overarching company level DWMP).

RBCS allows planning efforts, which lead to the development of investment decisions, to be focused in areas of greatest need and to de-prioritise areas which are not deemed to be causing any environmental or customer issues, or are unlikely to do so in the future.

At RBCS, each L3 catchment (aggregated from WwTW catchments) is screened against a range of performance indicators, also referred to as metrics or screening parameters. This series of metrics provide an indication of the environmental and customer impact of the sewerage and drainage in the area. This enables the required level of detailed analysis to be carried out in the DWMP process, or may eliminate areas from further investigations, if no issues are identified. Figure 36 (Reproduced from the DWMP Framework) shows where this RBCS methodology fits within the wider DWMP process.

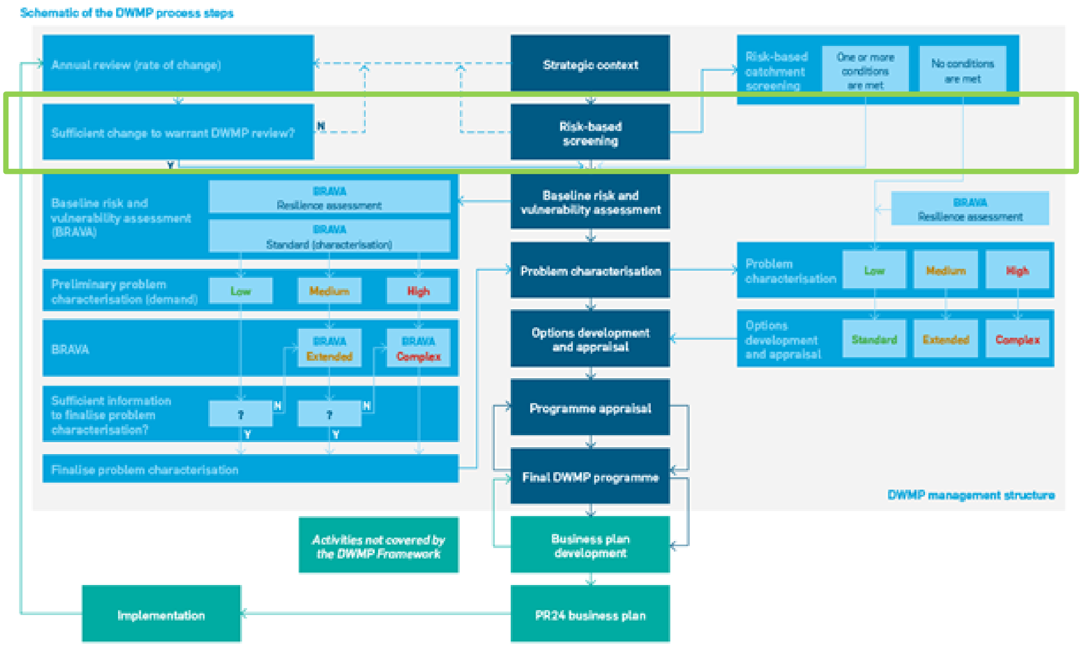


Figure 36 - DWMP Process and RBCS alignment (Water UK, 2021)

4.5.2 Methodology

We have assessed all L3 catchments against the risk-based screening checks outlined within section 4.3 of "A Framework for the Production of Drainage and Wastewater Management Plans" (WaterUK, DWMP Framework, 2018). A total of 18 risk-based screening parameters were assessed against customer and environmental impact measures of success.

Assessments were carried out at an appropriate level and the results were aggregated into the 106 defined L3 Tactical Planning Units (TPUs); which are grouped strategically based on drainage to watercourse and population size, to guide the prioritisation of next step BRAVA assessments. If an individual WwTW catchment triggered a specific metric, then the L3 TPU within which that catchment was located, would also trigger for that metric.

The performance indicator metrics are listed in Table 22.

Table 22 - RBCS Performance indicator metrics

Number	Performance Indicator (RBCS metric)
1	Catchment Characterisation (*Tier 2*)
2	Intermittent discharges impact on bathing or shellfish waters
3	Continuous or intermittent discharges impact upon other discharge to sensitive waters (Part A)
4	Continuous or intermittent discharges impact upon other discharge to sensitive receiving waters (Part B) (*Tier 2*)
5	Storm Overflow Assessment Framework (SOAF)
6	Capacity Assessment Framework (CAF)
7	Internal Sewer Flooding
8	External Sewer Flooding
9	Pollution Incidents (categories 1, 2 and 3)
10	WwTW Quality compliance
11	WwTW Dry Weather Flow compliance
12	Storm overflows
13	Risks from interdependencies between RMA drainage systems
14	Planned residential new development
15	The Water Industry National Environment Programme (WINEP / NEP)
16	Sewer Collapses
17	Sewer Blockages
18	Bespoke Indicators* (*Tier 2*)

Tier 2 - Indicators have been classified into two tiers, providing a mechanism to differentiate between the priority of each indicator tier when considering whether further assessment is justified (all other indicators being 'first tier').

*Bespoke indicators (Metric 18) will be included during Cycle 2.

Each metric has been assessed following the approach set out in the DWMP Framework, with limited amendments where appropriate to align to existing DCWW processes to ensure ease of repeat assessment.

Performance Indicator descriptions, a summary of the DCWW assessment methodology and the associated BRAVA Criteria to be used in the RBCS for our DWMPs are summarised in Table 23 below.

Table 23 - Performance Indicator Descriptions, DCWW assessment methodology summary and associated BRAVA Criteria.

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
1	Catchment Characterisation (*Tier 2*)	This provides a mechanism to understand the vulnerability of the sewer catchment (L3) to sewer flooding during an extreme wet weather event (defined as a 1-in-50-year storm event). Catchment vulnerability score = 1 to 5 (where 5 is the most vulnerable or sensitive to an extreme wet weather event). The catchment characterisation is based on the results of the	Catchment vulnerability score = 4 or 5 (i.e., the most vulnerable or sensitive to a one in 50-year storm).

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
		Catchment Vulnerability Assessment (CVA), for which a separate technical methodology has been produced. This assessment was carried out in March 2019 at the Level 4 WwTW catchment scale and has not been updated in November 2019 as significant changes were not expected.	
2	Intermittent discharges impact on bathing or shellfish waters	This is a mechanism to understand the significance of any impact of water company operations on bathing or shellfish waters. DCWW currently maintains a list of all intermittent discharges to bathing or shellfish waters, using information on the CSOs which have exceeded the relevant spill frequency thresholds specified in the DWMP Framework to assess whether the indicator has been breached at Level 4 scale.	Intermittent discharges within the catchment with existing quantitative spill frequency trigger permit conditions, event duration monitoring results indicate investigations are likely to be triggered.
3	Continuous or intermittent discharges impact upon other discharge to sensitive waters (Part A)	This mechanism is to understand the significance of any impact of water company operations on sensitive receiving waters not addressed by other indicators. On review of the NRW actions database and Natural England's designated sites system, no locations within the DCWW region were identified, and in the future these databases are not going to be kept up to date, therefore no catchment should be considered to breach this indicator.	Action recorded as 'planned' or 'underway' on the Natural Resources Wales Actions Database, **or** 'Remedy' on Natural England's Designated Sites system (associated with freshwater pollution discharges or freshwater drainage). And/or: Are included within a Nutrient Management Plan and/or a Diffuse Water Pollution Plan, requiring water company action to improve the discharge.
4	Continuous or intermittent discharges impact upon other discharge to sensitive	A mechanism to understand the significance of any impact of water company operations on sensitive receiving waters not addressed by other indicators. As for number 3 (Part A)	Action recorded as 'identified' on the Natural Resources Wales Actions Database, Or, 'Threat' on Natural England's Designated

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
	receiving waters (Part B) (Tier 2)		Sites system (associated with water pollution).
5	Storm Overflow Assessment Framework (SOAF)	This considers the current / potential future activity to identify and address high spilling storm overflows. DCWW currently maintains a list of all intermittent discharges which are being monitored as part of the ongoing SOAF. The indicator was considered to have been breached where any SOAF procedures where ongoing or likely within the catchment and was assessed at Level 4.	Any SOAF investigations ongoing in the catchment or planned (i.e., EDM data has crossed the SOAF spill frequency investigation triggers) or are likely to be triggered. Or model predictions (if available) indicate that SOAF spill frequency investigation triggers are likely to be crossed within next 5 years.
6	Capacity Assessment Framework (CAF)	The measure provides an indication of capacity constraints in the sewer network as a leading indicator to service failure. CAF assessments were carried out as part of the 21st century drainage programme and the output is a series of 10km hexagons covering the whole UK, which have been assigned a score of 0 to 5. A GIS exercise was required to establish where hexagons with a score of 4 or 5 intersect with any of the catchment boundaries (Level 4). To account for areas where catchments intersected with multiple hexagons, the catchment boundaries were dissolved, and an average risk rating was then calculated for each Level 4 catchment.	Assessment focuses on the 'present day' case. Where the foul/combined catchment is: Categorised as 4 or 5 (due to performance, in full or part, within the catchment being assessed).
7	Internal Sewer Flooding	Historical measure that records the number of internal flooding incidents per year (sewerage companies only). DCWW currently keep a record of all flooding incidents that have occurred in the region. This data is used for annual reporting purposes. A significant number of assumptions were required to collate incidents	For all catchments, the following must be true: Number of incidents is > 1 in total over the last 3 years, and If the incidents have been caused by hydraulic overload (HO) only, measures have not been put in place to address

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
		into an appropriate format which could be used for this assessment. These have been detailed separately. The metric was not updated in November 2019 due to the significant time commitment required to collate the data, so the latest available June return (2019) figures were not used. The metric was only assessed against data up to 2018	sewer flooding risk (for example, permanent solutions for hydraulic overload) for all properties that have experienced flooding incidents in the last 3 years. For catchments >= 2,000 pe the following must also be true: Annual flooding incidents (number per 10,000 connections) in any of the preceding 3 years is >company average or the baseline industry value for upper quartile (whichever is higher)
8	External Sewer Flooding	Historical measure that records the number of external flooding incidents per year (sewerage companies only) and is indicative of sewer capacity constraints. This is a common performance commitment by water companies to reduce flooding within the external curtilage of customer properties. Note: this is a variation from the PR19 common performance commitment, so the numbers considered in this assessment, as they exclude extreme events, will differ from figures reported for the performance commitment. Methodology as for Internal Sewer Flooding above.	As for Internal Sewer Flooding with the following difference: Number of incidents is > 10 in total over the last 3 years.
9	Pollution Incidents (categories 1, 2 and 3)	This is a historical measure that identifies incidents of unexpected release of contaminants that have resulted in environmental damage. DCWW currently maintains a list of all pollution incidents which have occurred (Pollution Register All Wales). Each pollution incident contains data for the “STWCatchmentAssetNo”, the reporting year for the incident and the category of the incident (severity). This data was used to	For any of the previous three years data, a category 1 or 2 pollution incident has occurred. Or: For any of the previous 3 years data the annual performance for the catchment is classed as “Amber” or “Red” (for 2017 this being greater than 25 incidents per 10,000km of sewer).

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
		assess this metric at L4. The assessment included data up to the end of 2018.	And, where category 3 incident has been recorded in the last 3 years: measures have not been put in place to address pollution risk.
10	WwTW Quality compliance	This is a historical measure relating to the performance of the WwTWs (discharge permit compliance (numeric)). DCWW currently keep a record of all sites that have recorded compliance failures. This data is used for annual reporting purposes. The data was used directly for the assessment. An export of the list of Level 4 catchments which breached the indicator was provided by the Treatment Performance Co-Ordinator (performed under a distinct data compliance methodology).	Based on EPA criteria. •In any of the previous 3 years, the WwTW discharge has been confirmed as failing and was included as such in the calculation of overall permit compliance. And: •Measures have not been put in place, or are not required (subject to Natural Resource Wales / Environment Agency agreement), to address the cause(s) of compliance failure.
11	WwTW Dry Weather Flow compliance (DWF)	This is a historical measure of compliance with DWF permits at WwTWs. DCWW currently reports on Dry Weather flow consent compliance at all sites where flow monitoring is undertaken as part of annual reporting. Data over the last 6 years was reviewed to assess if consecutive flow compliance failures occurred at any WwTW. For Level 4 catchments where no flow measurement is undertaken an assessment was carried out within the headroom database which looks at metered flow to commercial metered customers, and traders in the catchment, to assess whether the total of this plus an assumed residential flow (residential PE* 150L/head/day) and an assumed 40% infiltration rate is greater than the DWF consent for the catchment to identify WwTW which breach the metric.	Where flow measurement is undertaken, Q90 of the measured yearly flows exceeded the dry weather flow permit condition on two consecutive years in the last 5 years and: •no measures are in place to address compliance risk (or required by the Environment Agency / Natural Resources Wales). •measures have been put in place that address compliance risk but are considered temporary/short-term solutions. Where no flow measurement is in place, or in respect of maximum flows, headroom calculations indicate the works is at risk of

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
			exceeding its flow permit conditions.
12	Storm overflows	A measure that focuses on using available data to examine permit risks that have not been captured by other indicators (for example, issues to be considered include non-compliance with pass forward flow conditions, storm storage conditions (where relevant) and screening requirements). At the time of the assessment, there was no current dataset which could be used to assess this metric, so all Level 4 catchments were considered not to have breached the indicator. However, in an additional work programme with NRW/EA being completed outside of DWMP overflows identified as ‘unpermitted are being resolved.	Is there evidence to indicate that over the last 3 years any overflow is not operating in accordance with permit conditions.
13	Risks from interdependencies between RMA drainage systems	A mechanism to understand risk posed by other RMA assets in the catchment. A GIS exercise was undertaken to establish where assets are in the proximity of flood risk zones produced by other RMAs. The following flood zones were combined into a single GIS layer: •EA surface water flood risk maps, •EA sea/river flood risk maps, •NRW equivalent (see data manual) All assets listed in the relevant GIS layers that were within this flood risk zone were identified and those in each Level 4 catchment was then totalled.	Where it is considered that significant risks arise from interaction with other RMA drainage systems / receiving waterbodies.
14	Planned residential new development	This indicator uses predicted residential population growth forecasts to target catchments requiring investigations for potential future capacity constraints. DCWW currently maintains a database which monitors headroom at all WwTW catchments which contains information from a growth	The indicator was assessed as having been breached if the growth percentage for each catchment was higher than the specified value for that catchment’s current population.

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
		exercise which was carried out by developer services in 2016, where LDP growth data was mapped and filled in where necessary to establish an annual residential growth rate (households per year) for each Level 4 WwTW catchment. This rate was then compared against the growth rate tables in the DWMP Framework document to identify where catchments were considered to have a high rate of growth.	
15	The Water Industry National Environment Programme (WINEP)	The WINEP sets out the actions that water companies need to complete to meet their environmental obligations. WINEP and NEP actions are listed within the WINEP and NEP datasets. All those actions with a non-wastewater driver code were removed from these lists as well as any monitoring driver codes. The points were then mapped and compared against the Level 4 boundaries to assess if a WINEP/NEP driver was within any of the catchments.	Known WINEP/NEP drivers impacting the specific L4 catchment.
16	Sewer Collapses	This is a historical measure that identifies risks to the integrity of the sewer system. DCWW currently keep a record of all collapse and blockage data incidents that have occurred in the region (the MM39 data). This data is used for annual reporting purposes. A GIS exercise was required to identify the total sewer length in each catchment for normalisation of the incident frequency. This was carried out at Level 4. The June 2019 return population figures for each Level 4 catchment was also used for the assessment.	For catchments <2,000pe: •Sewer collapses are >= 2 per year in any of the preceding 3 years For catchments >2,000pe: •If the number of collapses (normalised by sewer length) in any of the preceding 3 years is greater than the average for the company over the last year.
17	Sewer Blockages	This is a historical measure that records obstructions in a sewer	If the number of blockages (normalised by sewer

No.	Indicator	Description (adapted from Water UK, 2021) & DCWW Methodology Summary	Criteria for the indicator to flag as a concern and needing further investigation in the BRAVA stage
		(that require clearing) which causes a reportable problem (not caused by hydraulic overload), such as flooding or discharge to a watercourse, unusable sanitation, surcharged sewers, or odour. DCWW currently keep a record of all collapse and blockage data incidents that have occurred in the region (the MM39 data). This data is used for annual reporting purposes. Each incident is recorded against a sub-catchment so a count per catchment (Level 4) was generated using this information.	length) in any of the preceding three years is greater than the company average.
18	Bespoke Indicators (Tier 2)	Bespoke Indicators to be applied in Cycle 2.	N/A

4.5.3 Outputs

The primary output of the assessment is the completed Risk Based Catchment Screening spreadsheet which provides a list of the catchments which should proceed to BRAVA, and detail on all the triggered metrics for each catchment in a tabular format.

The results are colour coded to indicate that a Tier 1 or a Tier 2 indicator has been breached, or that an indicator has not been breached.

4.5.4 How are the results used? – Requirement for BRAVA

Summating the total number of indicator breaches across both indicator Tiers results in one of the following conditions (Water UK, 2021):

- If two or more indicators are breached (excluding sewer collapses and blockages – see third bullet) then a BRAVA is required to identify whether and to what extent changes in future inputs impact on planning objectives.
- If one indicator is breached (again, excluding sewer collapses and blockages – see next bullet) then a BRAVA is required, **if the indicator causing the single breach is included within the first tier**.
- If only the sewer collapses and/or blockages indicators are breached then at present this is to be treated as if no indicators are breached, for example, there is no requirement to undertake the DWMP BRAVA and problem characterisation process steps, and current planning approaches to risk assessment and option development and appraisal are to be continued.
- If no indicators are breached, this implies that there is no current evidence to suggest that the L3 catchment is likely to be vulnerable to changes in future inputs. Wider resilience assessment for the catchment will still need to be undertaken.

Figure 37 presents the RBCS requirement for BRAVA flow chart reproduced from the Framework (WaterUK, 2018).

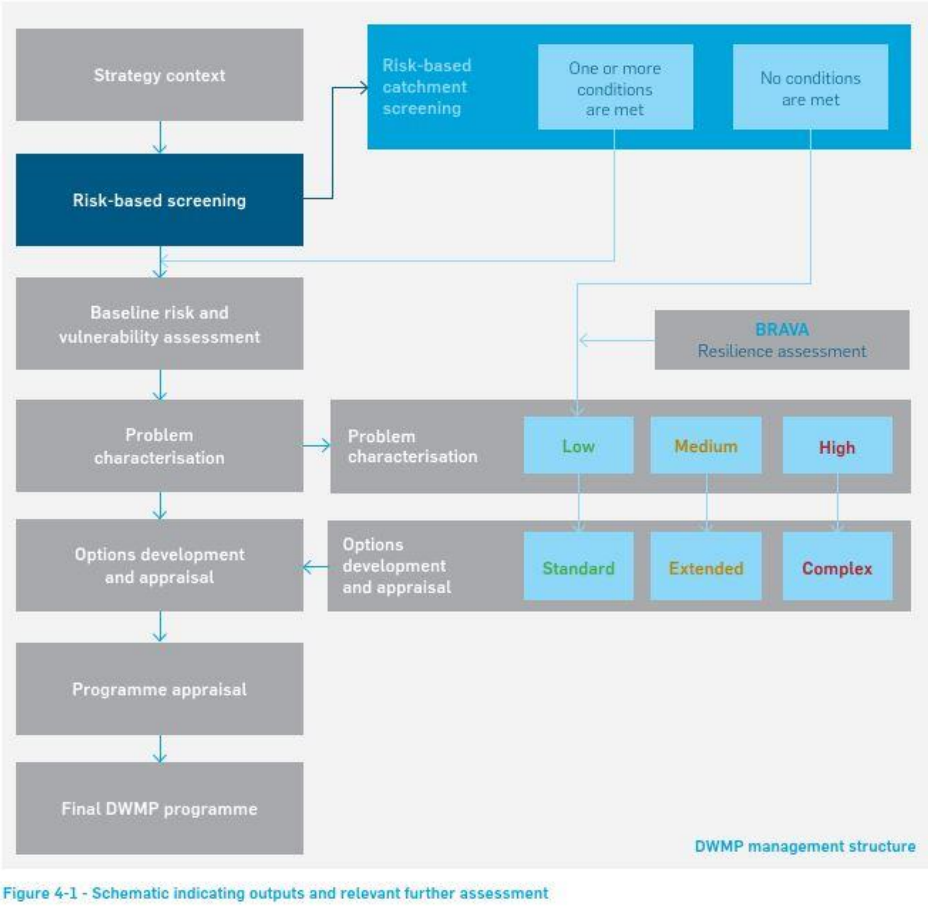


Figure 37 - RBCS and requirement for BRAVA (Water UK, 2021)

4.5.5 Summary of screening iterations

The initial assessment was first carried out in March/April 2019, and then revised in November 2019, to ensure that the 2018 data was captured for all metrics. This also enabled an initial understanding of the detail between the outputs and how performance variability may influence catchments proposed for BRAVA.

The third iteration started in May 2021 upon completion of the DWMP BRAVA stage, to further confirm the rate of change in catchments recommended for investigation through BRAVA. The results are based on the annual performance Review reporting figures for 2021 (APR21) where available. The Methodology was amended regularly to reflect changes in approach between iterations. The review was carried out to determine whether annual changes altered the number of areas requiring BRAVA significantly. The results indicated that there were very few changes and not enough to warrant this extensive process annually.

Of the 106 L3 TPUs – all **106 have been progressed to BRAVA** having met the requirements for BRAVA detailed earlier due to being summarised from the Level 4 assessment. A compiled results summary table for Level 3 screening is presented in Table 24, itemising the numbers of breaches recorded for each of the indicators. The outputs are also summarised in our area summaries of Level 2 and Level 3.

We have chosen to take all our Level 4 catchments through the BRAVA process as, when amalgamated together, they make a level 3 TPU. The approach confirmed that, instead of refining the number of areas so that focus could ensure the highest risks were taken for assessment at both Level 4 and Level 3, the approach, or the current level of risk, indicated all Level 3, and approximately 95% of the Level 4 catchments, triggered an assessment. In many ways this assessment should be considered as carried out on all zones and focus decisions can be made only at problem characterisation stage.

Whilst the overall number of catchments proceeding to BRAVA does not change significantly from year to year, there are some metrics for which the number of catchments breaching varies significantly. An analysis of the changes in Level 3 breaching each indicator has been undertaken.

Table 24 shows the RBCS results for the past three iterations at Level 3 tactical planning unit level.

Table 24 - Summary of Results for Tactical Planning Units (Level 3) – 3 Year Comparison

Year	Count of Level 2 Strategic planning area	Count of Catchments	Total population	1 Count of catchments breaching indicator: Catchment	2 Count of catchments breaching indicator: Bathing or shellfish	3 Count of catchments breaching indicator: Discharge to sensitive	4 Count of catchments breaching indicator: Discharge to sensitive	5 Count of catchments breaching indicator: SOAF	6 Count of catchments breaching indicator: CAF	7 Count of catchments breaching indicator: Internal Sewer Flooding	8 Count of catchments breaching indicator: External Sewer	9 Count of catchments breaching indicator: Pollution incidents	10 Count of catchments breaching indicator: WwTW Q Compliance	11 Count of catchments breaching indicator: WWTW DWF	12 Count of catchments breaching indicator: Storm Overflows	13 Count of catchments breaching indicator: Other RMA systems	14 Count of catchments breaching indicator: Planned Residential	15 Count of catchments breaching indicator: WINEP	16 Count of catchments breaching indicator: Sewer Collapse	17 Count of catchments breaching indicator: Sewer Blockages	18 Count of catchments breaching indicator: Bespoke Indicators	BRAVA analysis: Number of indicators breached (excluding blockages and collapses) All catchments	BRAVA analysis: Count of catchments with single indicator breach and indicator is Tier 1?	BRAVA analysis: Number of catchments proceeding to BRAVA?
2019	13	106	3,938,304	104	20	0	0	76	59	46	97	8	12	91	0	105	103	77	79	102	0	788	0	105
2020	13	106	4,106,206	103	21	0	0	57	59	44	93	7	12	91	0	105	103	87	75	91	0	773	1	106
2021	13	106	3,915,894	105	25	0	0	87	83	44	103	2	9	91	0	74	102	73	64	98	0	789	1	106

The following maps (Figure 38) illustrate the RBCS metrics triggered for the 106 L3s with a colour graded numerical representation:

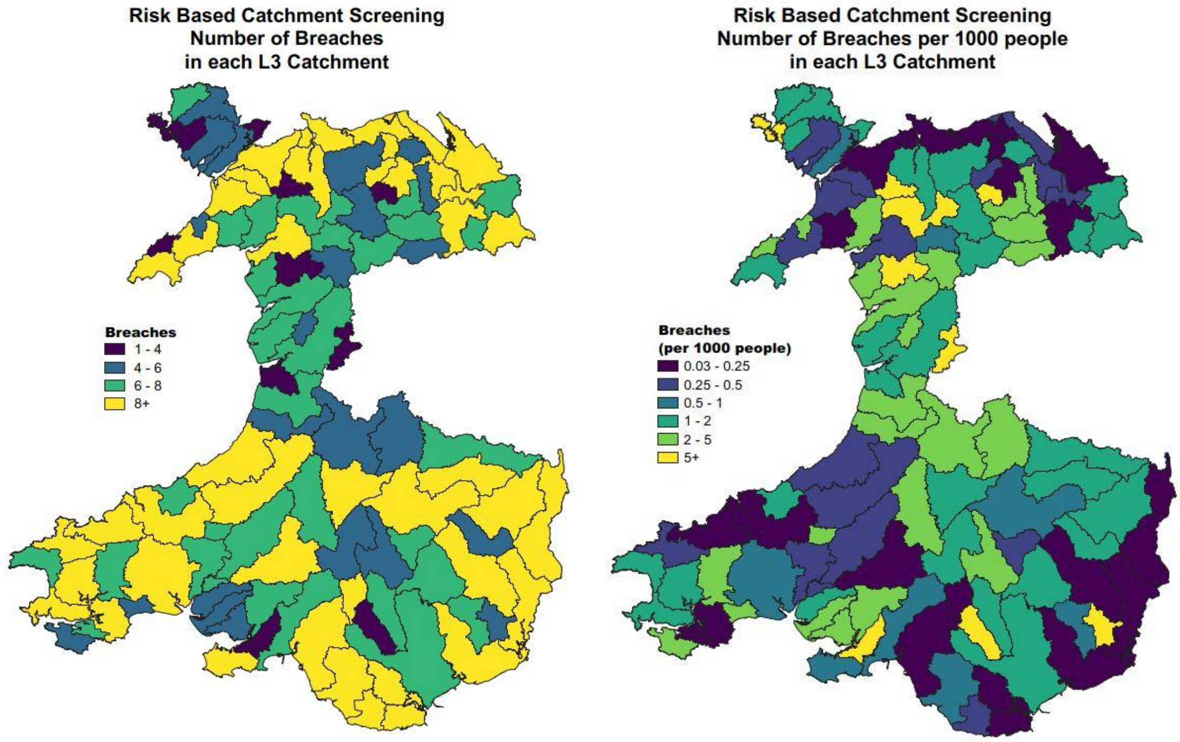


Figure 38 - RBCS L3 Catchment Breaches

4.5.6 Future Recommendations

4.5.6.1 Frequency of iterations

The RBCS assessment has been carried out at least once per year during cycle 1 of the DWMP. The results suggested that the broad number of L3 catchments triggering is unlikely to alter appreciably, recognising that there are still certain factors within the indicators which could significantly change with time and place having greater emphasis. These factors, considered with some indicators being based on 3-year averages, suggest that the optimal RBCS process is a complete assessment at the start of the cycle, with a second iteration a the 3-year mark to capture specific variance in emphasis across indicators.

4.5.6.2 Catchment triggering

Triggering 106 L3 catchments pushes significant burden on the BRAVA process in terms of computation and time. For Cycle 2, there is an opportunity to review metric thresholds to enable better targeting of catchments with more tangible drivers. Opportunities to review may include:

- Review RMA designation and integration, incorporating some element of proportionality;
- Introduction of a weighting/scalar element to support refined prioritisation and promotion;
- Review Tier 1/Tier 2 balance on metrics;
- Ensure full datasets are available in advance of the RBCS process (for example, SOAF for cycle 1); and
- Review thresholds for breach and normalisation metrics.

The assessment does not allow a top-down drilling to focus the approach; the methodology starts at the lower level and the approach then summarises up through the layers.

4.5.6.3 Alternative screening *assessment*

The supply demand approach is a quick assessment that can be undertaken annually from performance and monitoring data going forward. The approach allows capacity to be the focus, bringing together both network and treatment constraints, and then simply drilling down through the layers where the capacity is at risk. This is a well-known approach used in WRMP for many years. With the changes presented in this DWMP, a DWF and rainfall version can indicate where we should look first. This is a 'drilling down approach' with assessments at high level triggering investigation into a lower level, if there is an indicator to do so.

4.5.6.4 Wider feedback

The following items have been identified during Cycle 1 and will potentially influence the RBCS process in future DWMP cycles. They are detailed here to provide clear visibility of future change and will inform specific process steps once they are live.

It should be noted that the NRW actions database is being phased out, and that any actions previously recorded here would now form part of the NEP anyway. Likewise, with Natural England's designated sites, these should also appear on the WINEP list, so there may be scope to discuss whether this is a relevant metric for DCWW going forward.

It is considered likely that the CAF will change in future to more granular assessment comprising either Level 3 catchment boundaries or smaller Level 4 "Local Planning Needs" sub areas, rather than 10km hexagons. As part of the DWMP PSG meeting on the 14 March 2019, proposed changes to the DWMP Framework were agreed to reflect this. If this occurs, then the updated data should be used. This will prevent the issue of catchments being considered at risk for capacity based on their proximity to other, poorly performing catchments, rather than their own performance. At the time of carrying out the latest assessment, the CAF assessment had not been updated.

As part of the DWMP PSG meeting on the 14 March 2019, proposed changes to the DWMP Framework were agreed. One of these stipulates that any measures to address sewer flooding risk should not be limited to those which address HO issues. Therefore, it would no longer be necessary to assess the causes of flooding as part of the flooding metric. However, there would be an assessment of where measures have been put in place to address flooding for example, for OC flooding issues, such as pipe rehabilitation. This should simplify this metric going forward.

The approach used to assess the pollution indicator only includes a check for catchments where a category 1 or 2 incident has occurred. It is recommended that future iterations consider the additional check listed in the DWMP framework document, which allows for a method of assessing where a high rate of incidents (normalised by sewer length) from wastewater is occurring in Level 3 catchments. This part had not been included as part of this iteration as there was no guidance on what threshold would make a catchment 'Amber' or 'Red' included in the Framework. This will be reviewed in future iterations.

The measure for assessing flow compliance of catchments with no flow measurement in place could be improved by implementing sensitivity testing to identify the impact of lower assumed infiltration rates, or by using known infiltration rates elsewhere to better inform the 40% estimate. The installation of new Flow Pass Forward metering at treatment works in the current investment period should also inform this process.

The 'Catchment Overflow Plan' is currently being compiled as part of the SDP process. This will detail areas where there may be other consent breaches. This could be used to assess the storm overflows indicator in future iterations.

The methodology used to assess the risk of interdependencies between RMA drainage systems might be improved by compiling a better list of datasets from other RMAs as using the flood zones is a somewhat coarse assessment. Further investigations could be carried out on the assets themselves to better understand their vulnerability to interactions with other RMAs, for example, understanding where flap valves are in place, or where pumped outfalls are utilised.

During cycle 1 of the DWMP the base year for our plans was expected to be 2020. However in reality, to use 2020 data for assessments such as RBCS and BRAVA, 2020 would have had to be finished and annual performance reporting (APR) completed. which ends approximately June 2021. The end date of the APR is the critical path to commencing the DWMP. The chosen base year date impacts the delivery of the overall plan due to time it takes to carry out in-depth hydraulic modelling for all level 4 catchments. There are many locations and planning objectives to be assessed, all of which need to be assessed for multiple future time horizons, so this activity becomes constrained between waiting for the given base year to be confirmed and the deadline for Draft Consultation.

For example, with the DWMP cycle 1 base year as 2020, the results from 2019-2020 would be aligned to the annual performance review data. In terms of plan development this would mean that the Plan could not commence until the end of 2020 and all reporting had been completed. This would be as part of the APR assessment during July 2020. This is too late to carry out the subsequent stages. It is recommended that the base year would need to be at least one year prior to this. For the next cycle the base year would need to be 2023-2024 with the APR of 2024. This aligns with the last year of the AMP not the first year of an AMP.

As an alternative approach, in order to to reduce the impact and cost from hydraulic modelling the Plan could retain a modelled baseline each decade and extend each cycle by a decade, with the delivery years being modelled at five year intervals.

4.6 Plan Development Risk - Baseline Risk and Vulnerability Assessment

4.6.1 Introduction

In the DWMP process, Baseline Risk and Vulnerability Assessment (BRAVA) follows the Risk-Based Catchment Screening (RBCS) procedure that first identified which catchments require investigation (Figure 39).

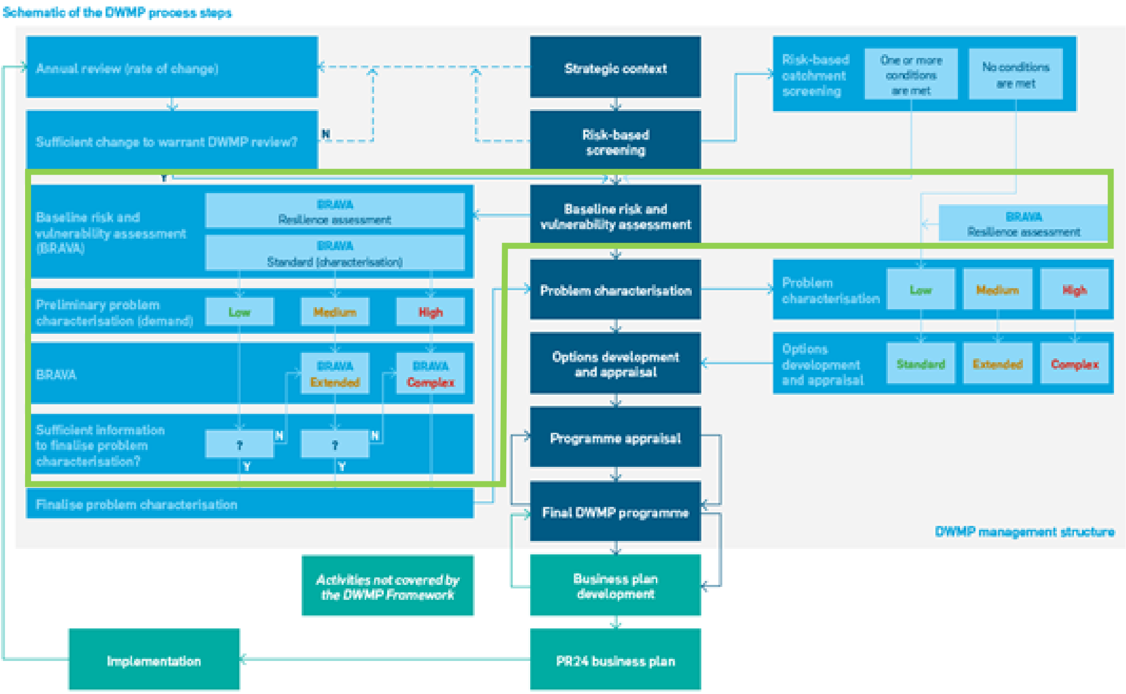


Figure 39 - DWMP Process and BRAVA alignment (Water UK, 2021)

The objective of BRAVA is two-fold:

1. To review the performance of the current wastewater and drainage system; and
2. To investigate the broader resilience concerns in the highlighted catchments.

The BRAVA process evaluates system performance against 'baseline' and future planning scenarios to 2050, with a view to understanding the **risk of service failure** and when it is most likely to happen (under chronic stresses or acute events). There are a series of key steps within the methodology which define the level of input and assessment required at this stage, determining both the **complexity of the assessment,** and ultimately **informing the level of optioneering required**.

It should be noted that the BRAVA process has developed and matured throughout Cycle 1 as more information has been included within the process, and the resulting assessments have evolved. This process will continue to evolve into Cycle 2, especially as part of the drive towards 100% model coverage for both networks and WwTW.

4.7 Methodology

BRAVA is made up of two stages: An initial problem characterisation followed by the BRAVA assessment itself. The following paragraphs explain these stages.

4.7.1 Preliminary Problem Characterisation

The BRAVA employs a tiered approach to ensure the level of investigation in each catchment is appropriate to the availability of data and complexity of the challenges identified in the RBCS. Preliminary Problem Characterisation (PPC) is the first step of the process. To enable the allocation of a PPC score, it is necessary to understand the initial risks within a catchment, and the future growth challenges it will face. It uses a **Preliminary Strategic Needs Score** (PSNS), and a **Population Growth Uncertainty Score** (GUS) to determine a Preliminary Problem Characterisation Score through a decision matrix detailed in Table 25 below. It then determines the complexity of the BRAVA assessment undertaken within the given catchment.

The focus of this score is to understand the level of demand, by combining growth with the performance challenges faced within the catchment.

Table 25 - Preliminary problem characterisation decision matrix, based on DWMP framework Appendix C, Table C-1, and BRAVA level mapping

			Preliminary Strategic Needs Score			
			Negligible	Small	Medium	Large
			1-2	3-4	5-6	7-8
Growth Uncertainty Score	High	± >10,000 population	Standard	Standard	Extended	Complex
	Medium	± 5000-10,000 population	Standard	Standard	Extended	Extended
	Low	±<5000 population	Standard	Standard	Standard	Standard

The resultant assessment of PPC provides a Low/Medium/High score which, based on the DWMP guidance, initially equates to the requirement to undertake a Standard, Enhanced or Complex BRAVA assessment. This requirement can then increase in complexity on a catchment-by-catchment basis depending on whether there is sufficient information within the BRAVA assessment undertaken to finalise the Problem Characterisation within the catchment and move on to the development of options.

4.7.1.1 Preliminary Strategic Needs Score

The PSNS is calculated based upon the number of indicators triggered in the RBCS, the type of indicator and overall availability of data. This is summarised in Table 26.

Table 26 - Preliminary Strategic Needs Score criteria

Preliminary Strategic Needs Score "How big is the problem"	Criteria	Score
Negligible	Single indicator trigger	1
	Two indicator trigger catchments	1
	Three indicator trigger catchments <500 population equivalent (PE)	2
Small	Three indicator trigger catchments >500 PE	3
	>four indicator triggers including <500 PE, only CAF, DWF, Other RMA and/or blockage indicator failure	4
Medium	Four indicators triggered	5
	>five indicators triggered - <10 indicators triggered.	6
Large	>10 indicators triggered	7
	>13 indicators triggered	8

An increase to the number of indicators triggered results in an increase in the score for PSNS, as part of the overall preliminary problem characterisation assessment.

4.7.1.2 Population Growth Uncertainty Score

The central planning estimate has been used to inform pre problem characterisation. We have utilised the **growth central planning estimate** for the company area and determined additional growth planning scenarios for catchments that are subject to an extended or complex BRAVA, in adherence to the Water UK DWMP Framework (WaterUK, DWMP Framework, 2018). More information regarding the Central Estimate can be found in 4.7.1.4,

The scenarios preferred going forward are those listed below.

- Past Build Rate (Dwellings/Year) – Historic new connections Build Rate; and
- Plan Period Rate (Dwellings/Year) – local development plan Build Rate.

The Office of national statistics forecasts are also considered however are not utilised in the PCC stage in this plan.

Should planning policy change significantly to influence growth patterns the assessment will be undertaken again.

4.7.2 BRAVA Assessment – Understanding the process

Following on from the allocation of an initial level of BRAVA assessment from the PPC, DCWW has decided to further sub-divided the Standard assessment into two levels: **Standard non-Modelled** and **Standard Modelled**. This formalises a level of investigation that is performed in catchments where less data is presently accessible or modelling decision support tools are unavailable, while also calling attention to a future need for more data collection in subsequent DWMP cycles. All catchments had standard non-modelled assessments undertaken to provide a consistent baseline across the entire region. Catchments with models available had additional processes undertaken.

4.7.2.1 Level of assessment – Defining Non-Modelled and Modelled requirements

The BRAVA levels have a supporting methodology which is proportional to the level of effort required to complete the risk assessment and subsequently finalise the problem characterisation. Each BRAVA level has been summarised in Table 27 below. This emphasises the evolution of the process and how additional data and scenarios are added to the process as the complexity of the catchment assessment increases. This also introduces an additional step within the standard level of Non-modelled and modelled requirements based on available data, decision support tools (including hydraulic models) to add confidence to predicted performance.

Table 27 - BRAVA Levels

BRAVA Level	Description
Standard	Non-modelled No decision support tools (DSTs) are available, assessment is based on available data and engineering judgement.
	Modelled DSTs are available to produce modelled results to forecast future risk for some planning objectives. A central estimate of growth is applied.
Extended	Run standard BRAVA DST modelled scenarios but also apply ±30% uplift on growth projections to address uncertainties.
Complex	Run standard and extended BRAVA modelled scenarios but also multiple climate change uplifts, bespoke growth and creep scenarios defined in consultation with L2 SPG. Examples of the types of scenarios which may be proposed include: ± % climate change in line with local upper and lower estimates. Full build out rate for predicted growth. For cycle 1 of the DWMP there were no complex assessments undertaken.

For Cycle 1, all catchments passing to a standard BRAVA had a non-modelled assessment completed in the first instance. Following on from this, catchments have undergone a BRAVA appropriate to the level of risk identified from the PPPC stage, based on a selection determining which catchments require additional information to complete the BRAVA based on historic issues. In Cycle 1, we have prioritised Level 4 catchments which have had historic internal flooding issues and have therefore passed those Level 4 catchments to the Standard Modelled tier. The Standard Modelled tier adds hydraulic modelling of the drainage system to the assessment.

Table 28 presents the BRAVA level catchment allocations.

Table 28 - BRAVA allocations showing the Level 4 distribution

No BRAVA	Standard Non-Modelled	Standard Modelled	Extended	Complex
37	606	172	10	0

4.7.2.2 Developing a Catchment Priority Score

To support prioritisation across DCWW, all catchments have undergone an assessment to generate a priority score. This is based on a series of performance critical planning objectives and an allocation against whether it is a Main Priority Driver, a secondary priority driver or Not a Driver. The Matrix in Table 29 below shows how specific drivers generate catchment priority scores within Cycle 1.

When moving between the non-modelled assessment and the modelled assessment which is a blend of using available data and DSTs (including hydraulic modelling) catchments have been flagged where there has been historical evidence of internal flooding, worst served customers, pollution, and external flooding. For this cycle of the DWMP this has driven the hydraulic modelling programme where the highest risk catchments were allocated to priority 1-3 and a hydraulic model has been used to supplement the BRAVA assessment. For the remainder of the catchments the non-modelled BRAVA tool has been used where an assessment has been made using the best available data and application of assumptions to create forecasting data. This process has matured within Cycle 1 and will continue to mature through Cycle 2 as more high confidence data can support the process, with a progression towards 100% modelled risk for both network and treatment performance. This approach was introduced to drive increased model coverage over time. New models were and are being built to ensure the highest risks experienced can produce options first.

Table 29 - Brava Triggers to define catchment priority

Priority Score	Internal Flooding	Worst Served Customers (WSC)	Pollution	External Flooding	BRAVA Trigger
1	M	S	S	S	Y
2	N	M	S	S	Y
3	N	M	N	N	Y
4	N	N	M	S	Y
5	N	N	N	M	Y
6	N	N	N	N	Y

M – Main priority driver	S – Secondary priority driver	N – Not a driver

For Cycle 1 of the DWMP due to time constraints DCWW have chosen to focus on bringing the catchments with a 1-3 priority score up to the DWMP modelling standards. This has meant that all catchments which have historic internal flooding issues have been hydraulically modelled for the BRAVA, generating the difference between standard non-modelled and standard modelled approaches. Without this decision the number of modelled catchments within the risk stage would have been lower.

Based on the prioritisation assessment undertaken the catchment allocation by hydraulic modelling priority can be seen in Table 30 below.

Table 30 - Brava Priority Catchment Allocation

	Hydraulic modelling programme for cycle 1 of DWMP						
	Priority 1	Priority 2	Priority 3	Priority 4	Priority 5	Priority 6	Priority 7
Number of catchments	25	106	51	7	17	592	37

4.7.2.3 Developing a BRAVA Score

The BRAVA process outputs a score for each catchment (Level 2 and Level 3) which indicates the level of concern in respect to the likelihood of achieving each Planning Objective (PO). The scores are driven by the exceedance thresholds set by DCWW. For each planning objective, there is a defined set of exceedance criteria which influence the assessment process. The score is between 0-2 and how that score is determined is outlined in Table 31 below.

Table 31 - BRAVA Scoring structure

Score	Description
0	No known concerns
1	Some concerns over exceedance
2	Significant concerns over exceedance

These scores are defined for each of the time horizons under assessment as part of DWMP up to 2050, providing both a specific horizon scoring snapshot, but also the picture of long-term change in risk within the assessed catchments.

4.7.3 Identifying the root cause of a risk

The conclusion of the risk analysis stage is to identify the causes of risk that require solutions. In terms of the work being carried out in RBCS and BRAVA, combined with the supply demand approach, it is the combination of the results that allow separation of root causes into classes.

These classes are inherent in the plan as reflected in the name of the plan itself - The Sewage Plan and Drainage Plan, and to identify the extreme root cause of an issue the emergency flood plan. To bring out the differences further the idealised graph Figure 40 can be used to focus the type of root causes within the identified classes, represented by coloured bands.

This concept works for the current day and also works for future 'what ifs' such as the change of a permit that will be in force in the next 10 years. The type of solution to match the risk can be concluded using the classes of rainfall. For example, the minimum size of a pipe needs to be in use the majority of the time and can be classes as meeting the sewage plan (blue area) the pipe has to be this size as the sewage volume only is estimated to need that size pipe, allowances are also then added for future growth, infiltration or misconnections and variable trade use. If the root cause is capacity to meet the sewage plan creating a surface water separate scheme is unlikely to be the root cause. In reality no real-world root cause is just 1 cause so at any given location every scenario plan has to be resolved to fulfil the root cause for each with solutions for each.

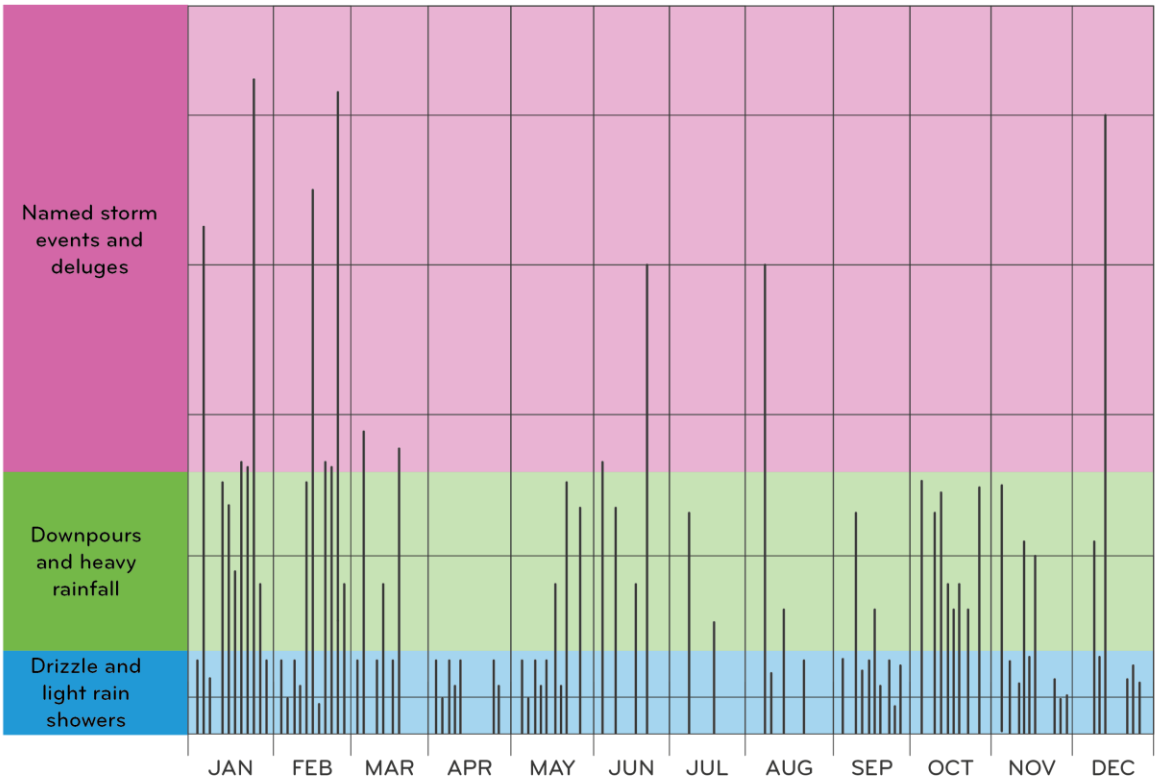


Figure 40 - Graph showing the annual idealised rainfall and how rainfall can be used to target interventions for great utilisation based on the frequency of event.

In terms of the **blue area – the sewerage plan,** the causes in this area are where changes in the network over time from growth and creep have occurred and there are now localised capacity issues. Historically, issues have only been identified when a tipping point has occurred, and someone is flooded, or a watercourse has instances of pollution and a mitigation to resolve the issues are then put in place. What we need is a proactive approach to identify these types of root causes before they occur and keep up with the mitigation of the issue before a flood or pollution event occurs.

In terms of the **green area - the drainage plan**, the causes in this area are when short term solutions to manage overland flow are diverted into the sewer or the future pressure of climate change can no longer be contained in a normal sewer and exceptional circumstances require joint working with other owners of assets and land with a view to work together to solve drainage as a community. Historically, sewers have played a large part in draining urban communities as they have grown. Communities are now much larger than they were and consequently different approaches to manage drainage are required.

The third area is the **pink area - the emergency flooding plan**, this is where the resilience to storms needs to be considered. In a storm event could service be maintained and if not, why not? It is then necessary to build into the system the ability to return to service faster.

4.7.4 Time Horizon Scenarios – Building our understanding of catchment change

As part of the BRAVA assessment process, all requirement time horizon scenarios to 2050 need to be developed for each of the standard assessment. This includes all potential attributes within a catchment which could influence performance. A consistent methodology for their assessment and application enabled the future change parameters into time horizon scenario models, generating the required performance against critical planning objectives.

When working with future time horizons the introduction of scenario planning to manage alternative futures is an important consideration. We have utilised the 'review of consents' terminology to highlight the difference between planning for the future using the current discharge permits and current legislation versus planning for an altered discharge permit or a future legislation. Even though this is not a DWMP framework requirement we have concluded that there is a need to develop this separate planning detail within the BRAVA stage as it will also support the delivery of future NEP/WINEP.

4.7.5 Population Growth and development

As previously discussed, growth and its impact are fundamental to understanding catchment risk. To support all steps within the DWMP, central growth forecasts focussing on known planning and development have supported the development of GUS and are also fundamental to the development of future change Time Horizon Scenarios. Our forecasts and supporting calculations have enabled known developments to be added to hydraulic models where they are likely to connect and within the time horizon which the development is likely to occur. These population uplift from the known specified development sites was then compared with the central estimate forecast and any additional projected population increase was distributed within the catchment within the relevant time horizon models.

It is important to note that a direct comparison between the water resource management plan projections of population and properties cannot be made. In terms of the development of services to customers there is a higher majority of houses and communities connected to the drinking water supplies than there are connected to council drains and foul sewers. The choice to manage your own cesspit and or soakaway system is common in many rural areas of Wales. However, these communities can be concentrated together incorporating approximately 50 properties and their scatter across Wales needs to be recognised. There is a legal mechanism in place for those communities wishing to be connected to the wastewater network systems and there are a few applications being constantly considered, designed, and incorporated over time.

4.7.5.1 Flow from houses – Population

Wastewater flow arising from domestic dwellings takes two forms; 1, foul flow originating as black water from toilets and grey water from bathing, dish washing and laundry; and 2, storm flow from surface drainage. These two flows entering the sewerage network differ in their drivers, levels of contamination and volumes. Grey and black water are directly linked to occupancy (population) and behaviour, while storm flow is linked to impermeable area and rainfall.

4.7.5.2 Flow from houses - Water consumption

Drinking water consumption is the best indicator of domestic foul flow, with approximately 95% of drinking water entering a property translating to foul flow as either black or grey water.

For the DWMP DCWW devised the central planning estimate (for growth) for the company area and determined additional growth planning scenarios for catchments that are subject to an extended or complex BRAVA, in adherence to the Water UK DWMP Framework.

4.7.5.3 Flow from businesses - Commercial properties

Wastewater flow arising from purely commercial properties (no additional processes using water or discharging additional chemical/biological components to the sewerage network) takes the same two forms as that being generated by domestic dwellings. The discharge patterns are directly related to business hours and an assumption of use patterns aligned to the scale of businesses.

4.7.5.4 Flow from businesses - Consented traders

Businesses identified as Consented traders have specific permits agreed with DCWW which define the daily flow peak and volume the business is allowed to discharge to the sewerage network. Where a permit has been granted, it is likely that the discharge contains chemical/biological elements which are considerably higher than typical domestic flow. Specific concentration limits will be included within the permit to manage the impact of these waters on the network and principally the biological processes at the WwTW.

4.7.6 Climate Change

The likely impacts of climate change are significant factors in understanding the future risks faced by the wastewater system. Climate change is likely to influence the frequency and severity of flooding events and the ability of the system to respond to and recover from these events.

The DWMP framework requires plans take a **long-term view** with a minimum period of 25 years. It is believed that the impacts of climate change will have begun to take effect within even that minimum time horizon. The DWMP framework suggests that the approach to climate change modelling as outlined in the 21st Century Drainage Capacity Assessment Framework (CAF) project should be used for the DWMP. This is unfortunately not possible as the UK Climate Projection Study (UKCP09) upon which the method was based, has been superseded by the revised UKCP18 outputs, rendering the approach redundant. At present there is no prescribed methodology for forecasting climate change specifically for the DWMP, but other activities such as the WRMP do offer some potential guidance.

In the absence of a consistent, up to date, UK wide climate change data set or forecasting framework a pragmatic approach has been used to develop a climate forecast for the first iteration of the DWMP. It is envisioned that this approach will be updated as the industry develops new tools for further cycles of the DWMP.

The following parameters influenced by climate change have been identified as relevant to understanding impacts on the drainage system.

- Rainfall;
- Sea level & Tidal range;
- River level;
- Soil moisture & ground temperature;
- Evapotranspiration;
- Water Quality; and
- Drought and water consumption.

Data sources describing future projections of these parameters are used to determine climate driven risk to wastewater assets against several scenarios and time horizons.

The FEH13 **Rainfall** dataset has been provided from the Centre of Ecology and Hydrology (CEH) and has been applied across the entire operational region using GIS. To simulate a broad range of storm events across the region 4 return periods will be generated 1-year, 5-year, 30-year, and 50-year, with storm durations 60-minute, 240-minute, and 480-minute as per the CAF method. **A regional uplift factor will be applied to the storm forecasts for each planning period over the 2080 time-horizon based on the UKWIR study 'Rainfall Intensity for Sewer Design'** (UKWIR, 2015). For enhanced and complex catchments, further sensitivity testing is required as per recommendations in the DWMP Framework guidance.

Figure 41 presents the UKWIR Linear regression of rainfall intensity. Figure 42 presents the applied regional rainfall uplift boundaries.

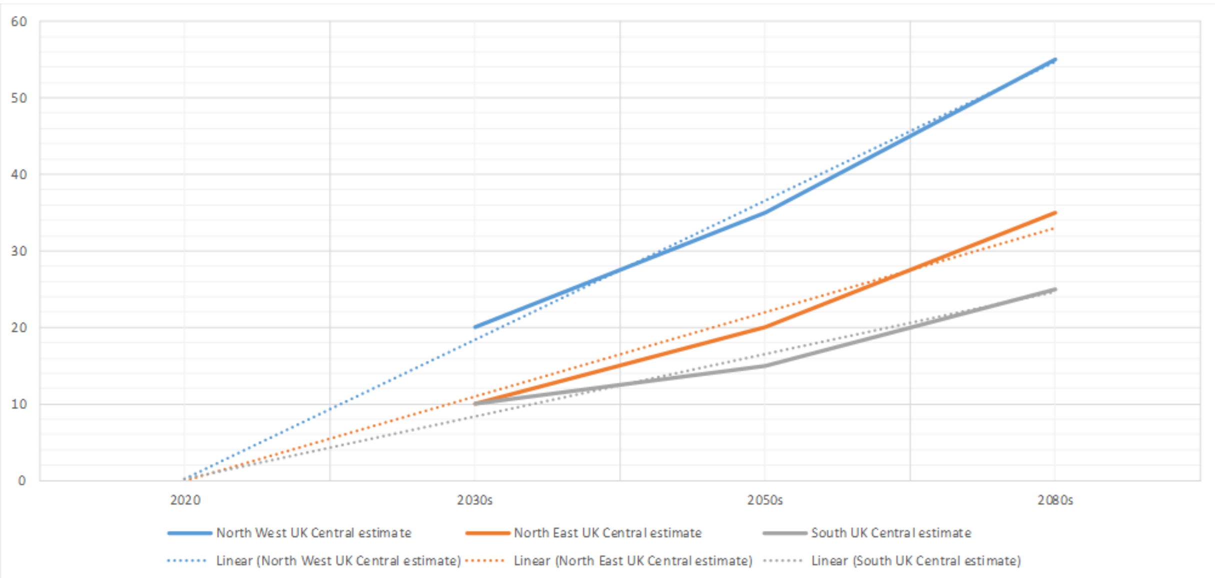


Figure 41 - Linear regression graph of UKWIR rainfall intensity for sewer design uplift values (central estimate only)

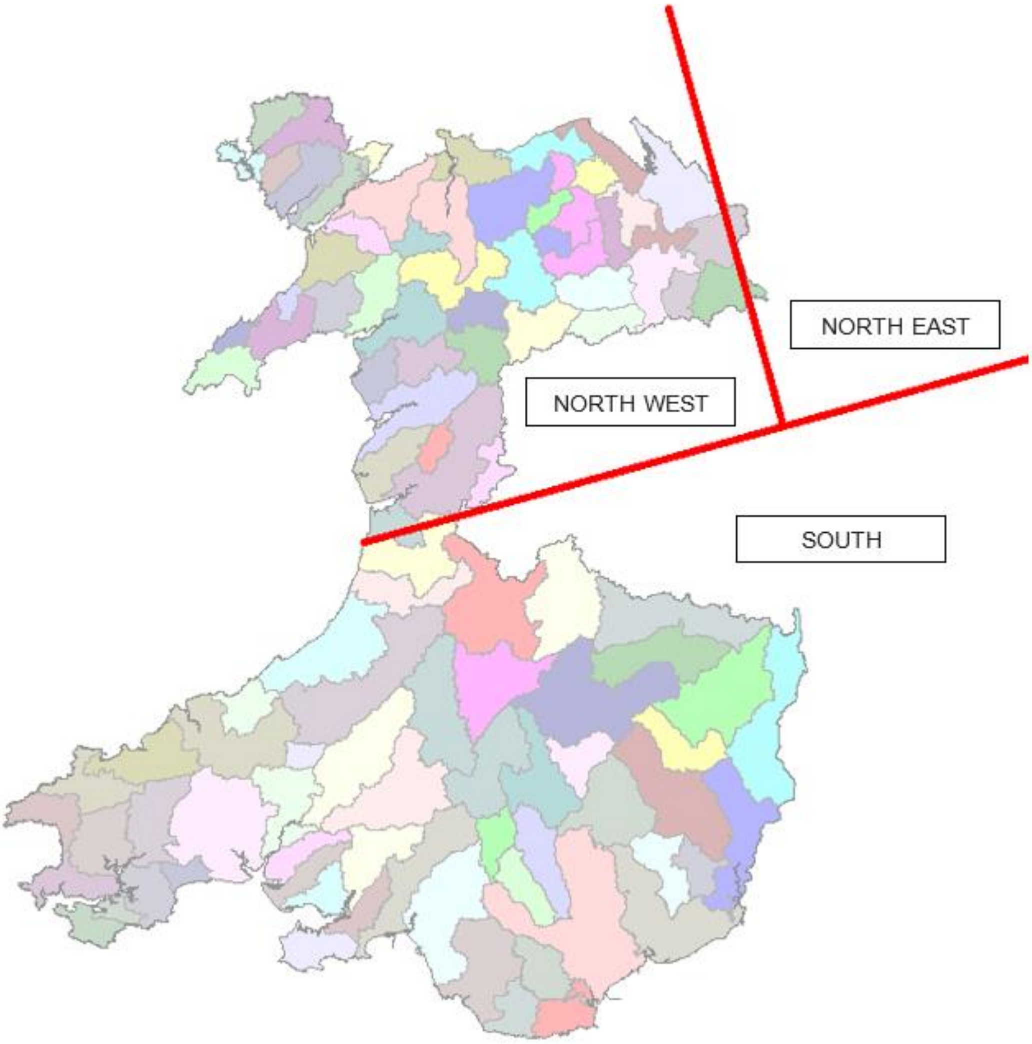


Figure 42 - DWMP Regional Design Rainfall Uplift Boundaries

Sea level/tidal impact is separated into two stages, with a screening process undertaken at the BRAVA stage to determine which catchments and assets require more detailed investigation at the ODA stage.

For the BRAVA stage assessment, the dataset generated for the Flood Risk Assessment Wales (FRAW) project by NRW was used. The FRAW has delivered multiple sources of information that will underpin decision making and steer investment across Flood and Coastal Risk Management (FCRM) activities in Wales. As part of the project, new Wales-wide, tidal (fluvial) and surface water (pluvial) flood modelling maps were produced for present day and climate change scenarios.

Tidal hazard mapping has been undertaken around the Wales coastline and in estuarine areas based on simple projection mapping. Extreme Sea Levels (ESLs) were taken from the new Coastal Flood Boundary Dataset 2018 (CFBD) and combined with a digital terrain model (DTM). The project produced results for the present day, 50-year, 75-year and 100-year climate change scenarios. Therefore, the best available dataset to use for pre-screening is the 50-year climate change scenario. Return periods available range from 30 year to 1000 year. For the initial pre-screening assessment, the 30-year return period will be used.

For the ODA stage, data the from the UKCP18 was used to update the methods proposed in the guidance document 'Adapting to Climate Change: Advice for Flood and Coastal Erosion

Risk Management Authorities in Wales' (Welsh Government, 2021). The updated dataset has been used to assess risk from sea level rise using GIS tools at the sites identified as needed more detailed analysis.

Forecasting of soil moisture follows methods outlined in CIWEM UDG Rainfall Modelling Guide 2015 (CIWEM, 2016), but is updated with data from UKCP18. Soil moisture on its own poses no direct risk but contributes to the risks associated with other parameters.

'River level', 'water quality' and 'drought & water consumption' have been excluded from the first iteration of a the DWMPs analysis due to data availability. Future cycles of the DWMP, the water industry will have more robustly tested methodologies and datasets available and will include these in further analysis of climate driven risks.

4.7.7 Urban Creep – Increasing catchment permeability

Urban creep is a one of the factors that could reduce resilience of our drainage and wastewater systems in future. It has been defined as 'areas that are already part of the urban fabric that have been subject to a change in permeability, for example, paving over front gardens, or extensions to existing buildings. Urban creep differs from 'urban expansion' or 'urban sprawl', in which previously un-developed areas, within urban areas, are developed leading to urban infill.

The Pitt Review (Pitt, 2008) identified urban creep as one of the factors impacting on flood risk, noting that 'Many responses to the Review felt that the summer 2007 floods were in part a result of the loss of many permeable surfaces in urban areas. The 2011 census found that 89.3% of 'usual residents' in Wales live in built-up areas, characteristic of a town or city (ONS, 2011) suggesting urban creep could have a significant impact on DCWW's wastewater systems.

The DWMP Framework (WaterUK, DWMP Framework, 2018) provides broad guidance on how urban creep should be estimated to understand its potential impact on drainage networks:

> *'Urban creep – should be applied based on the method that uses property density described in the UKWIR report 'Impact of Urban Creep on Sewerage Systems' (2010), unless there is an alternative method specified within the company's own procedures. For the 25-year planning horizon, sensitivity testing at +/-30% of the estimated urban creep should be evaluated. Companies can apply similar sensitivity testing for other planning horizons if this is likely to be significant …'*

The referenced UKWIR report (UKWIR, Impact of Urban Creep on Sewerage Systems, 2010), hereafter referred to as UKWIR2010, is widely applied across UK wastewater companies to forecast rates of urban creep and has been used to derive creep forecasts for DCWW's AMP6 Sustainable Drainage Plans.

A potential issue in using UKWIR2010 in DCWW DWMPs is whether the study is applicable across DCWW's wastewater operating area, given the study assessed a limited number of catchments (five cities/towns in England), for a relatively short timescale (at most seven years) more than 10 years ago. The DWMP Framework offers water companies the opportunity to use their 'own procedure' for forecasting urban creep, and with this in mind UKWIR2010 has been used to generate urban creep forecasts for the first cycle of the DWMP, given the time constraints.

The methodology outlined in below which is based on UKWIR2010, has been produced to calculate creep across all DCWW catchments, using property density and estimates of the available space within a catchment as the factors that controlling the rate of creep. Following a detailed literature review and discussion with subject matter experts, this is consistent with approaches used by other UK wastewater providers and by DCWW through its Sustainable Drainage Plans.

4.7.7.1 Surface Permeability

As urban creep is defined as the change of urban surfaces from permeable to impermeable surfaces, understanding the available permeable surfaces within urban areas is critical to estimating urban creep. The approach taken to calculate the available permeable area in the catchment is to subtract the impermeable area of the catchment from the total available area of the catchment. This is done taking into account property curtilage and, areas of parkland and woodland that are protected from urban expansion.

The impermeable areas are considered in two layers – paved areas and roof areas. The decision to split the layers was taken to reduce the size of the overall dataset but will also allow the calculation of each type of impermeable area at a catchment scale and allows the impermeable areas to easily be input into hydraulic models.

Firstly, the Ordnance Survey MasterMap (OSMM) was used to identify all paved and roof impermeable areas. For roof areas, building and structure polygons were identified, excluding any which were deemed to drain to sewers (for example, pylons). For paved areas, manmade road, track, and path polygons were identified, as well as other manmade surfaces within DCWW catchments. Several manmade areas which are likely to be permeable, such as landscaped slopes, mineral workings, and spoil heaps, were excluded from these layers. Figure 43 illustrates an example of an impermeable area mapping layer.

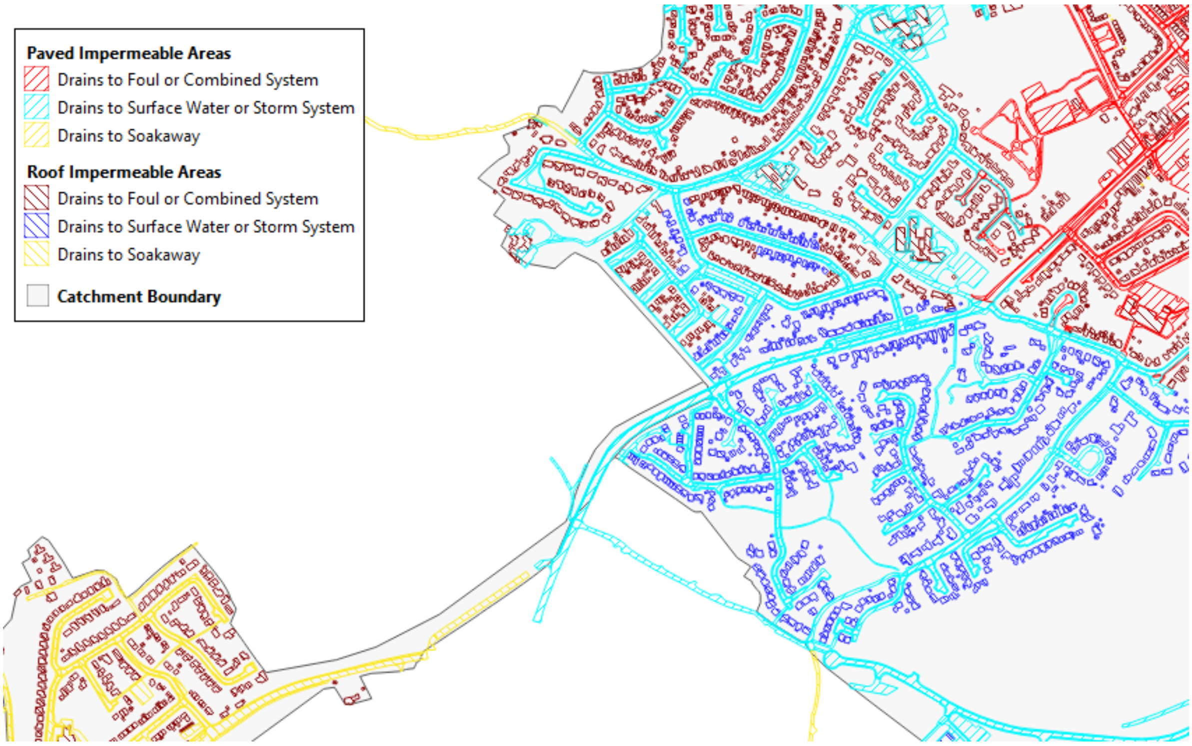


Figure 43 - Extract of the new impermeable area layers in southwest Mold.

To determine which system-type the impermeable areas drain to, data from the Consumer Data Research Centre (CDRC) Dwelling Age Group Counts (CDRC, 2020) was used. The ONS Rural Urban Classification (ONS, 2011) was also used to determine the system type for some impermeable areas.

Finally, numerous sheds, summer houses, greenhouses or other outbuildings are included in the roof impermeable area layers which are not connected to either the foul/combined system or the surface water system.

There are several limitations to the outlined approach to creating impermeable area layers for all DCWW catchments:

- By using OSMM data, the assumption is made that the classification of the OSMM polygons by the Ordnance Survey is accurate, and that polygons which are classified as buildings and structures are roofed and polygons which are classified as manmade surfaces are paved.
- Within property curtilage, the OSMM data generally defines polygons as 'General Surface – Multi Surface' and does not separate out the impermeable and permeable surfaces within the curtilage area.
- The impermeable area layers also assume that each OSMM polygon drains to the same drainage system type. Especially, OSMM polygons that represent roads or pavements can be very big and different parts of the road or pavement can drain to different drainage systems. Also, at many residential properties the roof at the front of the property drains to a different system to the back of the properties, which is not reflected in the impermeable area layers.
- Similarly, the paved and roof areas identified in the impermeable area layer are assumed to drain to either the foul, combined, surface water/storm system or soakaway. At present, impermeable areas which drain to other drainage systems operated and maintained by external stakeholders such as councils and the Highways Agency are assumed to either drain to DCWW systems or soakaway. With further investigations throughout the current and future DWMP cycles, areas which drain to other drainage systems can be identified and updated.
- The modal ages from the CDRC Dwelling Age Group Counts are used to assign drainage systems to roof and paved impermeable areas uniformly within each LSOA polygon. By doing this, it is assumed that within each LSOA polygon all roof impermeable areas drain to the same system, and all paved impermeable areas drain to the same system. In LSOA polygons where there is high variability in property age, there will be a lower confidence in the assignation of drainage system to impermeable areas than in polygons where the variability of property ages is lower. There is a considerable variation in the size of LSOA polygons, with the polygons covering considerably smaller areas in urban areas than in rural areas. This may lead to greater variation in property ages in rural LSOA polygons and lower the confidence.
- The CDRC Dwelling Age Group thresholds used for defining whether the impermeable areas within an LSOA polygon are combined drainage, partially separate drainage or separate drainage are assumed based on comparison with a limited set of impermeable areas surveys in SDP catchments. It is not possible to define accurate thresholds for the change from combined drainage to partially separate and separate drainage. Whilst most sewer systems constructed since 1945 are partially separate or separate (David Butler, 2010) the adoption of partially separate and separate drainage was not immediately adopted for all developments, particularly in brownfield areas.
- Except for buildings smaller than $4.5m^2$ that are assumed to be sheds, at present the impermeable area layers assume that no roofed areas drain to soakaway. In many areas roofs are drained to soakaway where it is not possible to construct storm drainage, however at present there has been no analysis undertaken as to which areas these roofs may be.

- The system types, which impermeable areas drain to, does not take account of the sewer records, modelled network, or any other source asides those mentioned. In areas where there are separate drainage systems represented in the sewer records, there is the potential to improve the representation of what system impermeable areas drain to by assuming these areas are either partially separate or separate drainage. At present, the impermeable area layers do not depend on the sewer records, but it would be possible to improve the layer to include these representations.

The above limitations outline some of the issues with the impermeable area layers created from the OSMM. It is envisioned at present that these layers would be used with existing impermeable area surveys and modelled layers to improve representations of impermeable areas in models, and to assign system types for the additional impermeable areas created by urban creep. This method is likely to be updated in future cycles of the DWMP to account for these limitations.

4.7.7.2 Property Density

The second major component of the urban creep calculation as outlined by UKWIR2010 is property density. The approach used to apply the property density method across all DCWW catchments is outlined below.

Firstly, all residential properties where urban creep is expected are extracted from the OSABP dataset to give a dataset of property points. The number of property points was then calculated within each UK postcode polygon which intersects with DCWW catchments, and the property density per hectare was calculated using the area of the postcode polygons. Figure 44 shows an example of property density for two adjacent postcodes. The property density was then assigned to each property point within that postcode, and the annual increase in creep was assigned to the property point based on the average increase in impermeable area for each property density group.

The curtilage areas as calculated in for permeability are used to calculate the maximum available area for urban creep. Where a curtilage is a multi-property curtilage, the total available area is divided by the number of properties within that curtilage. For the first cycle of DWMPs the maximum area that could be utilised for urban creep for each property is 25% of the total curtilage area at each property. For each property, the total urban creep was calculated for 5-year time intervals between 2025 and 2050 using the annual increase in creep, up to the 25% of the total curtilage area.

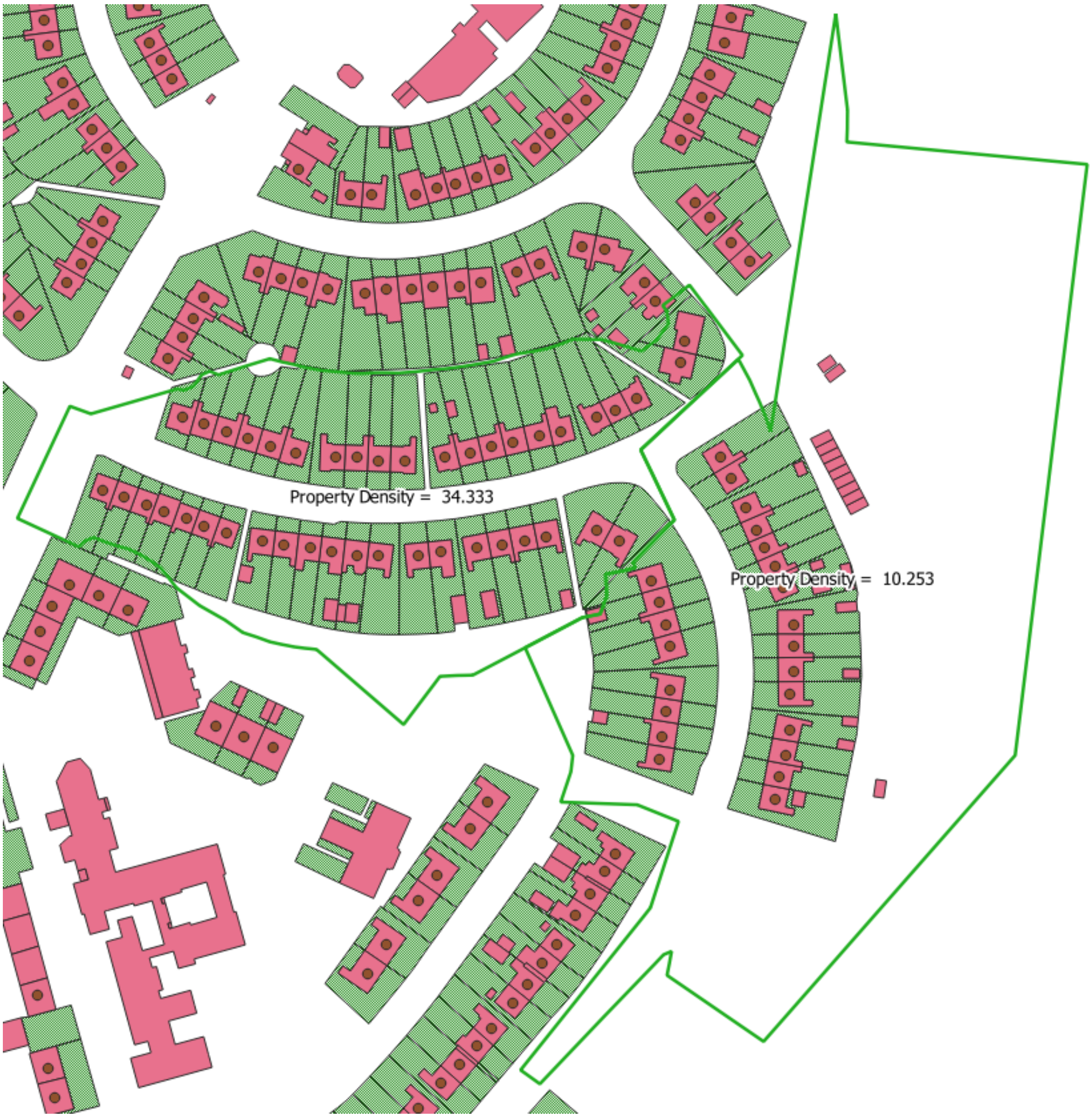


Figure 44 - Property density for two similar postcode areas. Other postcode areas omitted for clarity.

There are several limitations to using the outlined approach to calculating creep for all properties in all DCWW catchments:

UKWIR2010 was limited to analysing creep in five large towns and cities in England more than 10 years ago. Whilst there are large towns and cities within DCWW catchments, a large proportion of catchments are in rural areas. It is unclear how, if at all, the rate of urban creep varies in these rural areas compared to the five cities in England used in UKWIR report. A clearer understanding of the rate of increase in urban creep in rural areas, and in DCWW catchment areas, would improve the long-term estimates of creep in DWMPs.

In addition, the datasets used in the UKWIR2010 report cover periods between 1999 and 2007. It is unclear how much the increase of creep will have changed between the original study and present day. With economic downturns in 2008 and 2020, it is conceivable that the rate of creep will reduce as there is less money available to develop properties. However, in a separate study in Edinburgh, the rate of change of impermeable area was greater between 2005 and 2015 (8.19 ha/year) than between 1990 and 2005 (4.41 ha/year). A clearer understanding of current rate of increase in urban creep would improve the predictions for the next 25 years.

To understand the available area for creep, the curtilage area of each property was calculated in using OSMM polygons defined as 'General Surface – Multi Surface'. As touched upon previously, these polygons can contain both permeable and impermeable surface. Driveways, for example, are often not shown as paved surfaces in the OSMM data. The method above initially assumes that the entirety of the curtilage areas is permeable and available for urban creep. Many of these curtilage areas will be paved with impermeable areas. In the case of some properties, the curtilage may be completely covered with impermeable area, despite being defined in the OSMM polygons as 'General Surface – Multi Surface", whereas other curtilage polygons may be completely permeable. To account for this, the total amount of urban creep for each property has been limited to 25% of the available area. However, while this threshold was agreed with DCWW, the number could vary considerably between properties.

4.7.7.3 Creep Forecast Model

The forecast uses several datasets, including OS MasterMap, OS Address Base Premium, ONS Rural Urban Classification and CDRC Dwelling Age Group Counts to calculate the rate of urban creep at a property level for more than 1.2 million homes across DCWW's operational area. This method allows the estimation of creep for use in hydraulic models and more generally allows DCWW to understand the potential change in impermeable areas draining to their network to 2050.

As part of forecasting urban creep on a property scale, the methodology has also developed impermeable area layers and a curtilage layer for all DCWW catchments. The impermeable area layers have been used to determine the drainage system that areas of urban creep will drain to, whilst the curtilage layer has been used to determine the area available for creep at each property. The study outputs have been created using PostGIS SQL scripts to allow the layers to be easily reproduceable for future cycles of DWMPs, and when the input datasets are updated.

4.7.8 BRAVA Summary outputs

As detailed within the Methodology section, the BRAVA process has assessed catchments against planning objectives, across a series of time horizons to determine the risk of exceedance.

The targets for this first DWMP cycle's planning objectives have been normalised across the company area based on population or sewer length depending on the specific objective. An example of the distribution of targets can be seen in Figure 45. An example of the exceedance thresholds set for the targets are shown in Figure 46 which defined the level of risk which was used to trigger the need for an intervention. These exceedance targets have been calculated and amalgamated at Level 3 and at Level 2.

Figure 45 - Example PO target distribution Internal Flooding

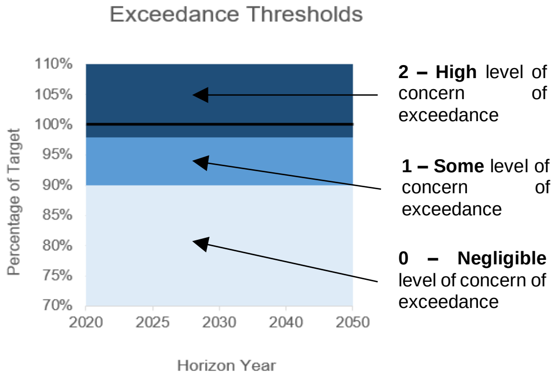


Figure 46 -Target exceedance thresholds

The results then informs the development of the Final Problem Characterisation. Table 32 below provides an example of the BRAVA output across two planning objectives and a selection of L3 catchments, identifying the allocated score based on exceedance concern.

Table 32 - Example BRAVA Output across two Planning Objectives

L3 Catchment	WwTW Compliance					Waste Pollution Incidents HO				
	2020	2025	2030	2040	2050	2020	2025	2030	2040	2050
Aeron - confluence with Gwili to tidal limit	0	0	0	0	0	2	2	2	2	2
Afan - confluence with Pelenna to tidal limit	1	1	1	1	1	2	2	2	2	2
Afon Chwefru - source to conf R Irfon	2	2	2	2	2	2	2	2	2	2
Afon Llynfi - conf Dulas Bk to conf R Wye	0	0	0	0	0	2	2	2	2	2
Afon Lwyd - conf Dowlais Bk to Pont Sadwrn	0	0	0	0	0	1	2	2	2	2

All the scores for all the catchments are collated into a master sheet, irrespective of the level of BRAVA Assessment Undertaken.

When the results are amalgamated together at different level of hierarchy such as at company level as shown in Table 33 and at Level 2 strategic planning areas in Table 34). The results using the framework direct effort to different places than final problem characterisation at Level 4 WWTW Catchment. Level 1 assessment would suggest the company to focus on sewer collapses, sewer flooding in a severe storm and into the future WWTW compliance. However, at Level 2 the picture is already less clear and more varied. This suggests that summarising at these levels using this method wouldn't drive the focus at a more localised risk.

The BRAVA assessments for 'Pollution due to storms' includes combined sewer overflows.

Table 33 - The Common Objective BRAVA results summarised at Level 1 operating area

Common Objectives summarised at Level 1	Sewer collapse risk	Internal Sewer flooding	Flooding in a severe storm	Pollution Risk	Storm Overflow Performance	WWTW compliance
2020	2	0	1	0	0	0
2050	Not Assessed	Not Assessed	1	Not Assessed	0	1

Table 34 contains the number of risks for each planning objective summarised at level 2. There are 13 'Level 2s' which means the total number for each planning objective is 13 distributed across risk levels of zero, one or two. The results in Table 34 shows greater detail and again if we were to investigate only those with risks scoring a 2, we would look at 5 out of 13 areas for collapses and 5 areas out of 13 for flooding in severe storms and a further one area at risk of WWTW compliance in 2050. This would mean investigating seven of the 13 areas as the risks do not always overlap. The greatest risk across the whole area is risk of severe flooding in a storm. Work undertaken on this annually again reinforces the need to drill down into the patches of the area with that risk as with latest reported figures showing only 25% of our population is at risk but this measure is showing the risk to be much higher.

Table 34 - The common Objective BRAVA Results summarised at Level 2 Strategic planning unit

Common Objectives summarised at Level 2	Sewer collapse risk			Internal Sewer flooding			Flooding in a severe storm			Pollution Risk			Storm Overflow Performance			WWTW compliance		
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
2020	2	6	5	8	5	0	0	8	5	9	4	0	11	2	0	11	2	0
2050	Not Assessed			Not Assessed			0	8	5	Not Assessed			10	3	0	4	8	1

Drilling down again into Level 3, Figure 47 shows the distribution of risk shown as a percentage of the 106 Level 3 TPU's and their summarised results from 0 to 2.

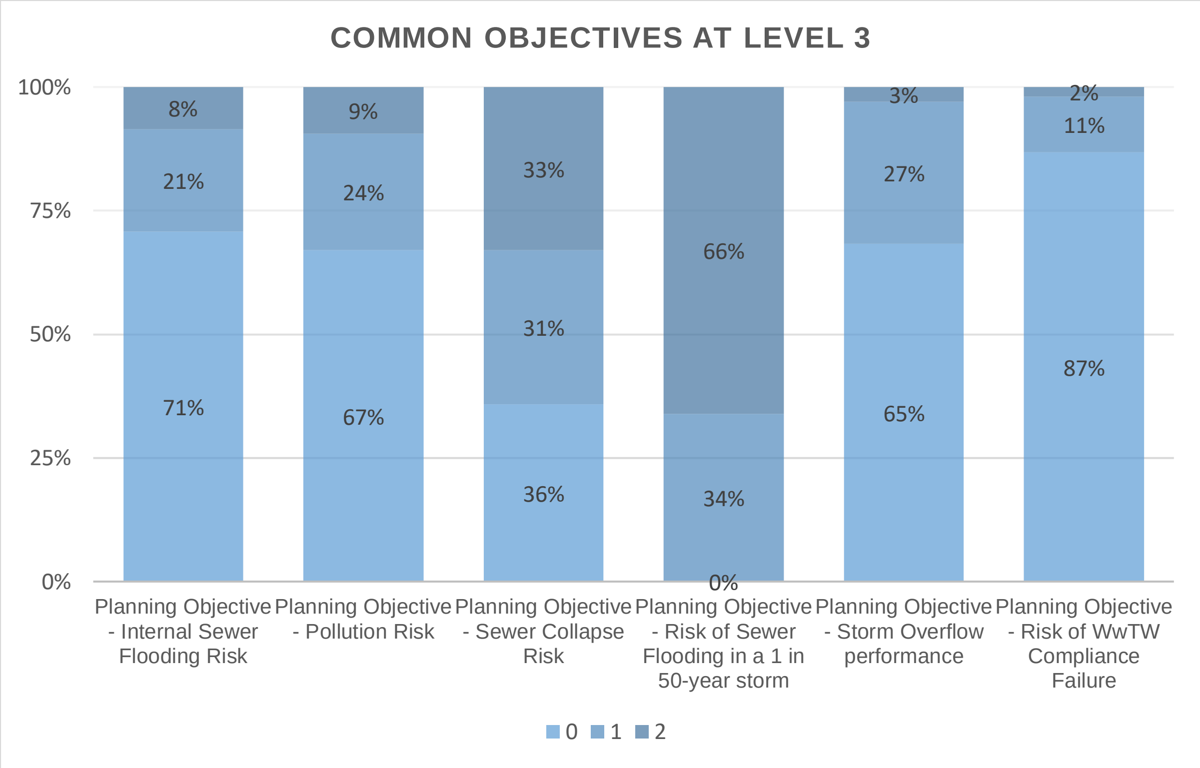


Figure 47 - Common Objective BRAVA results summarised at Level 3

4.7.9 Opportunity Mapping – Identifying joint opportunities

As part of the identification of BRAVA scoring, a series of opportunity maps were created, identifying regions where specific challenges had been identified (flooding, pollution, or both) and where there were potential opportunities to collaborate with local stakeholders in the resolution of these exceedances in planning objectives.

Examples of these maps can be seen in Figure 48 and Figure 49, highlighting the priority catchments for the 2025 and 2050 results.

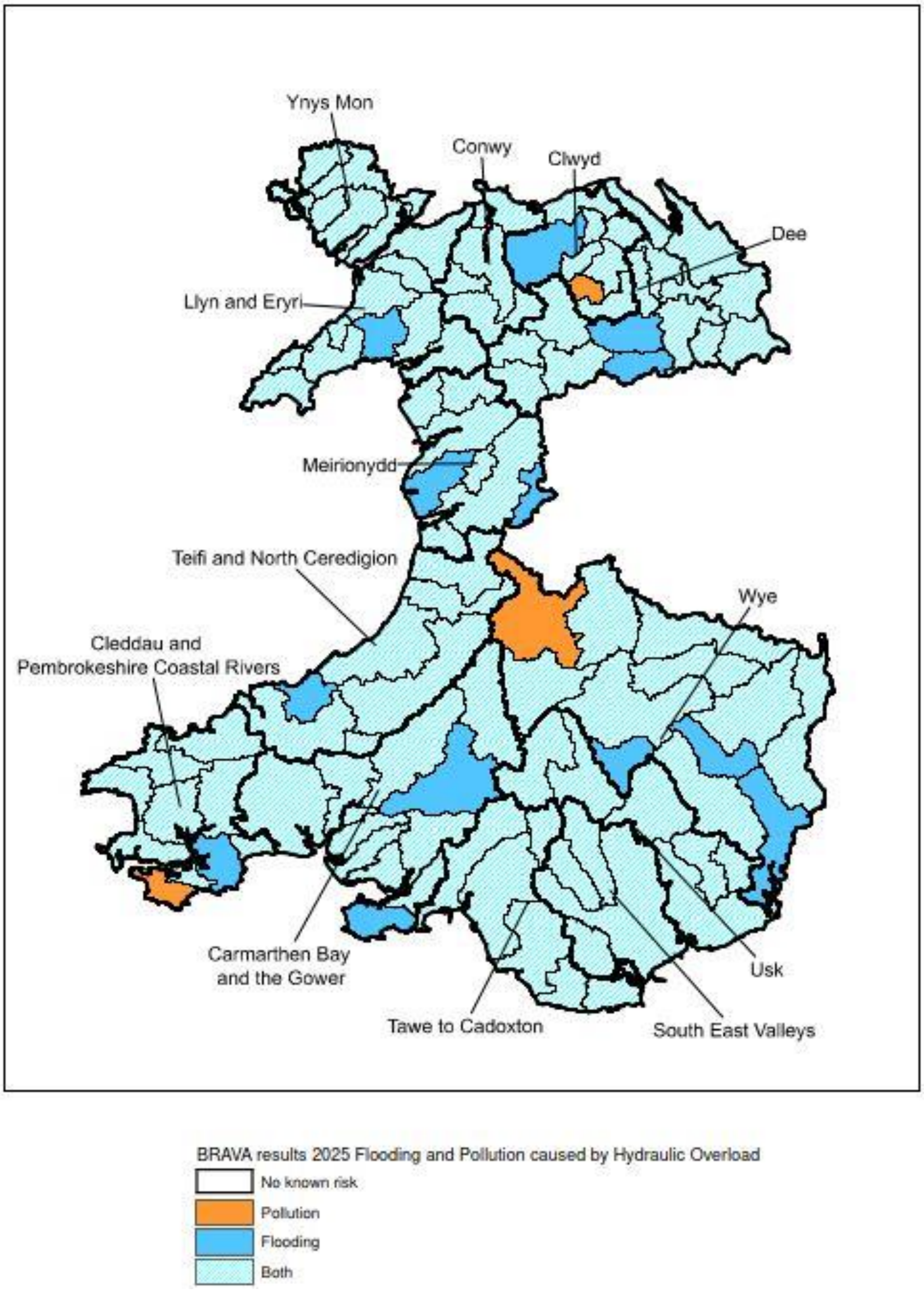


Figure 48 - Summary of BRAVA 2025 L2 & L3 Flooding & Pollution Results (2021)

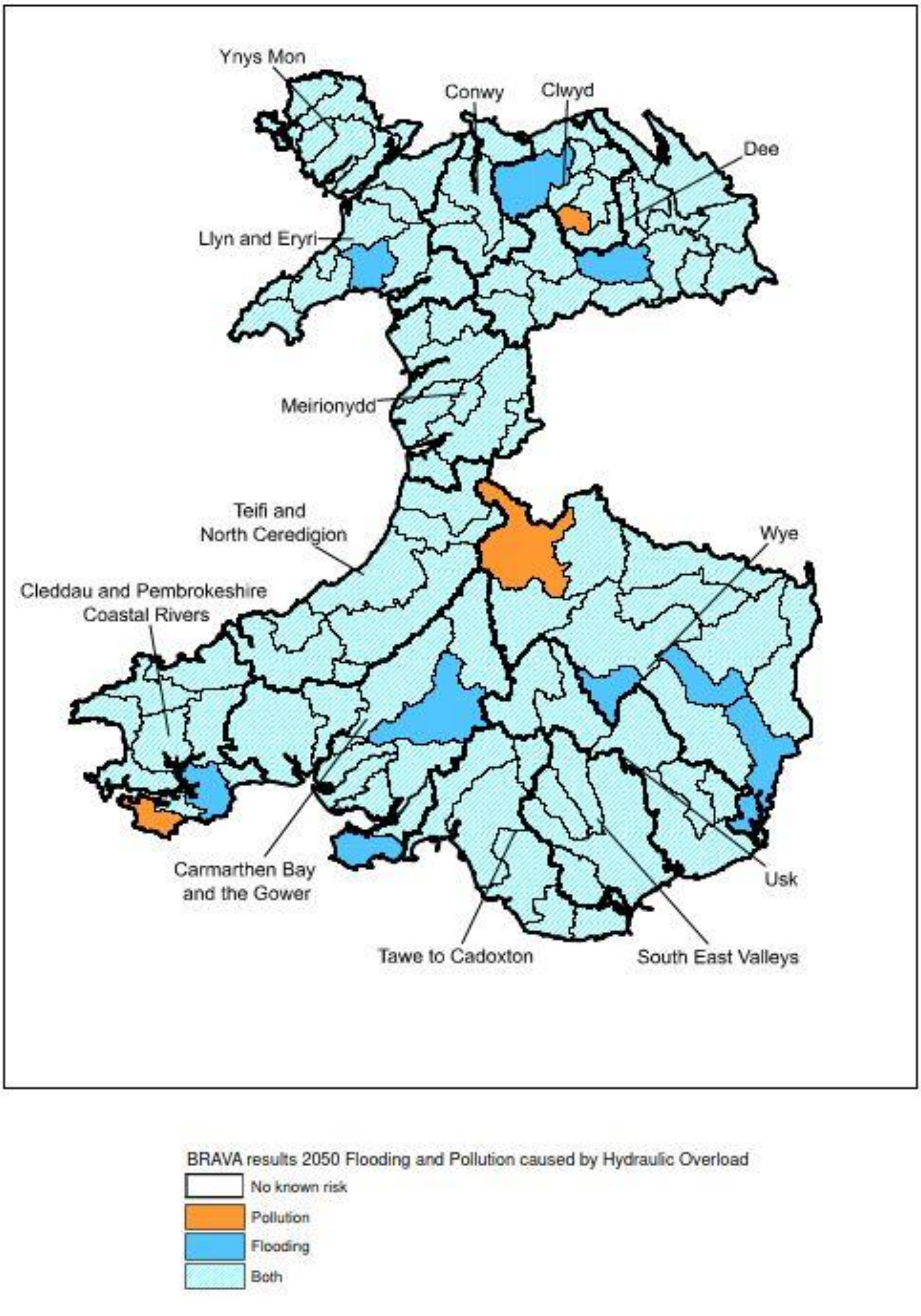


Figure 49 - Summary of BRAVA 2050 L2 & L3 Flooding & Pollution Results (2021)

We published summarised findings on our website in 'How and Where we want to work with you'. This was primarily used to let our stakeholders know our position and what support we would like. In this document, we have separated the company only tasks of maintenance, from the collaborative areas of pollution and flooding, to ensure that collaboration on these topics could progress while the plan developed.

The two maps in Figure 48 and Figure 49 show the distribution of risk over our operating area summarised in our themes. The first map shows the position at the start of the plan (2025) and the second map shows the position we are forecasting (2050). The results show that there is a trend of deterioration with areas such as the lower Teifi and North Ceredigion Level 2, and some areas in Meirionnydd Level 2 (area marked dark blue) in 2025 only showing flooding risk but, by 2050, worsening to show both areas (now more areas showing light blue), along with many other areas which already experience both flooding and pollution.

From this assessment, we have established that, when comparing risk between companies, the choices being made by a single company may be different to another company in the detail of the assessment and this affects the ability of this assessment to directly compare performance between different water companies.

The results from this section show that we have opportunities to work with other stakeholders and communities to reduce flooding, and to improve water quality, particularly when we take a theme-based approach. We have concluded that, as a water company, we need more time to develop our approach and improve our understanding of how drainage systems interact with one another, as this assessment was highlighted in most areas.

The remaining theme of resilience and maintenance is equally split across each BRAVA allocation of 0 to 2 with a third assessed as ‘zero’, a third as ‘one’, and a third as ‘two’.

4.7.10 Strategic picture

Table 35 shows a summary of whether the BRAVA results indicate that the Company will meet its targets over the planning period. In most cases, it was found that the targets would not be met. This is due to the assessment being a risk assessment of existing networks against future impactors and deterioration, therefore future interventions to address any risks are not considered. In some instances, the difference between the BRAVA and the target was significant.

Table 35 - Results summary

	Do the BRAVA results show that the company will meet its PR19 targets? Yes /No			
	2020	**2025**	**2030**	**2050**
Internal Flooding	Yes	No	No	No
Pollution	No	No	No	No
External Flooding	No	No	No	No
Sewer Collapse	No	No	No	No
WSC	Yes	No	No	No
Asset Resilience Wastewater (above ground)	Yes	Yes	No	No
Asset Resilience Wastewater (below ground)	Yes	No	No	No

There are several factors which need to be considered when reviewing these results:

The BRAVA results are representative of a scenario where the Company has not implemented any of its interventions, which are considered later. There will be schemes planned, or currently in construction, which will bring network improvements. The BRAVA is a snapshot in time and the results will be conservative.

Not all catchments have a BRAVA which utilised a hydraulic model. This has an optimistic impact on the results for flooding, pollution and WSC as the desktop study assumes no change in the catchment across the epochs. Despite the fact it is known that growth, urban creep, and climate change will likely alter the number of incidents observed in catchments, it is not possible to apply reasonable assumptions to a desktop study to model their impact without more research. Whilst some catchments will have the capacity for growth, urban creep and climate change in the future horizons, a lot of catchments will not. Therefore, this approach will be reviewed in future cycles of the DWMP.

Due to DCWWs historically risk-based approach to hydraulic modelling, some models have not received verification updates for longer periods than others and, therefore, results from hydraulic modelling in these catchments are of a lower confidence. There will also be variable levels of model confidence in the underlying data.

The APR 2020/2021 results have not fed into the BRAVA. This data had not been assured at the time of BRAVA completion.

The performance commitment methodology for Worst Served Customers has been applied to the hydraulic model. This has not been attempted before and the models are predicting a significant number of properties at risk.

4.7.11 PR24 Glidepath

The targets set at PR24 will significantly impact the BRAVA results for Cycle 2 of the DWMP. Any change or alteration to the glidepath of the targets in subsequent Price Review iterations will change the level of exceedance within a catchment in relation to its targets.

4.7.12 We also manage other types of pressures*.*

We have an obligation to improve biodiversity and to manage the spread of invasive non-native species (INNS). To do this we produce a Biodiversity Action Plan (BAP) and strategy of its own. We will be reviewing progress on the last plan this year with a report being published in December 2022 and the next BAP will be produced at the end of 2023.

We are also directed by our environmental regulators, NRW and EA, via a statutory environment programme. In this plan, we have included the statutory environment programmes; from the Water industry National Environment Plan (WINEP) for rivers in our English areas and the National Environment Plan (NEP) from our Welsh Areas. The timing of the delivery of schemes from NRW and EA have not aligned with the DWMP production for this cycle. However, our new environmental forecast model has indicated several sites that could be part of a future programme and we can investigate these as part of plan development to inform the next cycle and discussions with NRW. We will incorporate these as part of DWMP plan development separate to NRW/EA processes. We will also continue to work with our environmental regulators to define the WINEP/NEP programme; this will form our business plan which will be published in 2023. We will work with the industry to recommend how the assessment of NEP/WINEP drivers merges with the BRAVA process.

The newly enacted Environment Act has brought an additional requirement regarding monitoring. This requirement aligns with the needs of a developing plan, and more monitoring technology will be installed in both sewers and rivers to comply with this new requirement, whilst also supporting the maturing needs of the plan.

We have been supporting others with a small fund to help communities where we can work together to achieve our Welsh Water 2050 aims. These funds have been referred to as the community fund, partnership fund and biodiversity fund. The principles of funding others to be able to take their own actions and ownership of the outcome is very important. Citizen science shows that community ownership model brings greater benefits and longevity to solutions. We want to support projects with local developments to reroute surface water to a natural stream or river, and management measures to reduce the spread of INNS.

4.7.13 Data Comparison

Table 36 below summarises the difference between the BRAVA results and the company targets. When reviewing this data, it should be noted that the results of the BRAVA are a 'do nothing' scenario and do not account for future planned investment. It is anticipated that the actual future position will be better than forecast in the data.

Table 36 - Comparison of BRAVA results and Company targets

	Total for Company area (BRAVA Results without intervention)				Total for Company area (PR19 Targets)			
	2020	2025	2030	2050	2020	2025	2030	2050
Internal Flooding	209	292	319	394	300	273	252	100
Pollution (excluding category 4)	271	369	455	586	107	90	80	40
External Flooding	6,485	6,697	6,814	7,231	4,121	3,800	3,420	2,500
Sewer Collapse	519	1,194	1,209	1,273	255	255	255	255
WSC	244	360	809	855	368	359	270	100
Asset Resilience Wastewater (above ground)	81%	81%	81%	79%	78%	80%	85%	100%
Asset Resilience Wastewater (below ground)	42%	42%	42%	41%	28%	45%	60%	100%

The following notes provide some additional detail around the comparative figures for BRAVA and PR19 numbers:

- Pollution assessment - This is assessed for wastewater pollutions only. Modelled predicted pollution has been assessed based on a predicted escape from sewer occurring within a 25m reach of the watercourses in a 1 in 1 year return period event. Deterioration modelling results have been utilised to account for pollution from other causes.
- Sewer Collapse Figures – The large increase in predicted sewer collapse values is due to the deterioration modelling assessment. This is likely to be reran and assessed throughout PR24. An improvement in the projection model will impact assessment.
- Worst Served Customers (WSC) - This takes into consideration the inclusion of model predicted flooding to properties that would be categorised as a WSC based on the WSC criteria.
- The BRAVA assessment has scored all catchments for asset resilience AGA. Where catchments do not contain a critical asset, they have scored 100%. For this comparison, only the catchment containing critical assets have been included in the company average in line with the performance commitment methodology, so the results are comparable.
- The BRAVA assessment has scored all catchments for Asset resilience BGA. Where catchments do not contain a critical asset, they have scored 100%. For this comparison only the catchment containing critical assets have been included in the company average in line with the performance commitment methodology, so the results are comparable.

4.7.14 Future Recommendations

It was concluded during the risk awareness stage that both growth and creep are identifiable and, as such, it is possible to build constructable solutions to manage their change overtime. However, there is variability and uncertainty of climate change over time and the type of storm we need to provide a solution to is likely to be short rainfall events with higher intensity, which results in greater overland flows and less time to infiltrate into the ground. These events show that, unless we change the entry routes into the network itself, the flows will run over the highway tarmac and not drain into the network at the same speed to match the rainfall event. This means that we need to develop hydrology solutions that match the type of storm event we will see in the future. This is also an area where a water company does not have sole responsibility to manage, or powers to alter drainage.

The programme of work here is to develop as many opportunities as possible, whether they overlap with other RMA's or not, but to develop the opportunity in such a way that we, as a company, either lead or are ready with our requirements to work with other RMAs on joint investment schemes. We would like both DCWW and other RMAs to be ready to work together in the way described in the 'where we want to work with you' (Water, Where we want to work with you, 2021) proposal so that we can develop greater resilience for the communities we serve and not be limited by issues of ownership or statutory powers in our approach. We would welcome the support of government to require, facilitate or encourage the level of engagement needed to develop and deliver an integrated drainage approach which could be named as "The National Drainage Programme".

4.8 Plan Development Risk- Final Problem Characterisation

The Water UK DWMP Framework defines **Problem Characterisation** within the planning process as:

‘A problem characterisation step that identifies the nature and complexity of the interventions required and assigns the catchments to different levels of options development and appraisal.’

4.8.1 Introduction

Figure 50 shows where Problem Characterisation fits within the wider DWMP process.

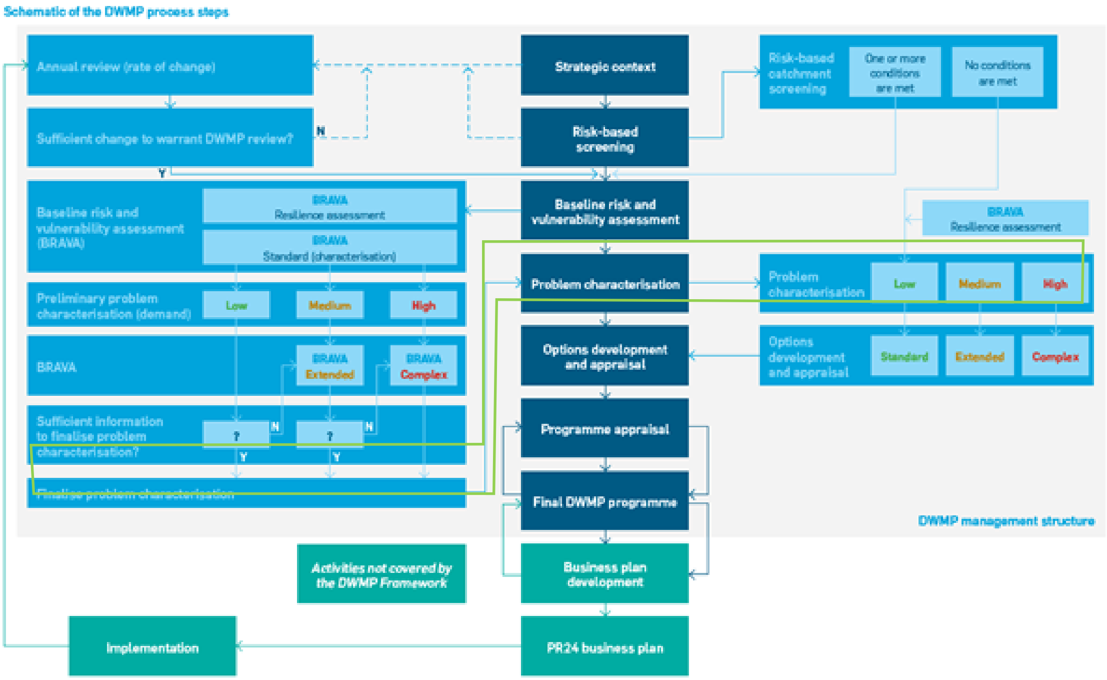


Figure 50 - DWMP Process and Problem Characterisation alignment (Water UK 2021)

Within the BRAVA process, problem characterisation occurs in two stages; Preliminary Problem Characterisation (PPC), as discussed previously, which was driven by growth uncertainty; and Final Problem Characterisation (FPC), which seeks to ensure that the approach to options development and appraisal processes are appropriate and proportionate.

In a similar approach to the method used in PPC, FPC establishes a Final Strategic Needs Score (FSNS) and a Complexity Factor Score (CFS), which are combined via a decision matrix to determine the Final Problem Characterisation Score (FPCS) and ultimately influence the optioneering approach within the Options Development and Appraisal stage.

4.8.2 Methodology

To maintain efficiency in the options stage, planning objectives were grouped thematically for final problem characterisation. This enables catchments requiring similar solutions, as identified by BRAVA, to be tracked at a higher level. This is summarised in Table 36.

Table 37 - Planning Objective Themes from BRAVA

Water Quality	Water Quantity	Resilience	Maintenance
WwTW Compliance DWF* WwTW Compliance Biological capacity Storm Overflow Performance	Internal Sewer Flooding (HO) External Sewer Flooding (HO) Waste Pollution Incidents (HO) Worst Served Customers (HO) Risk of Flooding in Severe Storm	Asset Resilience Wastewater (above ground) Asset Resilience Wastewater (below ground)	Sewer Collapses Waste Pollution Incidents (OC) Internal Sewer Flooding (HO) External Sewer Flooding (HO) Worst Served Customers (OC)
*DWF compliance included in WQ on basis that if consent is being exceeded it could pose a risk to the capacity to treat flows and therefore impact on water quality.			

The planning objective themes influence how the BRAVA outputs are used to determine the FPCS over three time-horizons, near-term (2020-2030), medium-term (2030-2040) and the long-term (2040-2050).

The first stage in the FPC is the calculation of a **Final Strategic Needs Score** (FSNS) which describes the **magnitude of the problem**. The FSNS is found for each theme at near/medium term and long term. From the guidance this is based on two questions:

- What is the level of concern that without intervention, planning objectives relating to demand will be impacted?
- What is the level of concern that without intervention, planning objectives relating to supply will be impacted?

For the purposes of this cycle of the DWMP, we have taken the view that to answer these questions separately would require a level of hydraulic modelling not currently available or feasible within the available time, and that we will move toward this level of detail in future iterations of the DWMP. The BRAVA scores have therefore been used as the best available proxy, given that the BRAVA score indicates the scale of problem within the catchment.

The FSNS has been calculated in the following steps:

- Calculate average of all BRAVA scores within the theme for each the assessment period (2020, 2025, 2030, 2040 and 2050) at a WwTW level.
- Determine the maximum of the average scores (rounded to the nearest whole number);
- Add the maximum of the average scores from near/medium-term to the maximum of the average scores from long-term.
- Multiply by 2. This factoring is to ensure that the overall score aligns with the outputs expected from the DWMP guidance which suggests supply and demand should be scored separately and then added together.

The above procedure generates an Outline Strategic Needs Score for each catchment with a value between 0 and 8 that is in line with the guidance and that will be consistent with future methods.

The second stage in the FPC is an assessment of the **complexity factors** which influence how challenging the problems are to solve. This challenge is represented by the Complexity Factor Score (CFS). The assessment explores the risks and vulnerabilities within the DWMP. The goal being to identify whether these complicating factors, alongside the overall level of strategic risk, should lead us beyond standard planning approaches. The resulting CFS provides a general direction for developing suitable options.

The focus for the complexity factor assessment is risks associated with supply and demand, in line with the first stage of the FPC process. The questions in the complexity factor assessment use a scale of significance to characterise their answers, following the previous structure summarised in Table 37 above.

The questions which address demand risks can be summarised as:

- What is the level of concern about near/medium, or long-term system performance, due to pressures from climate change, new development, and urban creep?
- To what extent is the uncertainty associated with the socio-economic forecasts a cause of concern to the required level of investment?

The questions which address supply risks can be summarised as:

- What is the level of concern about near/medium, or long-term system performance, based on historical performance or unexperienced but likely future circumstances?
- What is the level of concern about near/medium, or long-term system performance, based on impacts of asset deterioration, system misuse or data availability?
- What is the level of concern about potential changes to the regulatory requirement for newly emergent contaminants entering the wastewater system?
- Are there opportunities for cross catchment interventions which increase capacity or address supply needs?

The first questions of both demand and supply assessments are split to provide separate results for near/medium-term and long-term, giving a total of 8 questions within the assessment.

In this cycle of the DWMP, we have conducted a ‘first pass’ of the complexity factor assessment applying assumptions based on engineering expertise, as this is an inherently involved process which requires more data than is currently available. This approach is supported by the national DWMP guidance, which includes provision for “highly uncertain” and even “don’t know” responses to these questions.

Where the “don’t know” response has been unavoidable, the catchment is flagged for additional consultation with catchment planners, subject matter experts and data collection in future DWMP cycles. These catchments will be closely monitored during the next AMP, but will not be passed to optioneering stages, as it is not possible to characterise a problem requiring resolution.

In a similar approach to FSNS, the CFS is derived from the sum of the maximum scores from each of the above questions in each time horizon (near/medium and long term). An example of this scoring derivation can be seen in Figure 51.

Question Ref.	Question		2020	2025	2030
CF* – Q1 (Pt 1)	Are there concerns about near or medium term system performance due to growth, urban creep and climate change?	0	Not applicable to score as this is the baseline value	No change in number of incidents between 2020 and 2025.	No change in number of incidents between 2020 and 2030.
		1		1-10 increase in incidents between 2020 and 2025.	1-10 increase in incidents between 2020 and 2030.
		2		>10 increase in incidents between 2020 and 2025.	>10 increase in incidents between 2020 and 2030.
		Don't Know	If there is no hydraulic model and the combined non-modelled BRAVA score for Internal, External and Pollution is >2 mark as "Don't know".		
CF – Q1 (pt 2)	Are there concerns about long term system performance due to growth, urban creep and climate change?	0			
		1			
		2			
		Don't know			

Figure 51 - Question Scoring example against time horizons

The FSNS and CFS spreadsheets are concatenated via a decision matrix to generate a Final Problem Characterisation Score (FPCS) which is used to in the optioneering stage. This matrix is shown below in Table 38.

Table 38 - Problem characterisation decision matrix

		Strategic needs score ("How big is the problem?")			
		Negligible	Small	Medium	Large
		1-2	3-4	5-6	7-8
Complexity factors score ("How difficult is it to solve")	High (8+)	Low	Medium	High	High
	Medium (5-7)	Low	Low	Medium	Medium
	Low (<4)	Low	Low	Low	Medium

The allocated FPCS (low, medium, and high) indicate the categorisation of options development approaches suitable to the scale of challenge:

Low / Standard (green) – process defaults to companies existing investment planning practices to maintain existing levels of service.

Medium / Extended (amber) – the options development and appraisals process will build upon the standard processes to provide extended analytic approaches in supporting investment planning practices.

High / Complex (red) – the options development and the appraisal process are undertaken considering a wide range of tools and approaches to explore.

In addition to these three categories, aligned to the DWMP Framework, this stage was also used to provide additional categorisation where there was **DST development** requirement, the catchment required **monitoring**, or was identified as having **no issues**.

4.8.3 Outputs

Table 39 shows how the framework recommends areas to be categorised. Our results showed that most areas have standard problems with the majority within the green areas. There were 24 areas that had pockets at a very localised area that were in the yellow and red. This exercise, and the capacity versus demand assessment earlier, shows us that there is a need to drill down closely into the zones and split them up until the risk is equally spread in a hydraulically connected area.

The results of the problem characterisation, which are calculated at Level 4 WwTW level, can be summarised at the different DWMP Levels. Table 39 provides an excerpt of the problem characterisation results grouped into the planning objective themes detailed earlier, and it provides problem characterisation summary taking the worst individual grouping.

Problem Characterisation concludes with a simple 3 choices; Standard, Extended or Complex.

Table 39 - Example Final Problem Characterisation Output for WwTW (prior to wrapping up to L3)

Catchment name	Water Quantity Level of Concern and Optioneering and decision-making approach	Water Quality Level of Concern and Optioneering and decision-making approach	Resilience Level of Concern and Optioneering and decision-making approach	Maintenance Level of Concern and Optioneering and decision-making approach	Overall problem characterisation conclusion for the catchment
FIVE FORDS (WREXHAM)	Extended	Standard	Extended	Extended	Extended
CHESTER	Extended	Standard	Extended	Standard	Extended
PORTHMADOG	Extended	Standard	Extended	Extended	Extended
KINMEL BAY	Extended	Standard	Extended	Standard	Extended
BANGOR TREBORTH	Extended	Standard	Extended	Extended	Extended
GANOL STW	Extended	Standard	Extended	Extended	Extended
CILFYNYDD	Extended	Standard	Extended	Standard	Extended
NEWPORT NASH	Extended	Standard	Extended	Extended	Extended
CARDIFF BAY	Extended	Standard	Extended	Extended	Extended
GOWERTON	Extended	Standard	Extended	Standard	Extended
LLANNANT	Extended	Standard	No Issue	Standard	Extended
PEN-Y-BONT (MERTHYR MAWR)	Extended	Standard	Extended	Extended	Extended
SWANSEA BAY	Extended	Standard	Extended	Extended	Extended
AFAN	Extended	Extended	Extended	Extended	Extended
BETWS-Y-COED	Extended	Standard	No Issue	Standard	Extended
CAPEL CURIG	Extended	Standard	No Issue	Standard	Extended
HENLLAN (NR DENBIGH)	Extended	Standard	No Issue	Extended	Extended
CAERNARFON	Extended	Standard	No Issue	Extended	Extended
LLANBEDR (GWYNEDD)	Extended	Standard	No Issue	Standard	Extended
ABERSOCH	Extended	No Issue	No Issue	Extended	Extended

Table 40 - Company-wide Problem Characterisation results (Wastewater Treatment Works Catchments)

Theme	Quality	Quantity	Resilience	Maintenance
High - Complex Optioneering Option	3	0	3	2
Medium – Extended Optioneering Option	41	5	16	25
Low - Standard Optioneering Option	467	478	8	623
No Issue	235	245	806	70
Monitoring	82	98	1	97
DST Development	7	9	1	18

Our results showed that most areas have standard problems with the majority within the green areas. There were 44 level 4 areas that had pockets at a very localised area that were in the yellow and red area of Table 38. We have learnt from this exercise, and similarly to the capacity versus demand assessment earlier, that there is a need to drill down closely into the zones and split them up until the risk is equally spread in a hydraulically connected area. Again, a comparison can be made to the WRMP process and a defined methodology, titled Water Resource Zone Integrity (2016), which is published by the EA and is available upon request.

Extract from Water Resources planning guideline (Government, Water resources planning guideline, 2023)

> *"Your customers in a resource zone should face the same risk of supply failure and the same level of service for demand restrictions."*

Converted to Wastewater and incorporated into this plan to address customers and the environment as follows:

> *"Customers in a zone should face the same risk of service failure."*

We have taken this to mean the customer priority defined in Figure 52 which has been reproduced here, are Repeated flooded customers, internally flooded customers, etc.

> *"Protected areas in a zone should face the same priority need"*

We have taken this to mean that designated protected areas defined in Figure 52 reproduced here, are SAC, SSSI, etc.

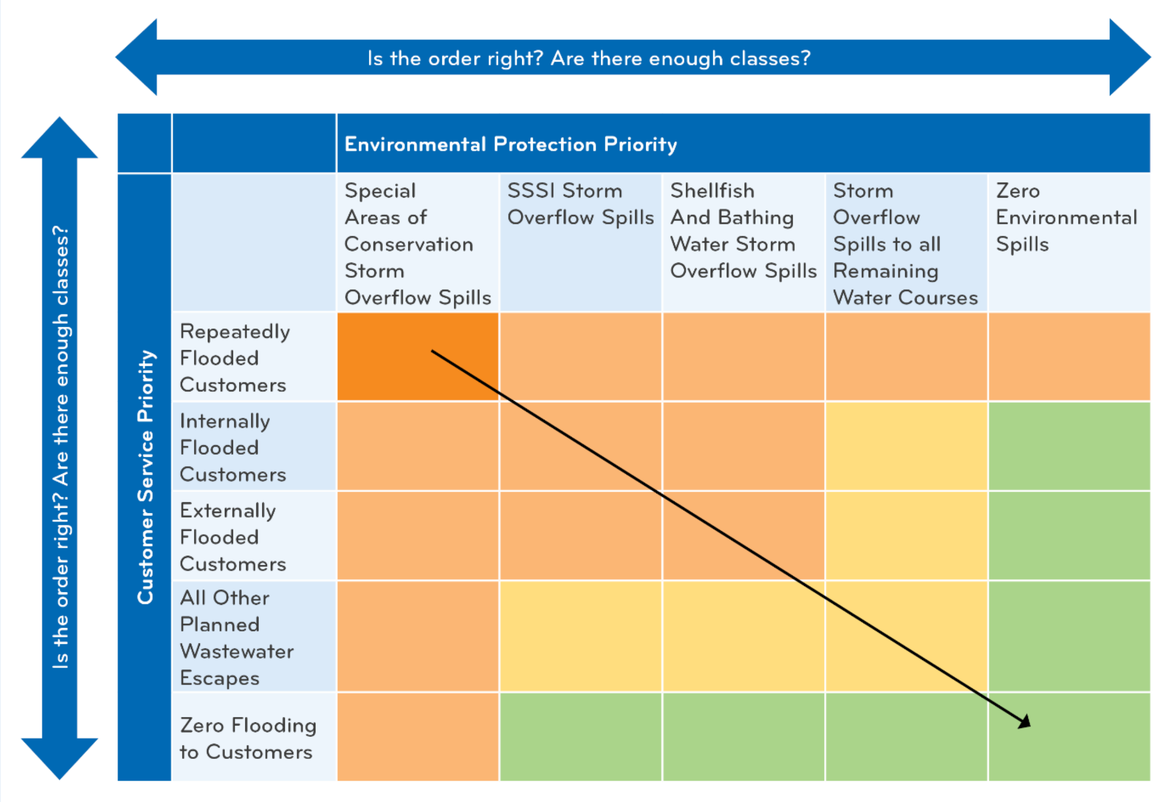


Figure 52 – Priority Matrix Reproduced

It should be noted that, where a location has multiple designations, the locations have been categorised under the highest designation, and other designations within the location will also be addressed by the plan simultaneously. This will not include all designated sites in the region, but the ambition for the plan is to work from highest priority to lowest through each subsequent cycle of the DWMP, until all areas have a detailed bottom-up plan whether they are standard, extended or complex.

This defines the priority areas to be taken forward to options development at a tactical scale. However, our plan also considered the strategic scale. Strategically, we need to consider the whole picture before drilling down tactically to the locations that are at the greatest risk and require an intervention sooner. This drilling down process has been initiated for this plan as the DWMP hierarchy. This starts without the operating area, then the Level 2 strategic planning units and on to the Level 3 Tactical planning units.

From this plan, we have included that, to obtain risks and opportunities that can be turned into deliverable programmes of work, we will need to drill down even further, and we recommend that to produce a workable deliverable scheme would be a hydraulically connected area which is made up of solutions to all assets with that area or even further down to asset level.

Hydraulically connected Areas

A hydraulically connected area is defined as a sub divided section of a network that drains to an asset, such as a pumping station, a storm overflow or a storage tank, that alters how the next section drains down.

We have started to define these areas within our network. In terms of planning for the long term, we will need to 'solve' each of these areas in turn to reach the first milestone of Welsh Water 2050 and then on to the final destination.

4.9 Other Risk Assessment Approaches

4.9.1 Methodology

No matter what we have been trying to measure in wastewater in the past, the detailed performance commitments make the task of continuous improvement on a catchment basis very complicated. The list of our detailed performance commitments can distract from our fundamental functions as a sewerage undertaker which can be summarised as:

> *The company should provide a service to customers with regards to the collection of sewage and trade effluent, its transportation through a network of assets, and in the cleansing of that effluent and its return to the environment in a condition fit for the receiving water.*

The company is also tasked with providing a service via the collection and routing of surface water flow from rainfall, the legal reason for SW drainage responsibilities.

The recently passed Environment Bill inserts a new requirement for water companies into the Water Industry Act. This requirement implies that understanding the capacity of the sewerage and drainage systems is paramount to success. Currently, there is no standard approach to assessing the capacity of the whole sewerage system. What is needed is a formalised assessment of system capacity and how that capacity is to be used to make decisions. In anticipation of this, we have developed a methodology for use in this plan. Within DCWW, we have considered that an understanding of this strategic network capacity needs to be understood alongside performance against the specific planning objectives and should support options development.

4.9.1.1 Defining the minimum capacity of the network

Our approach is to undertake a company-wide assessment of network capacity using a simple GIS approach to calculate the volume of flow within the network during dry weather, and then to assess if the pipes are sized appropriately to transport the full Dry Weather Flow (DWF) through each pipe, pump, pumping main and off-line storage down to the wastewater treatment works. Where any capacity shortfall has been identified, the locations will be highlighted as ‘at risk’ and taken forward into options development. This assessment assumes that no escape of water should occur under dry weather flow conditions. This assessment can be carried out using multiple growth creep and climate change future forecast data to produce a view of the risk that we cannot contain and treat DWF for the duration of the plan.

A second pass of the same assessment is also calculated to add in an allowance that can be equated to the volume of rainfall falling on household and non-household roofs using typical rainfall event intensity, occurring frequently within a given year, and which are reflected within DCWW detailed hydraulic modelling. If any additional asset is highlighted as not having sufficient capacity, then these too are identified and taken forward into options development.

Once this assessment has been completed, we can conclude that the network is adequately sized to meet the long-term strategy. The extent of application of this approach is limited during the trial period as we gain endorsement from government and regulators.

4.9.1.2 Defining the capacity of our treatment facilities

Our approach is to estimate the initial capacity of our treatment works as the same as the capacity referenced on the site’s permit. In terms of change in capacity over time this initial definition assumes that the future permit will equal the current permit. In addition, a programme of new monitor installations is continuing to provide further data on flows at our treatment works sites.

An additional approach has been developed that will take the process level data for each WwTW and calculate the design standard for each of the processes known to exist at a site and then conclude the design capacity. This tool has been designed so that biological processes are included within the design of the flow calculation allowing it to be used to directly compare with the network capacity assessment.

The next stage in this process is to bring in measured data from long-term data collected at treatment works sites and carry out the same process level assessment.

These approaches can be compared to identify any sites where there has been a reduction from the permit or design and any identified can be taken forward into optioneering. The first stage of this approach is to develop the tool to calculate the forecast. This approach will continue to develop and, again, will be discussed with our regulators to obtain endorsement.

4.9.1.3 Defining the capacity of the environment to receive wastewater and drainage flows

A DWMP sets out how water and wastewater companies intend to ensure a robust and resilient drainage and wastewater system over the long term (minimum of 25 years). The DWMP framework has been developed in response to the need to improve the approaches taken by the water sector to long-term drainage and wastewater planning, with a view to providing greater transparency, robustness, and line of sight back to investment decisions.

A key challenge to the DWMP relates to how changes in environmental conditions (climate change and land use in particular) in combination with population growth, might impact the quality of river waters. Changes in conditions downstream of water industry assets will have a direct impact on investment planning. It is in this context that the SAGIS modelling system has been used to support the DWMP. SAGIS has been used as part of a novel and innovative risk-based screening approach to identify catchments and infrastructure whose management may be sensitive to changes likely to occur within the DWMP 25-year planning horizon.

SAGIS (Source Apportionment GIS) is most usefully conceptualised as a ‘system’ of interconnected tools and processes made up of mathematical models (such as SIMCAT), a GIS interface, data on discharge and water quality, river network and hydrology data, and data on chemical inputs to rivers and lakes from different sectors. SAGIS provides a source apportionment breakdown of in-river chemical concentrations arising from inputs from different contributing sectors which enables regulators and water companies to use a common system to develop programmes of measures whilst maintaining the Polluter Pays principle.

SAGIS has full coverage of Wales, Scotland, and England, with five SAGIS model ‘regions’ covering Wales (three of which are transboundary). SAGIS is already used by water companies and regulators in business-as-usual applications for asset and catchment planning, as well as discharge permitting. SAGIS provides a catchment perspective and takes account of how riverine inputs from different sources and sectors propagate in a downstream direction and overlap with one another.

Of relevance for the DWMP, SAGIS provides the capability for scenario planning at various DWMP-relevant planning scales. Scenario planning entails the formulation of ‘what if’ type questions to explore the consequences of change and/or specific actions. In the DWMP context, conditions in the future may be substantially different from those of the present because of changes in policy, the environment, socio-economic factors, and asset performance, all of which may play out over the longer term. A scenario planning approach therefore provides DCWW and regulators with the opportunity to better prepare for these changes, as well as to help DCWW decide on the type(s) of future to be planning for.

The aim of a DCWW project was to use SAGIS modelling within a method development framework to explore how scenario planning might be used to inform the DWMP programme, and to help DCWW decide on the type(s) of future to be planning for. The specific objectives were to:

Develop a methodology to identify catchments and wastewater infrastructure whose management may be sensitive to environmental changes over the longer term (focusing particularly on phosphate, ammonia, BOD, and nitrate).

Identify a suitable reporting and data visualisation protocol (i.e., how should the vast amount of data that will be generated via modelling be presented in a form that facilitates easy interpretation).

Develop tools and approaches to support DCWW's longer term planning capability. The model has shown to be able to provide answers for current quality which is used within the National Environment Programme. However, it has now also demonstrated that it can be used to forecast environmental change. Our environmental regulators have not yet endorsed the approach but we will be working with them to gain endorsement going forward.

4.9.1.4 Population Growth

Population growth is a significant consideration for the DWMP because it is the primary driving force behind the increasing demand upon the wastewater system. For this assessment, we have utilised the **growth central planning estimate** for the company area and determined additional growth planning scenarios for catchments that are subject to an extended or complex BRAVA, in adherence to the Water UK DWMP Framework (WaterUK, DWMP Framework, 2018).

The growth forecasts in the Central Planning Estimate (CPE) are derived from data provided from Local Authority Development Plans, national statistics databases, and stakeholder consultation. A master spreadsheet was developed and populated throughout the process to store the forecasts and supporting calculations across all sewerage networks.

The central estimate of growth is calculated for each WwTW catchment using the calculated rate of property development derived from:

- Past Build Rate (Dwellings/Year) – Historic new connections Build Rate; and
- Plan Period Rate (Dwellings/Year) – local development plan Build Rate.

The calculation also includes influences from occupancy rate changes due to forecast socio-economic circumstances across regions. This change in existing population will then impact on total population for each forecast, Figure 53 shows the impact changes in existing population may have on the central estimate forecast.

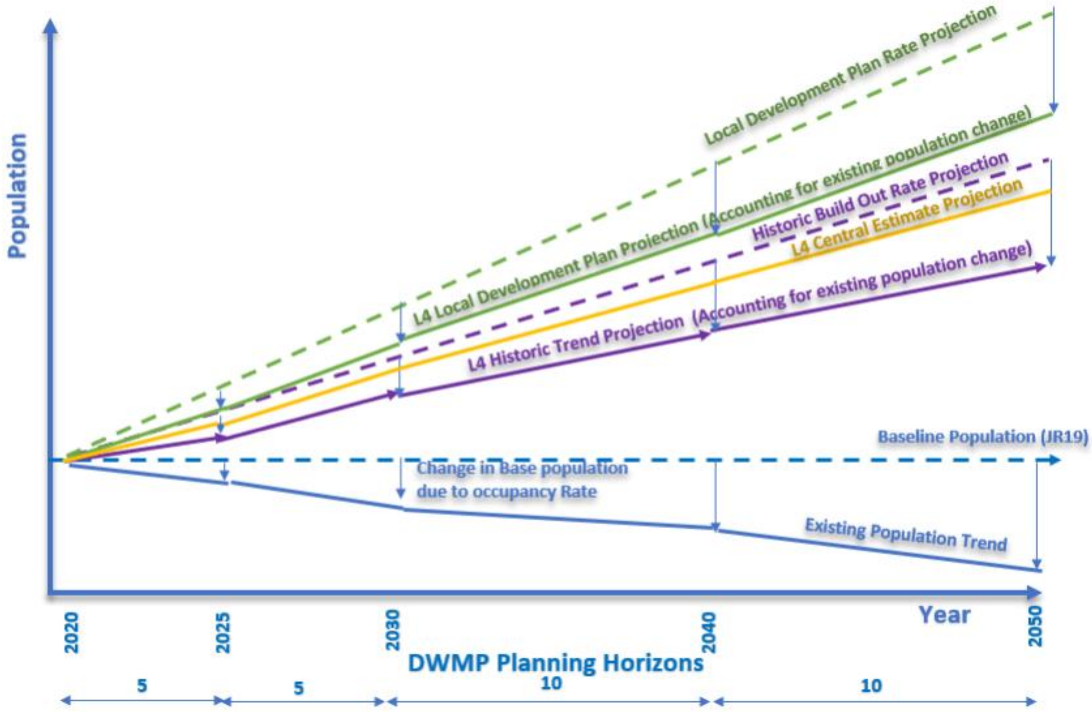


Figure 53 - Existing population change impact on Central Estimate forecast across planning horizons

Any forecasting process carries with it a degree of uncertainty, which influences to what extent the results can be acted upon. For the purposes of the PPC, it is the uncertainty within the growth forecast that is most relevant, rather than the predicted growth itself.

We have assumed that uncertainty within these forecasts is based upon absolute predicted growth from development plans and known/planned urban expansion and infill, rather than a catchment wide percentage change, as this is more likely to reflect the impacts of housing policy across the region and the impacts of that development on our networks. Furthermore, this assumption better suits the timescales of completing this cycle of the DWMP. The absolute growth in the catchment provides limits as follows:

- ± <5000 population = Low
- ± 5000-10,000 population = medium
- ± >10,000 population = High

This reflects the assumption that growth and planning policy is not anticipated to vary significantly in the short term, and the plans for urban development are planned strategically in terms of timescale.

Properties are forecast based on the same local development data but at the detail required to be used in the more detailed L3 areas.

Occupancy rate is linked to the demand forecasts and to the office of national statistics occupancy rates.

Per capita consumption (PCC) is also required to establish a robust forecast. The WRMP has provided the forecast based on consumption. The DWMP has mapped the PCC from the WRMP zones to the nearest DWMP zones.

This forecast is used in the supply demand process to indicate capacity and within the DWMP framework assessments.

4.9.1.5 Understanding strategic network capacity – Dry Weather Flow (DWF) Risk

DWF is an important factor when assessing the impact of sewage treatment works discharges on the environment. DWF represents the pollutant volume from our domestic and trade customers which passes for treatment. When combined with the concentrations allowed by our WwTW permits it allows us to calculate the polluting load discharged to the environment and, where needed, compare that with the capacity of the environment to accept those loads across our catchments.

At a simpler level, DWF also represents the flows entering our network in dry weather and allow us to understand the proportion of our network's capacity required to retain these flows.

To gain a better understanding of capacity risk assessment we have adapted the concept of **supply and demand** from the WRMP. However, there are fundamental differences between water, wastewater and drainage networks that must be reflected in our approach. The wastewater system is open to rainfall runoff which rapidly changes the volumes to be contained within our sewers, pumping stations and treatment works during storm events, especially in dense urban areas. By contrast, the water network is closed and normally only changes in response to customer demand. Consequently, the wastewater supply demand approach incorporates layers of complexity/uncertainty that are not required for water management planning.

When the DWF capacity of the sewerage network is compared graphically against the capacity of the treatment works (including environmental capacity to absorb the treated sewage from) now, and into the future, at a strategic, company-wide level, the risks could imply that there are no DWF risks overall, i.e., that the sum of all our treatment capacity is sufficient to treat all the flow we currently receive under dry weather conditions across our operating area. However, at a local level, some areas will have adequate capacity, whilst others do not. The DWMP assessment of DWF capacity can be compared to a tree, with assessments at L1 representing the whole tree, at L2 the branches and leaves, and so on. When a DWF assessment is undertaken down through the levels, the areas that show an imbalance are the areas to investigate first. This is a targeting tool that can be carried out quickly and easily across different levels of uncertainty without excessive analysis.

We have explored the use of a DWF supply demand assessment to see if this tool could be used to prioritise areas that need increased capacity. It is based on an approach that drills down from the company wide assessment to identify those areas that are forecast to have capacity deficits – this is our '**top down' approach to assessing capacity**. An explanation of the assessment information and conclusion is presented below.

4.9.1.6 Top-Down Capacity Assessment Methodology

At a company level, when our total treatment capacity is summed and compared to the demand needs under DWF, it demonstrates that the company has enough capacity at a strategic level if all the systems were interconnected to manage incoming 'load' demand in dry weather. However, it also shows that there is no allowance for uncertainty in the assessment to account for any current under-estimation of future demand. DWF is defined as:

$$PG + Imax + E = DWF$$

Where:

Imax = the maximum Infiltration occurring within the network (an evidence-based winter value)

PG = Population (P) multiplied by Consumption (G) defining residential contribution

E = Trade Effluent

Headroom

Headroom, or capacity availability over and above the predicted demand, is an approach to manage uncertainty while developing the forecast data. It allows us to build in a margin of uncertainty into our forecasts for the future requirements. It also allows us to consider how much resilience we have in the system and to what level of risk our customers and stakeholders are willing to accept. This ranges from high-risk position in which there is zero headroom to a low-risk position (100% headroom).

For example, we could invest in the capacity of a sewage pumping station to provide double the forecast demand (i.e., 100% headroom). Alternatively, we could provide only for the existing demand (i.e., 0% headroom). The former would provide us with a very low risk position but at a high cost, whilst the latter would be a high-risk position but at lower cost. Building some headroom into our design is sensible to cope with the changes that might occur, and we need to consider how much is acceptable.

Demand from customers and trade also varies during the year, so that even at a company level, it shows that with this new approach a different consideration of how the industry plans for the future should be continued into Cycle 2.

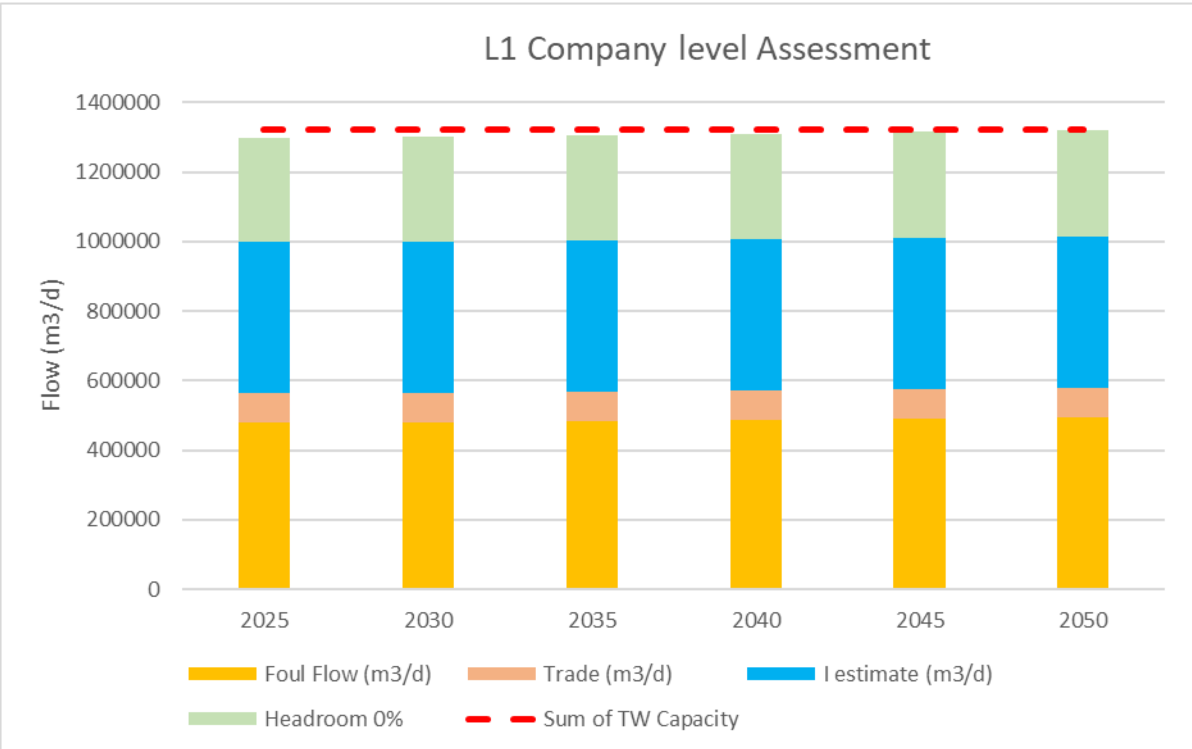


Figure 54 - Components of the L1 Company level capacity assessment

The assessment of headroom is an amalgamation of all the uncertainties in system capacity. It includes allowances for different assumptions for example, infiltration, trade and foul flows and is based on forecasts of population, which alters in line with our company demand forecast. Figure 54 shows a representation of capacity assessment at L1, showing the various components, including headroom.

We can then do the same analysis at the DWMP Level 2 SPU and Level 3 TPU to understand areas where we expect supply demand deficits to occur with and without an allowance for headroom and use this to inform our planning approach in these areas. The series of figures below show DCWW's L2 areas with 0, 10 and 20% allowance respectively for headroom. The figures highlight areas with a capacity deficit against DWF, when this is likely to occur over time and, as is illustrated by the analysis, the greater the headroom allowance (or uncertainty) we incorporate in the plan, the more areas that will show a deficit.

Table 41 - L2 capacity assessment – 0% Headroom

Surplus/Deficit at L2 0% H	2025	2030	2035	2040	2045	2050
Wye						
Clwyd						
Ynys mon						
Llyn and Eryri						
Conwy						
Dee						
Meirionydd						
Tawe to Cadoxton						
South East Valleys						
Usk						
Teifi and North Ceredigion						
Carmarthen Bay and the Gower						
Cleddau and Pembrokeshire Coa						

Table 41 above highlights that Conwy is the L2 area with a capacity deficit from today even with 0% headroom allowance and this will remain throughout the planning period.

Table 42 - L2 capacity assessment – 10% Headroom

Surplus/Deficit at L2 10% H	2025	2030	2035	2040	2045	2050
Wye						
Clwyd						
Ynys mon						
Llyn and Eryri						
Conwy						
Dee						
Meirionydd						
Tawe to Cadoxton						
South East Valleys						
Usk						
Teifi and North Ceredigion						
Carmarthen Bay and the Gower						
Cleddau and Pembrokeshire						

When an additional headroom factor of 10% is included (Table 42), it identifies a risk within Llyn & Eryri but, at 10%, the dropping demand forecast based on the Return to Sewer rate resolves the problem by 2045 (the foul flow from customers is expected to reduce by then). This illustrates an important link between the WRMP and DWMP and the benefits across both water and wastewater management planning.

Table 43 - L2 capacity assessment – 20% Headroom

Surplus/Deficit at L2 20% H	2025	2030	2035	2040	2045	2050
Wye						
Clwyd						
Ynys mon						
Llyn and Eryri						
Conwy						
Dee						
Meirionydd						
Tawe to Cadoxton						
South East Valleys						
Usk						
Teifi and North Ceredigion						
Carmarthen Bay and the Gower						
Cleddau and Pembrokeshire						

Looking at a greater headroom allowance (Table 43) highlights a greater level of risk. Llyn and Eryri are again identified but this time the risk remains for the whole 25-year period, and towards the latter part of the 25 years risk is identified in the Wye.

In a similar way, we can drill down to carry out the same assessment at Level 3. As an example, if we take Conwy, where a capacity deficit has been identified at L2, we can drill down even further to the four L3 TPUs it contains to understand how widespread the issues are.

The results at L3 in Table 44 below show that Nant Y Groes is the area within the Conwy L2 area is at risk even with 0% headroom allowance to account for uncertainty, but the other three areas do not show similar risks. Even in the Nant y Groes L3 area, there are eight areas served by their own WWTWs. Of these, there appears to be a deficit in two and most of the risk is in largest of the areas.

Table 44 - Conwy L3 capacity assessment – 0% Headroom

Surplus/Deficit at L3 0% H	2025	2030	2035	2040	2045	2050
Nant y Groes						
Llugwy - Conwy to Nant gwryd						
Conwy - tidal limit to Merddwr						
Conwy - Merddwr to Caletwr						

Table 45 shows that even with a 10% headroom allowance for risk no additional L3 areas are identified with capacity deficits.

Table 45 - Conwy L3 capacity assessment – 10% Headroom

Surplus/Deficit at L3 10% H	2025	2030	2035	2040	2045	2050
Nant y Groes						
Llugwy - Conwy to Nant gwryd						
Conwy - tidal limit to Merddwr						
Conwy - Merddwr to Caletwr						

However, Table 46 shows that when a 20% headroom allowance is used an additional L3 area is identified with a capacity deficit.

Table 46 - Conwy L3 capacity assessment – 20% Headroom

Surplus/Deficit at L3 20% H	2025	2030	2035	2040	2045	2050
Nant y Groes						
Llugwy - Conwy to Nant gwryd						
Conwy - tidal limit to Merddwr						
Conwy - Merddwr to Caletwr						

It should be noted that this is a new approach to assessing capacity at the strategic level and we have adopted it to enable us to get a more holistic approach to our network and WWTWs capacity. There are some drawbacks to this approach namely, there are multiple assessments required to understand what capacity means. However, the process of drilling down into the detail does allow the components that make up the risk area to be more clearly identified. Consequently, during cycle 1 this top-down adoption of a holistic approach will be developed into cycle 2 as one possible approach to be incorporated into long term planning.

4.9.1.7 Hydraulic Capacity Assessment tool – A bottom-up approach

This initial definition of treatment capacity will allow Cycle 1 to compare with the high-level cycle 1 network assessment and produce a simple network capacity versus treatment capacity risk assessment tool.

Taking the fundamental wastewater principles into account, and using WRMP as a blueprint, capacity can be calculated using a supply and demand mass balance approach. The components of supply and demand and their translation for use in Wastewater are discussed below.

The wastewater business has already produced many mathematical based principles for use within Wastewater. One such principle relates to the components of demand and, in the simplest terms, this can be used to compare against the WRMP blueprint.

The WRMP utilises two scenarios against which water resource service is assessed. The same principle applies in Wastewater.

Annual average conditions from a WRMP is the equivalent of 3X Dry Weather Flow capacity in a DWMP. There are, on average, 192 days in a year with no rainfall (MetOffice, UK Climate Averages, 2022) and average population consumption.

However, whilst the *critical period*, or most challenging demand conditions for water supply considered in the WRMP, are calculated on peak hot and dry days, the equivalent we have considered in the wastewater context for the DWMP would equate to peak rainfall occurring after an extended period of wet weather i.e., storm duration and antecedent conditions.

In the very simplest approach this can be calculated using the same equation above but by multiplying the rainfall affected components by a standard variable, that has been defined by wastewater practitioners as either 3x, 6x or 12x DWF and using the estimated maximum infiltration that would occur under these conditions (I_{max} calculated from the treatment works flow meter and or CSO event duration monitors [EDM] and is typically an observed winter maximum). These multipliers equate to different storm volumes. The 12x multiplier would equate to a worst-case winter storm for instance.

$$12(PG) + Imax + 12E = 12DWF$$

This component driven capacity assessment has been part of the performance commitment for years but, by bringing these together into a single view, capacity can be viewed as a single value for supply and a single value for demand. However, as described earlier, supply demand balance in the in the wastewater business differs from water because it is an open system. This means that capacity demand is driven by both customer need and rainfall runoff and is more complex to define. It is not possible to retain all the flows and treat draining to a combined sewerage network under all weather conditions[6].

As a result, the wastewater system is often equipped with storage to buffer excess flows and/or relief points (CSOs) that allow the excess flows drain safely to the environment without backing up and flooding customer's homes and businesses. This makes any supply demand assessment very complex, but we believe it is right to continue to develop this methodology and use it positively as the foundation of a new assessment approach for use within the Wastewater business.

During the first cycle, an assessment of capacity at differing levels can be calculated. The NRW or EA permit figure has been used where it is stated in the permit. Where it is not stated, an assumption has been used.

In some prioritised level 4 WwTW catchment locations, a WwTW's capacity forecast tool has been utilised. This has meant that data has been gathered for that WwTW that drills into the detailed capacity and constraints of individual treatment process units on the site that would act as the limiting factor on that works. With this tool, we can re-evaluate the design capacity of a WwTW (i.e., based on the process stage with the least capacity). With this assessment, we will be able to forecast when the hydraulic capacity of the site is likely to be exceeded given population, trade load and flow changes. This assessment provides the tipping point at which the WwTW will no longer be capable of treating the volume of flow and loads arising in the catchment.

These two elements covering treatment and network hydraulic capacity represent the components of demand in a supply demand balance. Consequently, by using the assessments arising from the equations above and altering the variables feed into it represent each area we can use the resulting forecasts to produce the demand profile for the first capacity assessment. When these two assessments are brought together, a supply demand capacity surplus or deficit can be concluded. This same approach can be calculated at any level from the company operating area down to detailed hydraulically connected risk zones.

During cycle 2, the main effort of the DWMP evidence improvement programme will be to:

- Further define the components to calculate capacity;
- Develop robust procedures to increase reliability and confidence in the calculation; and
- To install a system of permanent and temporary monitoring on our network and treatment sites to build on our CSO EDM monitoring already installed.

This will provide an improved assessment of the demand side balance concluding with more certainty of the location for the next investment.

[6] For example, in one area rainfall runoff in a 1 in 1 year storm increases the flow draining to the combined sewer by around 40-fold in comparison with dry weather

4.9.1.8 Extreme Flood risk - Sea Level Rise

We have segregated the plan into three areas, of which one area is extreme flooding. This flood plan aims to work with National Infrastructure to locate areas where the level of the sea and river will mean that flood water will affect property and currently is beyond governments level of protection. As a company, we must ensure our assets that are at risk in this area first support the level of protection government aim to provide to the population, and secondly that, once a flood has passed, service is returned to normal as soon as possible.

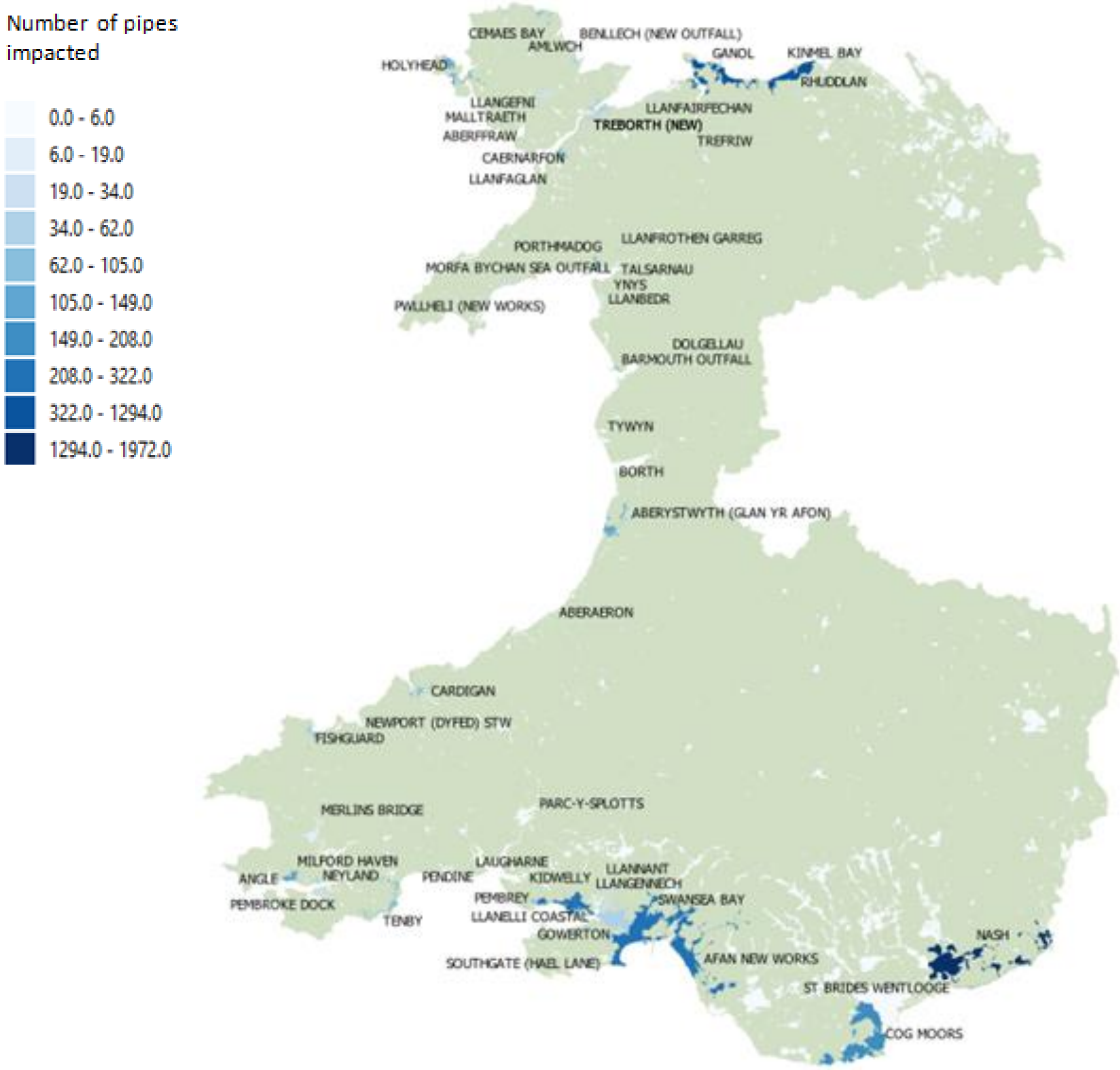


Figure 55 - Sea Level rise future risk

The map in Figure 55 shows the areas with more than 20 pipes or chambers that are impacted by a sea level rise scenario of 1.25m. The darker shading reflects more pipes being affected by the assessment and highlight the areas that are most vulnerable to the impacts of sea level rises. These areas highlight the need for sea defences and consideration pf how these areas would drain in the future if the current assets were submerged for long periods of time. The 1.25m scenario is a high climate change scenario, but it does show the distribution of areas across our coast where we need to concentrate our efforts to work with the National Infrastructure Commission and Natural Resources Wales.

4.9.1.9 Storm response – Additional uncertainty in drainage resilience

The world we live in is more complex than applying one assessment for all types of storms. It is important to understand the differences between, for instance, a summer storm versus a winter storm; a deluge versus a continuous drizzle and the different impacts they can have on hydraulic performance and network capacity, as well as the flooding and environmental risks resulting in capacity exceedance. In this first cycle plan, we have been investigating what these scenarios really mean to customers.

In the plan, 'Risk' has been characterised using a combination of rainfall/storm types which impact catchments and asset types in different ways. The assessments undertaken to support our understanding of risk have included these differing rainfall patterns, to ensure the understanding of risk now, and in the future.

The implication to the later stages of plan development can mean the difference between a plan that allows future bills to increase only aligned with the rate of inflation, or alternatively, a future bill that includes both the rate of annual inflation plus a considerable increase to allow for investment in on the ground solutions to reduce flooding and pollution.

Where does this make a difference? "Generally, customers served by foul only networks should be less vulnerable to storm water runoff causing flooding in their homes and gardens. However, because some of these areas have misconnections (in which surface water is erroneously connected to the foul only system by builders and customers) there can be a risk for these customers also".

For the first cycle of the DWMP, we have used a 60-minute storm that statistically is likely to occur only once in any given year during the summer. We have used that storm to explore the impact of storms on sewer flooding risk, and how that risk will change with the added impacts of climate change, growth, and urban creep between now and 2050. This will give us a baseline to use in the next planning cycle so we can compare the risk posed by other types of storm event.

4.9.2 How does the supply demand approach, worst risk approach and RBCS/BRAVA approach compare?

As a comparative example, Conwy L2 area was highlighted in the supply demand capacity assessment, as the Level 2 area with a shortfall in either network or treatment capacity. The results of that assessment show that it should be the first strategic (L2) area to focus on.

The same Level 2 area was also highlighted in the Problem Characterisation (PC) method. However, in terms of PC, the DWMP process ranks risks into Standard, Enhanced and Complex, with a key element of that ranking being driven by population size and growth risk. Both the PC and Supply Demand methods identified the Conwy Level 2 area as a risk but, because the Level 2 catchment was not ranked as Enhanced and Complex it was not taken forward to Options development.

Nevertheless, we found that, because the supply demand capacity assessment uses the same assessment to drill down to level 3, it provides added value at a tactical level, which further refines the geographical area to focus on.

The worst risk approach has helped us identify where to prioritise the efforts in options development and appraisal (ODA). Through the worst risk approach, we have found that the focus for Conwy and other L2 areas has not been on the greatest risk but the greatest improvement to both customers and the environment.

It has been a useful exercise during this non-statutory phase to explore alternative approaches to RBCS and BRAVA. It does suggest that there are alternative approaches that should be considered that may reduce the amount of effort upfront to coordinate where the effort needs to take place in ODA.

4.9.3 Future Recommendations

The recommendation for the continued use of the supply demand approach is that it will bring together 2 separate assessments and, for the first time, demonstrate a combined picture to manage sewage.

The cyclical nature of the DWMP allows us to monitor change. During each five-year DWMP planning cycle, we will update our risk assessments (BRAVA and problem characterisation) to determine if the current pathway needs to change.

There are some risks that have not been considered in the first cycle of the DWMP, for example odour problems at specific assets. This is because the work we have carried out in the first cycle is intended to focus efforts on the most impactful risks, however we understand that some of these risks are significant issues for some customers and we will investigate expanding the scope of risks we look to address in future cycles.

4.9.4 New Developments of National Importance

We are aware that some major developments can impact on our planning process but have uncertainty as to if, and when, they are delivered. An example of this is Wylfa Power Station on Anglesey, which has been discussed over the last decade but has not materialised. Another area that we will continue to consider is the strategic nature of Milford Haven's industrial development.

4.10 Recommended Catchment Based Review of consents process

Our environmental regulators NRW and the EA issue agreements at points where the sewer system interact with the river and coast. These agreements come in two forms:

- Descriptive, which relates to smaller and less environmental sensitive facilities; and
- Numerical, which contain variables of flow and quality standards to control impacts to the ecology and biodiversity; these normally have parts that relate to dry weather and a part that has different values for wet weather conditions.

The main principle at a treatment work is to protect the biological process to ensure that it carries out its task of cleaning the water before it is discharged. the size of the treatment work is carefully chosen to ensure this.

The changing climate and changes being driven by human patterns of usage is altering the underlying flow and load volumes in that calculation.

The decision to change policy with regards to storm overflows spills is also going to alter the underlying flow and load volumes in the calculation. It is anticipated that a review of the treatment work facilities across our area will be required within the next 15 years so that the biological treatment continues to be protected.

In Figure 56, a simple model has been drawn of the interactions between the assets and the environment. The current conditions flow model shows that, as flow travels through the system, there is a separation into the environment through discharges of untreated water. The second system model shows as each discharge is reduced and disconnected; more flow will need to be contained within the sewer model. Furthermore, assets such as pipes, pumps, storage, and treatment will need to be readjusted to accommodate the future position. This links to the calculation of the three areas of the Wastewater System, the Capacity of the Network, Treatment work and the environment. The dynamic nature of the natural world is setting the need for the review of consents plan, and our plan is showing the beginnings of an approach for this.

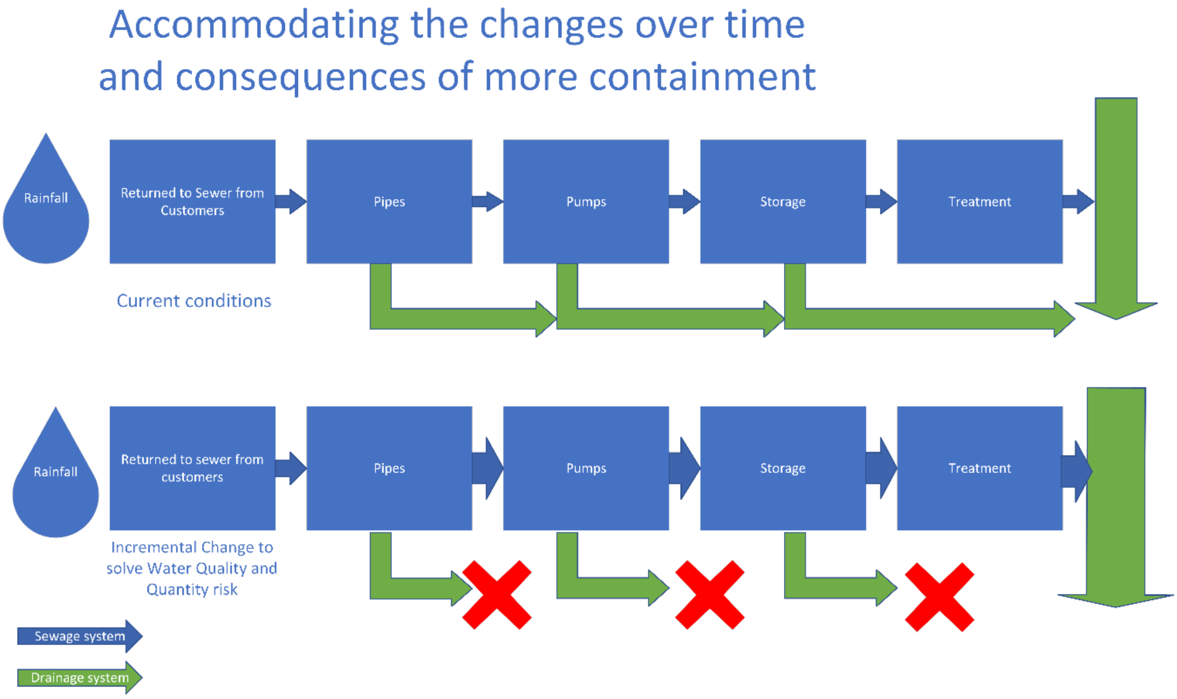


Figure 56 - Catchment based approach to Storm Overflows while maintaining compliance at all locations

The flow currently arriving at a treatment works is lower because the system is designed to let water out while it drains to the treatment works. In the future, as each storm overflow and customer escape is contained, a larger amount of flow will arrive at the treatment works and a larger amount of flow will arrive when it is raining.

The consequence of this gap between dry days and wet days will need an alteration and is required to protect the biological process and, similarly, the environment and ecology of the river and sea. This variable flow and load i.e. the water quantity and the quality difference between dry days and wet days could become more extreme and even nature based, or low carbon solutions may be put under pressure which again will drive more need to protect the natural process I.e., the biological process that forms the active cleaning of wastewater. Again, this suggests that, to reduce the likelihood of high variability driven from climate change and heavy rainfall, sewage and drainage systems must be managed differently in the future.

A simple example is shown in Figure 57. On dry days, the volume of wastewater arriving at a treatment work is directed through the works and out into the environment. As it rains in the catchment, and water starts to arrive at the treatment works, the treatment processes need to be protected so an amount of flow is stored, and when the rain stops, that stored water is returned thought the treatment process and on to the environment. Larger storms such as a deluge cannot be stored, and this is designed to spill directly into the environment as per the agreement with our regulators.

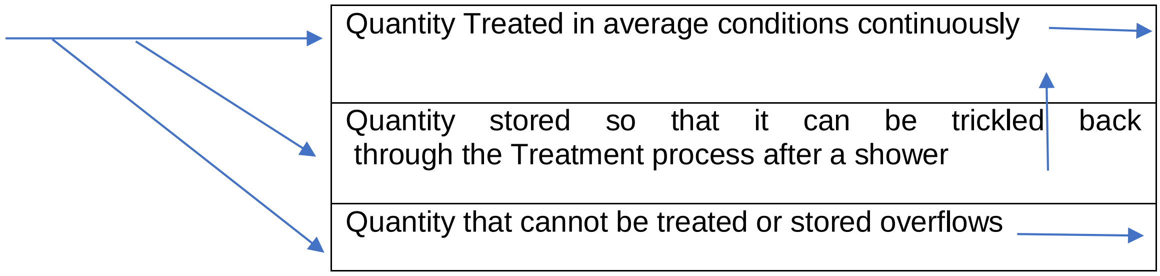


Figure 57 - A simple example of rainfall storage and treatment capacity contain and how flow is routed with storm intensity.

It is the Excess Quantity of water discharged to the environment during high intensity and low frequency events that cannot be treated due to biological constraints in treatment process, such as diurnal change and seasonal sudden change.

We next considered what does this mean. Our network delivers flows in litres per second and this base flow, the sewage flow, arrives daily. When it rains, the flows ramp up as the storm passes and continues to rise until the flows start to drop again after the storm, so a treatment works needs to be able to manage both the constant flow and the changing flow. An approach to manage the changing flow is to store most of it so that it can be trickled back along with the daily constant flow. However, these tanks are also designed to operate during a time when intensity and frequency were lower, indicating that storage at treatment works will need to be bigger in the future. The more frequent storms also indicate that greater storage will be needed if a policy of contain is eventually concluded. This is because a storm tank design is designed to drain down over a period of time. If these times are shorter in the future, then the tank will need to be bigger to allow each hour of rainfall to be stored until the series of rainfall events stop which then allows capacity to be again made in the storm tank as it trickles through the treatment works before discharge to the environment.

Figure 58 shows the new maximum capacity of storage and volume needed to be stored above the original assessment. The volume of additional flow to be stored is the area between the two curves, not just the peak.

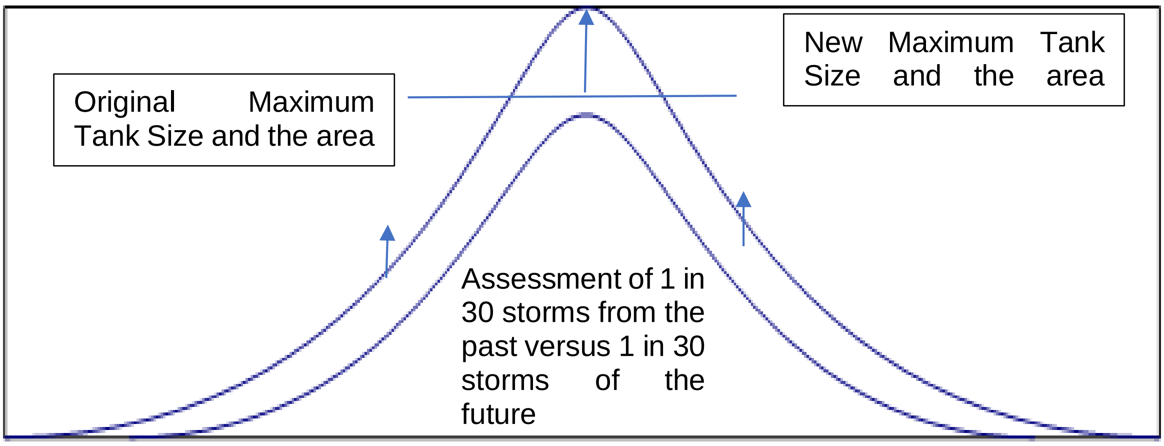


Figure 58 - Curve of current and future rainfall impacting on the size of a storage tank

Again, this indicates a need to reassess the resilience to the latest frequency and intensity of storms and consider setting a new storage design, or retaining the current design and changing how rainfall is designed in the network system to a surface water or sub surface drainage only system.

This analysis reinforces the 3-system approach to manage flow and load. The continuous volume of flow is directly linked to the sewage plan to include drizzle and low intensity rainfall which helps with dilution in the network itself, and self-cleaning velocity flushes, which is also a hydrological principle that needs careful consideration as we make changes to any water cycle. At a point where the drainage cannot be contained at the treatment work, and it then spills out to the environment, the volume will need to be managed differently in the network as it cannot be contained at the treatment process. This is because the biological process needs to be protected and the volume of excess water becomes too great; sometimes greater than three or four Olympic sized swimming pools. This links to the drainage plan.

The load on the river, which is the other element of an agreement, relates to disperse and dilution which we discussed earlier. During dry weather, the more flow we treat through the biological process, the less the river will need to dilute. However, the ability of the river to disperse flows is also important. Climate change means we will need to add more nature based processes in addition to the current treatment works process to overcome that dispersion problem by using natural groundwater trickling to support base flow in the river, and use the natural groundwater filtration system to disperse and dilute flows more naturally and slower.

As an example:

The flow currently arriving at a treatment works is lower because the system is designed to let water out while it drains to the treatment works. In the future, as each storm overflow and customer escape is contained, a larger amount of flow will arrive at the treatment works and a larger amount of flow will arrive when it is raining.

This first Plan has been exceptionally difficult as it has not just been turning the handle on tried and trusted wastewater principles and practice. The delivery of the framework allowed us to take the opportunity to delve much further.

This started with a ‘willingness to support’ citizen science research programme, which set the direction of travel.

We then learned how to merge the principles of wastewater management with the principles behind Water resource management (such as hydrology and hydrogeology) and worked on course modelling versus detailed modelling.

We looked at dry weather, average weather, wet weather, and extreme weather conditions and how each of these had a contribution to a calendar year of 365 days.

This led us to understand why co-funded opportunities are not commonplace, which is primarily because our focus in terms of frequency and intensity rarely overlap, and each organisation has a conclusion when factors from other contributions are significant or insignificant to their project.

The work was also quantified, using a simple method to allow for an informative decision relating to differing policies for both volume of water escaping to a water body or customer home and business, and the realisation that the cost to achieve net zero is not currently affordable without further discussion with customers. It is customers who set the pace of change by what they can afford.

The final piece that connects all the above to normal wastewater planning is to monitor performance using the primary objectives for customers and one for the environment. These are: internal sewer flooding, external sewer flooding, pollution events, improvement in river water quality and treatment works compliance.

The framework has also allowed us to add a deviation from normal practices to understand risk in a river catchment, rather than at company level. Another added element is that there is a need to carry out a consistent forecast to a minimum of 25 years.

When all this information is combined, we improve our understanding of what is happening and why.

4.10.1 Our proposal for cycle 2

The framework has given us a great start to the way we manage sewerage and drainage, and river and coastal water quality. We have attempted to evolve what we would have undertaken as part of previous wastewater company planning and have challenged ourselves to go further during this non statutory phase before the new regulation of this process is developed.

- We now have an assumption as to when environmental harm could occur.
- We now have an assumption as to when amenity is at its highest;
- Marrying this with sewage planning leads us to developing risk assessments which go further than asset planning;
- We now have an assumption that sewage needs to be contained, but we still need guidance to the level of containment and government policy to inform that decision;
- Marrying this with drainage planning leads us to developing integrated national drainage plans with other organisations, with a focus not only on the extreme wet, but on a full range of conditions;
- We now have an assumption that rainfall needs to be separated but we will need guidance to the level of separation and government policy to inform that decision;
- We need to understand how our systems work with differing levels of rainfall intensity and frequency now, and in the future; and
- We need to understand how our rivers and coastal water could change into the future and consider how their ability to dilute and disperse water of varying quality will change.

These concluded assumptions during our first cycle will now be fed into our risk and options methodology; we want to understand not only what happens in the worst-case conditions, as indicated in the framework and general wastewater planning, but also to be able to understand average, wet, and dry conditions, and make plans for each. This is different to standard wastewater planning.

5 Options Development and Appraisal – Building our Plan

5.1 Introduction

The Water UK DWMP Framework methodology was developed to focus the level of planning effort, i.e., proportionate to the risks identified, with a view to providing a measure of consistency across the industry.

> The Water UK Framework outlines the following key areas for **Options Development** and subsequent **Options Appraisal**:
>
> A methodology that covers:
>
> - The hierarchy of **options** for consideration;
> - The development of, and criteria for movement between, unconstrained, constrained, and feasible **options lists**; and
> - An **appraisal** process to define **preferred options** based on **'best value'** and incorporating ecosystem services assessments / natural capital approaches.
>
> A key principle in developing options is the need to work in collaboration with customers and stakeholders (including third parties) in their identification, co-creation, and assessment.

Options development and appraisal (ODA) is the process resulting from initial RBCS, subsequent requirements for BRAVA, and problem characterisation, as illustrated in Figure 59 below.

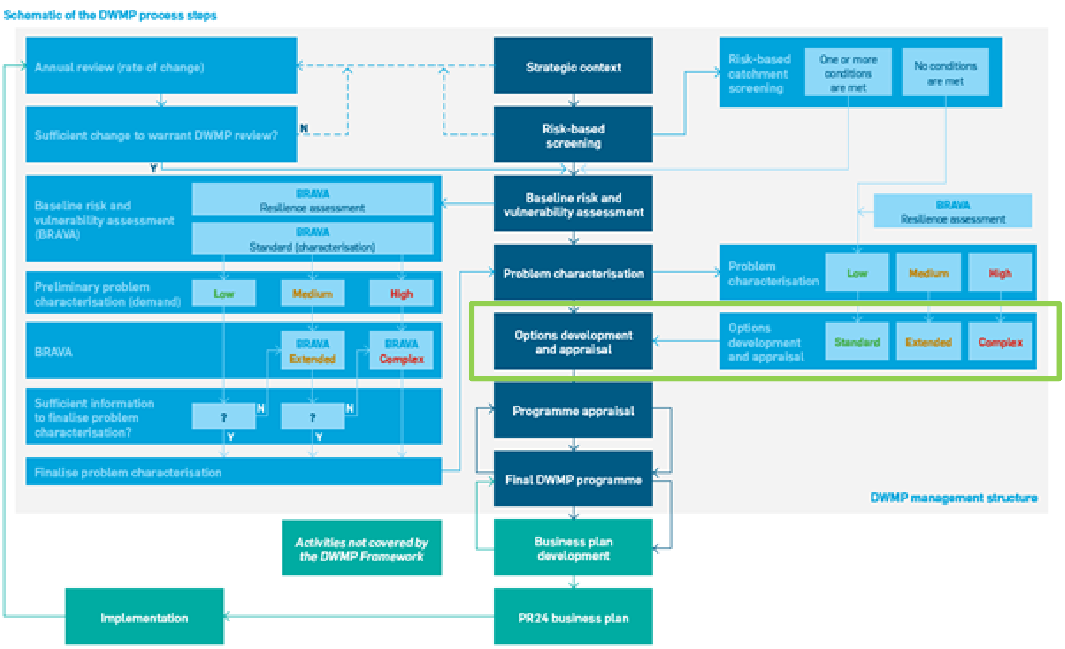


Figure 59 - DWMP Process and Options Development and Appraisal alignment (Water UK, 2021)

The DWMP has been created with the specific company challenges and needs of Welsh Water customers in mind. The framework provides direction, but also flexibility, in terms of where companies already have appropriate processes in place – where these may vary from the framework, WaSCs need to identify how the selected processes are appropriate.

The options stage sets out the scope, cost and likely timing of interventions that could be chosen to achieve long-term company objectives. It assesses the value of different options – in terms of impact on flooding and pollution, but also their wider value to nature and to people.

The framework indicates that the ODA stage, along with the programme appraisal stage, should be completed no later than the end of June 2022. The tight timeframes have therefore limited the scope of the first cycle of the DWMP, with additional scope planned for Cycle 2 and beyond.

The following **Options Development and Appraisal** chapter sets out the approach for Cycle 1 and limits the assessments undertaken with the aim of completing the options stage within the timescales set in the framework. The first part of the chapter provides greater detail on **Options Development** - how the company has developed its plan, for example, approaches to Sustainable Drainage Systems, treatment works capacity, scenario development, resilience, and options development.

The subsequent sections of this chapter present **Options Appraisal** including approaches to option costing and benefits valuation.

This chapter provides a summary which details what future parameters, scenarios and assumptions have been assessed in the development of this plan and outlines how DCWW's first cycle DWMP complies with the guidance.

5.2 Methodology – Wastewater Networks Assessment

5.2.1 Options Development Appraisal – The DWMP framework strategy

The options process outlined in the Framework involves starting with a long list of options and, over a series of steps, refining to a shorter list of best-value or preferred options that could feasibly address each identified risk. At each step, more assessment criteria are used to further refine the list. **The long list of options is referred to as 'generic-options' and the final, refined list as 'feasible-options'. From the feasible options list, 'preferred-options' are selected**.

The terms 'unconstrained' and 'constrained' are used in the framework for intermediate steps between the 'generic' and 'feasible' stages. The DWMP framework, however, notes that the approach should be proportionate, and that some companies may move directly from the unconstrained to the feasible options list. In practice, we found that the definition of additional stages between generic and feasible added an unnecessary complication to the options process. There are limited ways to address a flooding risk, for example, and screening options based on catchment characteristics led to a manageable list of options for more detailed testing.

The overall approach to the ODA process is shown schematically in Figure 60. The approach is applied at each L3 TPU. In summary, the outputs from the BRAVA and Problem Characterisation steps provide an indication of the planning approach to be taken for the L3 TPU that is appropriate to the complexity and scale of the risks identified.

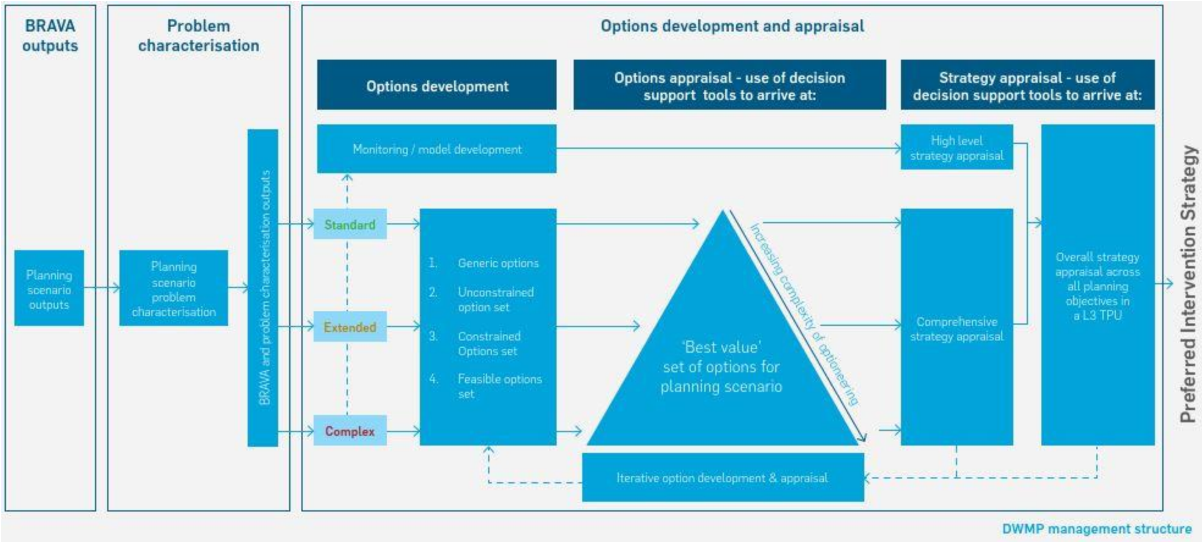


Figure 60 - Outline of the Options Development and Appraisal process (Water UK, 2021)

Regardless of the approach, the framework emphasises the importance of a robust and auditable screening process, detailing which options have been discounted and why.

The framework suggests that the options process should be followed for any WwTW catchment where a risk has been identified. The framework notes that the approach should be **proportionate**. A catchment with a low-level risk is likely to warrant less detailed option development than a catchment with a high level of risk. The BRAVA stage of the DWMP has indicated the level of risk in each of DCWW's L4 WwTW catchments and this risk level has dictated how detailed an option development has been for a given catchment. A standard approach following Business-as-usual has been used, with any identified as enhanced or complex following the DWMP ODA approach. Drivers from a NEP perspective, however, follow their own approach.

5.2.1.1 The Options Development Pathway – Driving towards preferred options

The objective of the DWMP is to enable a consistent approach to the development of catchment strategy at all levels within a company. A critical part of this is the options development journey, a process undertaken to enable targeted feasible options to be defined at a catchment level in a consistent manner, enabling feasibility as well as acceptability to be included within the process.

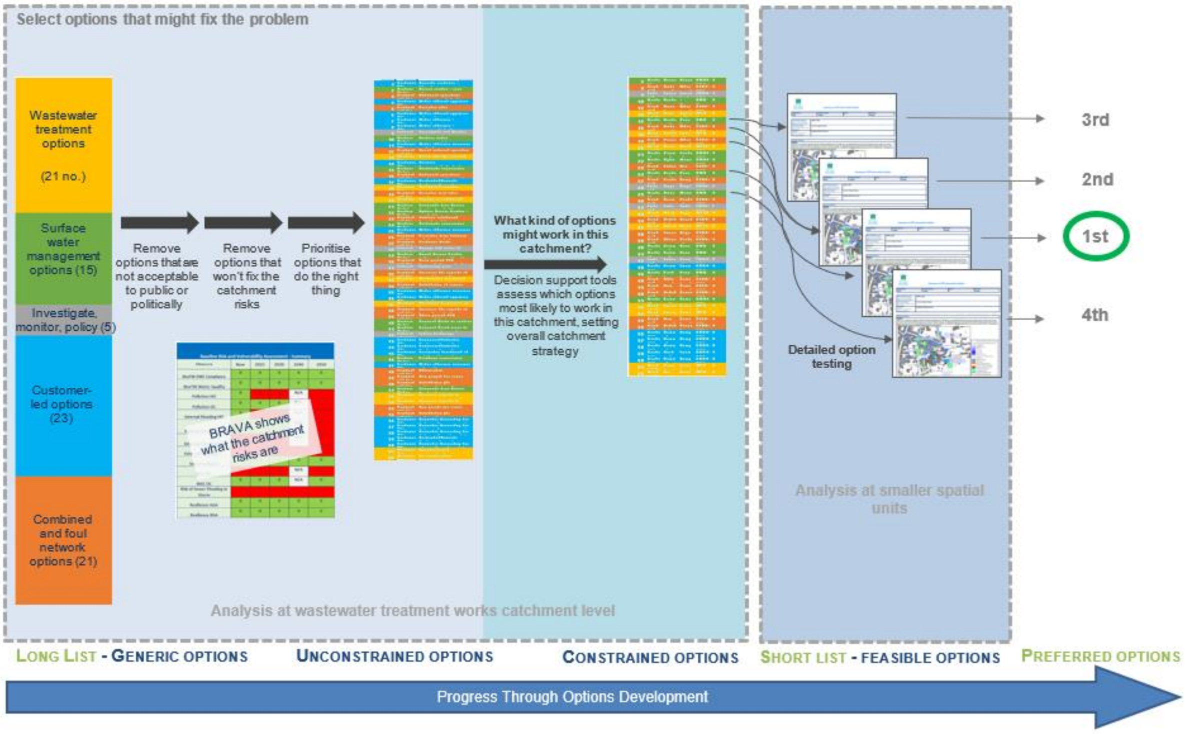


Figure 61 - Options Development Pathway

The process of working through the options development pathway (shown in Figure 61) is managed within the DWMP Options Screening Decision Support Tool. This spreadsheet tool helps planners to identify the options that are likely to be viable for each of the WwTW catchments in Welsh Water's operating area by working through the options development pathway to deliver a set of feasible options, before a preferred set of best value options are presented for each catchment, as part of the DWMP plan.

The following sections outline each stage of the Options Development Pathway, reviewing the definitions within the Water UK guidance and how DCWW have delivered the refinement of the process and the options included to meet the needs of our customers and catchments. It should be noted that, to achieve particular planning objective requirements, there may only be a certain number of options which are known to be feasible up front. In these cases, DCWW have enabled these options to jump straight to the feasible 'toolkit' for those specific planning objectives.

5.2.1.2 Generic Options – The starting point

The DWMP Framework defines Generic Options as

> *"…the range of potential option types for consideration across all aspects of drainage and wastewater planning" (Section .5.)*

As part of the development of the DWMP framework, Water UK produced a generic options list containing 43 options, which was created as a starting point for all water companies.

Expanding on this, DCWW developed a list of 200 'stakeholder friendly' requests which were likely to be made in future cycles. This generated **85 generic sub-options,** based on the original 43 provided by Water UK, forming the baseline DCWW Generic Options toolkit.

The generic sub-options were grouped into the following categories, in line with the DWMP Framework:

1. customer side management;
2. surface water management;
3. combined and foul sewer systems;
4. wastewater treatment works; and
5. Indirect Measures (an additional category added including investigations and policy).

These sub options were the starting point for the DCWW options development pathway. Within our DCWW processes, this has been called the **Options Long List**.

5.2.1.3 Unconstrained Options – Defining acceptability for stakeholders

The DWMP Framework defines Unconstrained Options as

> *"…a broad spectrum of options derived primarily from the generic options list but with, where appropriate, the addition of site-specific options."*

All 85 sub options identified at the generic options stage were internally peer reviewed by DCWW Stakeholders and each was allocated a score between 0 and 4 for 'Political Acceptability' and 'Customer and Stakeholder Acceptability', with scores of 0 demonstrating the highest level of acceptability and 4 demonstrating the lowest (i.e., 'unacceptable'). This filtering process supported the definition of the unconstrained options list.

These two screening criteria were identified as 'red flag' criteria, failure of which would prevent the sub-option being considered further down the options development pathway, resulting in exclusion from the unconstrained options list and its suitability for inclusion within a catchment strategy.

The remaining 80 unconstrained options were scored against each service measure, based on how well the option would resolve the problem. For instance, option SW05-001 (connect roofs to surface water systems), could resolve 'quantity' service measures relating to hydraulic overload, but would not resolve 'maintenance' service measures which relate to other-cause issues.

5.2.1.4 Constrained Options – Meeting the needs of a catchment

The DWMP Framework defines Constrained Options as

> *"…derived by assessing the unconstrained option list against a set of screening criteria created through engagement with L2 strategic planning groups (SPGs). It would be expected that the criteria agreed would be applicable to all L3s in the L2 SPA"*

The unconstrained options list faces **four challenges** to determine what options can make the screened constrained options list and form the basis of the catchment level feasible option toolkit. These challenges are:

Does the option fix the problem? - This challenge removes unconstrained options from consideration if they are not expected to resolve the problems identified within a catchment. For instance, in a catchment with no 'quantity' service measure failures, no options would be proceeded which only resolve quantity service measures.

Is the option applicable at L4? – This challenge removes options which may not be suitable for implementation at an L4 level and are more suited for more strategic catchments. For instance, an option for reducing water consumption might be better implemented at a L3 scale, or higher. These options are therefore put on hold at this point but are not rejected outright.

Are interventions suitable based on catchment characteristics? – The characteristics of each L4 catchment have been defined using GIS analysis and data from DCWW sewer records. These characteristics are used to automatically remove some options from consideration based on their suitability and available catchment/asset information. For example, catchment transfers to another water company are discounted if the transfer distance is too far.

Does the option do the right thing? - Each option has been assessed for how well they perform against specific criteria, for instance, community impact, environmental impact, reliability, cost, etc. (as scored in the 'Generic Options' sheet). Low scoring options are given a higher rank and could be removed at this point as they might resolve the problem, but result in an unacceptable social, environmental, or economic impact. This challenge, whilst included within the assessment process has not been invoked to refine the constrained options list, however it does provide option prioritisation to support the development of preferred options.

5.2.1.5 Feasible Options – Effective solutions that deliver for a catchment

The DWMP Framework defines Constrained Options as

> *"…a subset of the constrained options list. A range of criteria, based on more detailed information, is used to refine the constrained list to a range of feasible Options. For the DWMP it is recommended that a preferred option from the list of feasible options is selected, based on cost and benefits assessments … and endorsement obtained through engagement within the strategic planning groups."*

From the constrained options stage the feasible options are defined based on an additional range of criteria which ensures acceptability in the context of the catchment as well as the ability of the option to against the planning objective requirements. Firstly, the options are reviewed for **feasibility and risk**:

- Customer acceptability.
- Political acceptability.
- Timeline for implementation – is a significant amount of work required to implement the option?
- Dependencies – does the option rely on, or provide an opportunity for, co-creation and implementation?
- 'Third parties' – does the option lend itself to third-party operators providing an alternative service?
- Planning and regulatory constraints.
- Engineering and cost.
- Engineering complexity.
- Cost.
- Performance.
- Outcomes – can the option deliver the desired outcome?
- Flexibility to adapt.
- Resilience – does the option increase resilience in the system above and beyond meeting desired outcomes?

In addition, there is a wider understanding of the operational aspects of an option – 'does the option impact on wider compliance risk in the system?' and finally an environmental assessment and an understanding of best value options through collaboration, driving environmental net gain.

These options provide the catchment level toolkit used to meet planning objective requirements. Within our DCWW processes, this is called the **Options Short List**.

Some options have been allocated to the hierarchy and are only appropriate for delivery at level 1 (the company operating area), or at level 2 (regions of the company), and at level 3 (more locally but still broad at a community level).

Customer side options, such as education, are considered separately to other options. The company already have education and media programmes that cover water efficiency and blockages. We explored how to target more locally and consistently, and costed variations of media campaigns, in additional to activities already considered as our normal operation. This work can be seen in the overall company journey plan for this iteration. During cycle 2, we will be looking to trial localised campaigns to marry up with the company message and bring greater benefit to the company campaign.

5.2.1.6 Preferred Options – Delivering best value for DCWW and our customers

The DWMP Framework defines Preferred Options as:

> *"…for the DWMP it is recommended that a preferred option from the list of feasible options is selected, based on cost and benefits assessments, for the appropriate L3 and endorsement obtained through" (Section D.3)*

The selection of preferred options has been carried out at the Wastewater Treatment Works (WwTW) catchment level. The interventions that have been developed for each risk cluster within the catchment have all been collated and the Net Present Value (NPV) for the following aspects been calculated for the intervention to calculate the TOTEX of the intervention for the life cycle of the schemes.

1. CAPEX;
2. OPEX;
3. Repeat CAPEX;
4. Variable OPEX;
5. Carbon; and
6. Benefit.

In addition to the costs of intervention, the NPV of the benefits calculated through B£ST have been calculated for the life cycle of the intervention; this provides a 'negative' cost.

The preferred interventions for each risk cluster have seen selected based on the Annual Incremental Cost (AIC) over the lifecycle of the scheme. The preferred schemes to resolve the assessed catchment drivers, in this cycle the Worst Served Customer flooding and CSOs which spill to Special Areas of Conservation, have then been reviewed with catchment knowledge to understand if the scheme should progress forward to Programme Appraisal. The HRA and SEA have been undertaken on each preferred option to assess if the option is likely to be blocked and scored on a Red-Amber-Green (RAG) status.

Both measures should be assessed over the whole life of the option (or at least until the long-term planning horizon).

5.2.2 Developing the Plan – An options development approach for all catchments

Three levels of option development are outlined in the DWMP Framework. Based on assessments through BRAVA and Problem Characterisation, catchments, and the option development required, are categorised as one of the following:

Standard – follow company's 'existing investment planning practices to maintain or enhance existing levels of service.' It was anticipated that a 'standard' approach would be applicable to most catchments.

Extended [Enhanced in DCWW terminology] – 'build upon standard processes to provide extended analytical approaches.'

Complex – 'Uncertainties in the forecasts … The likely complexity of the interventions required to meet all planning objective exceedances is high involving multiple options and/or stakeholders and the potential lead in times are long.' An adaptive pathway approach may be applicable in complex catchments. Note, no catchments were identified in Cycle 1 as requiring complex optioneering, however the Long-Term Drainage Strategy for Ofwat has resulted in the assessment of 44 catchments against a simplified adaptive planning approach.

In addition to these above, we introduced the concept of a companywide storage equivalent approach i.e., the cost to reach a company strategy, which is to be used to quantity the quantum of the work required to reach an ambition or milestone using a simple approach of volume exceeded greater than the capacity of the system multiplied by the cost to store that volume. It was established that this company approach was required when the scale of the risks identified were quantified. By the inclusion of this step in a company programme, the combination of the standard, extended and complex would then total the company wide estimate.

Our approach has been segregated into three separate processes aligned to the framework. For all standard risks, we have chosen to allow the current business process to address risks as part of the normal approaches to planning. It is anticipated that any NEP requirements would be addressed as part of a standard approach. We have also separated out the approach for growth, creep and climate change in our network from an approach for climate change for surface water management.

In this plan, we will develop the ODA process of the framework and we will test the approach using our priority catchments, and then create a climate change opportunity assessment ready to develop additional joint projects.

The business-as-usual approach is aligned to the price review process of PR19 and the improvements to business planning being made during the development of our PR24.

5.2.2.1 Our approach to options development

Network assessment - Long-list of options to address flooding and pollution risk - Even if our assets are big enough to cope with foul flows, flooding and pollution can still occur due to rainfall, infiltration, blockages, or collapses. Through consultation with stakeholders, we have developed a long list of options that could address flooding and pollution risks. However, every option will not work in every catchment. We have considered the characteristics of each treatment works catchment and the types of issues to refine the long list of options for each catchment.

Resilience for growth – We undertook a regionwide assessment of the capacity of every one of our pipes, pumps and treatment works for foul flows now and in future (foul flows include flows from residential properties, commercial premises, and consented traders). To ensure that our networks are not a blocker to economic development in Wales, we need capacity for growth that has already occurred, and for growth that is likely to occur in future.

Set the catchment strategy – We have assessed what type of options are likely to have the greatest benefit in each catchment. Infiltration removal may be effective in some catchments, whereas Sustainable Drainage Systems (SuDS) might be more effective in others. These tests have set our long-term direction for each catchment.

Localised option tests – Where we have a known, significant risk, we have spent more time testing and refining options. This gives us a higher level of confidence in the likely scale of investment needed in priority areas. Where practical, these localised options align with our long-term catchment strategies.

What are 'SuDS'?

These are a sustainable solution type.

In natural environments, rain can soak into the ground.

The problem to be solved. In urban areas, where surfaces are sealed by buildings and pavements, rain is not as easily absorbed into the ground. Instead, drains take surface water away. In some cases, this can cause flooding or affect river and coastal water quality. This is caused when combined sewers are filled with surface water, leading to a mixture of sewage and rainfall runoff. This is released into rivers through combined storm overflows to prevent customers' homes and businesses from being flooded.

Sustainable drainage systems (SuDS) are drainage solutions which provide an alternative to taking surface water away through pipes and sewers to watercourses. Examples include special paving which allows water to reach the ground underneath, swales, tree pits and rain gardens. There are also other landscaped areas designed to fill up in wet weather such as ponds and constructed wetlands.

SuDS act like natural drainage and bring a range of benefits:

- Storing or re-using surface water;
- Decreasing the amount of water draining fast to watercourses; and
- Improving water quality.

They also reduce flooding as these features give more time for the water to soak into the ground.

5.2.2.2 Cycle 1 Strategy – A top-down approach

What are we trying to fix?

The BRAVA stage of the DWMP assesses a catchment's performance against our current planning objectives. For each planning objective, each catchment is scored 0 if there are 'no known concerns', 1 if there are 'some concerns over exceedance', or 2 if there are 'significant concerns over exceedance'. A score of 2 indicates that we may fail to meet our planning objectives and that an option may need to be developed.

These scores are, however, based on current planning objectives, as set in our PR19 business plan. We recognise that external pressures, or improvements in data availability and confidence, can lead to shifting targets. For example, we have seen increasing focus on the performance of our overflows and introduction of a new Environment Act, all of which could lead to changes in our future targets.

Recognising this, we have developed **'reference option'** costs, which aim to inform DCWW, its stakeholders and customers of the likely cost to hit different future performance targets. These will allow us to discuss what our future targets should be. Can we afford a no-spill future? Is it feasible to stop all flooding in future?

5.2.2.3 Scale of investment needed in our networks (reference options)

The reference option is a high-level strategic top-down approach that provides a cost to achieve different levels of service for flooding and overflow discharges across Wales. The cost is representative of the broad type of work we may need to undertake to maintain and/or improve the network.

This will provide a company-wide indicative figure quantifying the cost to achieve a no network discharge for 2050 scenario which can aid DCWW in discussions about affordability, both internally, and with external stakeholders.

The approach taken provides costs for incremental service improvements at L1 through to L4 and, therefore, comparative analysis of the cost across regions can be made. The reference option includes a range of scenarios, as shown in Table 47, that enable us to consider the cost implications of achieving different levels of service and we can use the reference option as a tool in discussion with stakeholders.

Table 47 - Reference Option scenarios

Category	Horizon	Area impacted	Level of Service assessed
Storm Overflows	2020, 2030, 2050	SACs, SSSIs, Bathing Waters, all	40, 20, 10, 0 spills per annum
Flooding Escapes	2020, 2030, 2050	Internal flooding, external flooding, highway flooding.	Increasing 2-in-10, 1-in-10, 1-in-20 risk to a 1-in-30 level of protection and resilience to a 1-in-50 level of protection

The reference option can be used to discuss affordability over time as it includes the life cycle costs related to interventions: Capital Expenditure (CAPEX), Operational expenditure (OPEX) and repeat Capex, as well as the carbon impact.

The reference option assesses benefit in terms of achievement of target service levels. Due to the broad nature, it does not consider potential social-economic benefits assessed as part of detailed solutions, as the exact details of the schemes are not defined.

The reference option is not meant to be directly compared with detailed options developed for individual risks, instead it sets the context within which detailed options are considered.

The assessment incorporates three parts:

1. **Storm overflow assessment** - Calculating required storage volume for storage of discharge volume from storm overflows for a range of scenarios.
2. **Sewer flooding assessment** - Calculation of required storage volume for storage of network sewer escapes for a range of scenarios.
3. **Non modelled assessment –** extrapolating the results from the modelled catchments to provide a holistic view of cost.

5.2.2.4 Storm Overflow Assessment

The hydraulic model predictions of spill frequency and volume for each overflow modelled within a catchment were used to identify the equivalent storage volume required for retention of specific spill frequencies. The storage volume was used as this can be generated relatively simply by taking the spill volume of the nth annual spill (when annual spills are ranked in order of descending spill volume) and assuming that this will be stored within a tank (so any lesser spills would be avoided as the tank is larger than the volume spilt). However, it could equally represent an upsize or RainScape solution, should these prove to be as cost effective during detailed optioneering, and are therefore considered to be a generic reference option.

Early consideration was given to assessing the water quality impact of spills. Assessing spills in relation to the current WFD status of the receiving watercourse was considered but discounted as there would be uncertainty over the cause of any WFD failure and the extent to which CSO improvement would change the WFD classification. To obtain a more accurate understanding of CSO impacts a detailed assessment of receiving water quality with and without the CSO would be required, and this was not considered feasible within the timeframe. In the absence of detailed Water Quality modelling the assessment of spill frequency and volume is considered an appropriate substitute that enables rapid large-scale assessment.

Once the equivalent storage volume has been identified a cost model, DCWW's Solution Target Pricing Tool (STPT) has been applied to this volume to output a CAPEX, repeat CAPEX, OPEX and carbon cost for the option. This assessment has been carried out on a per asset basis and then aggregated to L4 to provide a catchment-specific overview.

As options are linked to individual assets, costs can be aggregated to Level 2, 3, or 4 or assessed against a variety of scenarios. For example, we have identified which assets discharge into the following areas, to support the assessment of the costs associated with alternative investment policies:

1. **SAC Assets** – Assets that discharge to a Special Areas of Conservation (SACs). The extent of SACs has been defined by the extent specified by NRW and provided in GIS layers by NRW.
2. **SSSI Assets** – Assets that discharge to a Site of Special Scientific Interest (SSSI), the extent of SACs has been defined by the extent specified by NRW and provided in GIS layers by NRW.
3. **Bathing River/Bathing Water Assets** - Assets that discharge to a bathing water, defined by the extent specified by NRW and provided in GIS layers by NRW. In addition to the Bathing Waters a pre-emptive assessment to identify potential future locations that are at risk of being classified a 'Bathing River'.

A supporting GIS layer has been created through the project to identify indicative Bathing Rivers, this has been collated using available open access data, including the following:

1. Website recommendations for wild swimming locations across Wales;
2. Known water sport activity locations; and
3. Assessment of STRAVA heat map to identify river locations that customers use for wild swimming.

All other assets – All assets that do not fall into the above 3 categories.

This categorisation of the asset discharge location allows assessment of strategies to achieve specific drivers on individual assets or scenarios across catchments at all levels of the DWMP.

The assessment uses inputs from all the DWMP epochs assessed: 2020, 2025, 2030, and 2050 taking account of the relative applications of growth, creep, and climate change in a combined assessment.

The following scenarios have been assessed in this cycle of the DWMP, for each epoch, providing indicative environmental requirements at sensitive sites for discussion with regulators and stakeholders:

- **Maintain** - No increase in discharge volume in future.
- **40 spills** - Reduce spill frequency to a maximum of 40 spills per annum in a typical year.
- **20 spills** - Reduce spill frequency to a maximum of 20 spills per annum in a typical year.
- **10 spills** - Reduce spill frequency to a maximum of 10 spills per annum in a typical year.
- **No spills** - Reduce spill frequency to 0 in a typical year across all assets, this does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.
- **No Spills to SACs** - Reduce spill frequency to 0 spills in a typical year at SACs and 40 spills at all other assets. This does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.
- **No Spills to SSSIs** - Reduce spill frequency to 0 spills in a typical year at SSSIs and 40 spills at all other assets. This does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.
- **No Spills to BW/BR** - Reduce spill frequency to 0 spills in a typical year at BW/BRs and 40 spills at all other assets. This does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.

These scenarios provide an understanding of the scale of investment needed to achieve the environmental destination and are indicative of SOAF investigation thresholds and common aspirational spill performance. They are all providing evidence to support the journey that would be required to get to a zero spills catchment, however the journey and the end environmental position will differ catchment by catchment over the duration of the strategic plan. These scenarios provide an understanding of the investment needed to achieve the environmental destination which will need to be discussed with local stakeholders and customers at both catchment and strategic level.

Figure 62 shows an example of the Storm Overflow Assessment at an individual asset level, highlighting the scale of investment required for the individual asset.

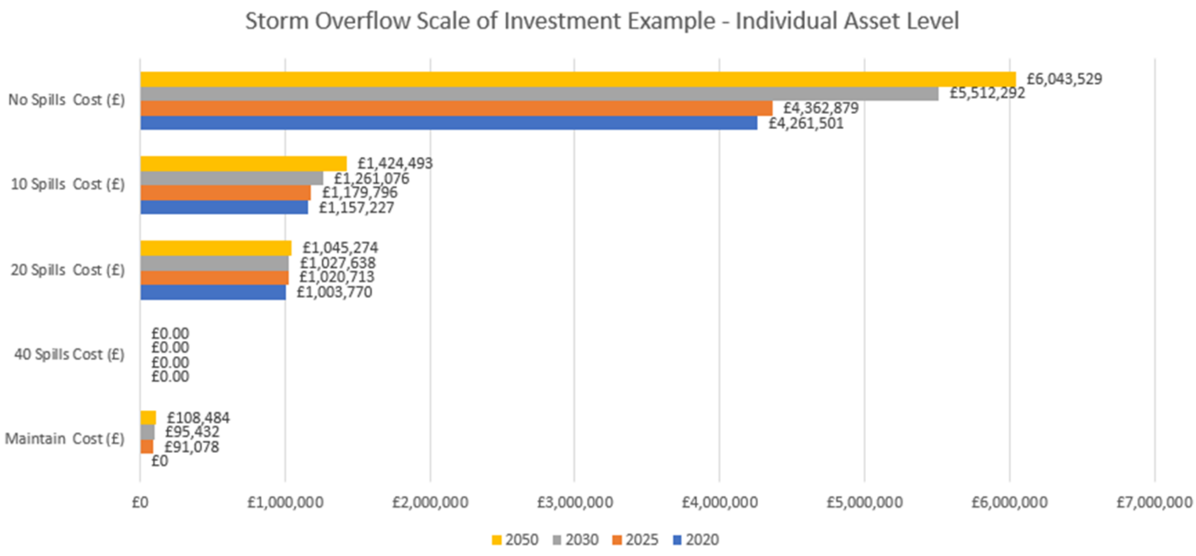


Figure 62 - Storm Overflow Asset Scale of Investment Example

5.2.2.5 Sewer flooding assessment

To assess the scale and associated cost of resolving all flooding across the DCWW operating area an approach, consistent with the methodology for the modelled overflow process stated above, was taken for the modelled flooding assessment. The assessment was carried out using the hydraulic model representation of the catchment by running design storm events for 1-in-30 and 1-in-50-year storm intensities and identifying the flood volume at each manhole. This exercise was carried out for 2020, 2025 and 2050 design horizons. Within this cycle, it was not carried out on the 2030 planning horizon due to time constraints.

The method of assessment varied depending on the availability of models and existing model simulations.

Development of flooding equivalent storage cost model

For each flooding risk cluster identified in the catchment, the cumulative storage equivalent volume was calculated for both 1-in-30 and 1-in-50-year storms for the ‘current’ scenario, then increases in flooding assessed for the 2025, and 2050 epochs. If there was no prediction of flooding from the hydraulic model at a known flooding risk cluster, then a scheme was costed at a standard model enhancement option cost prepared for the DWMP.

At a catchment level, and when combined with the other modelled catchment datasets and the non–modelled approach, this reference option provides a tool for the business to use internally and with external stakeholders to convey the costs associated with mitigating flooding now and in the future across different levels of the DWMP.

5.2.2.6 Non-modelled catchments

Where a catchment is not modelled or prioritised, CSO spill frequency and flood volume results are extrapolated and applied based on the modelled catchments to generate a cost. Event Duration Monitoring (EDM) data has been used as an alternative source for spill frequency data for non-modelled catchments. Generated costs are summarised into each regional boundary (L1, L2, L3 and L4).

5.2.2.7 Prioritising option development

Final Problem characterisation prioritised only a small number of level 4 catchments via the extended and complex route. The BRAVA scoring (0 to 2) has enabled us to prioritise our catchments even further for investigations. Based on overall performance, catchments have been ranked from 1 – high priority to 7 – low priority. (See BRAVA reports for details). The first 39 catchments ranked as high priority (1) have proceeded to more detailed option testing. With the additional 5 catchments proceeding that completed the extended and complex location from final problem characterisation.

Within each priority 1 catchment, decisions still need to be made about where to invest to hit our targets. If a catchment has 'significant concerns over exceedance' (2) for hydraulic flooding, for example, which flooding should we fix first? Or should we be working towards a catchment with no flooding? Two approaches have been trialled to provide choices to our business, customers, and stakeholders (Network Options A & B).

5.2.2.8 Network Option A

This is an incremental, tactical approach designed to address risk based on the level of criticality assigned to it. A criticality classification was assigned to risk as shown the matrix shown in Table 48.

In this first cycle of the DWMP, options have been developed to address priority '1' risks, and subsequent priority risks will be developed in later cycles of the DWMP.

Table 48 - Risk prioritisation

Priority	Flooding	Pollution
i (Highest)	Worst Served Customers (WSC's)	Special Areas of Conservation (SAC's) impacted
Ii	Reported internal flooding listed on DCWW's hydraulic flooding register (the Definitive Flooding List)	Sites of Special Scientific Interest impacted
Iii	Reported severe external flooding listed on the Definitive Flooding List	Bathing Waters impacted
Iv	Reported external flooding listed on the Definitive Flooding List	Other high amenity watercourses impacted
v (Lowest)	Reported highway flooding listed on the Definitive Flooding List	Other watercourses impacted

5.2.2.9 Network Option B

This methodology is like a Water Resources Management Plan (WRMP), whereby the level of service in a prioritised drainage catchment area is assessed and options derived which ensure the entire catchment area is brought up to the same level of performance. In Cycle 1 of the DWMP, the approach has been trialled in three catchments: Llannant, Gresford and Cilfynydd.

The level of service trialled has been to ensure no flooding or spills from a Combined Storm Overflow (CSO) up to, and including, a worst case 1 in 30-year rainfall event. Flooding from both surface water systems and from combined/foul systems have been considered. The methodology has been applied to the short-term planning horizon 2030, and the long-term planning horizon 2050, including an allowance for growth, creep and climate change based on the average emissions scenario.

We recognise that the 'option B' approach will incur significant investment costs. We are viewing this as a long-term aspiration, beyond the timeframes of the DWMP, and are considering how we might phase the required investment. We intend to develop and trial this approach in additional catchments through 2022.

5.2.3 Standard Options Methodology – Setting the Catchment Pathway

Standard – process defaults to companies' existing investment planning practices to maintain or enhance existing levels of service.

Under the Framework, companies are expected to produce the following for each feasible option:

- A description of the option, including a schematic map and/or conceptual diagram
- A description of how the option being described differs from baseline activities and the scale of benefits to be achieved against single or multiple planning objectives
- Assessment of customers' likely support
- Estimated time to investigate and implement
- Assessment of risks and uncertainties
- Assessment of flexibility to adapt to future uncertainties
- A note on the option's dependencies on other schemes or options
- An assessment of factors or constraints specific to the option
- Environmental impacts of the option, including Habitats Regulations Assessment, if appropriate
- Assessment of costs and benefits, over an appropriate time-period, split into capital, operating and financial costs. Companies should use their standard approach for calculating net present value. Environmental and social costs should be included.

This section details how we have developed options to fix issues in our wastewater networks. We have used strategic tools to assess capacity for growth across all our network. High-level assessments have allowed us to set a pathway; a vision for the types of options that should be implemented in each catchment.

Our standard options approaches, applied to all catchments, are explained in this section. A more detailed, iterative option development process has been applied in higher risk parts of the network, as explained in 5.2.6 – 'Localised Options Test', and at higher risk treatment works, as explained in section 5.3– 'Wastewater Treatment Works Assessment'.

5.2.3.1 Network Resilience (Creating capacity for growth)

Ofwat defines resilience as 'the ability to cope with, and recover from, disruption and anticipate trends and variability to maintain services or people and protect the natural environment' (Ofwat, Resilience in the round, 2022). Anticipating and planning for future trends is at the core of the DWMP and each of the option approaches described in this document improves understanding of resilience.

Cycle 1 of the DWMP has focused on gathering data to better understand resilience across our network. We have developed new tools to understand how long we have available to respond in the event of an asset failure, and how much capacity we have for growth, urban creep, and climate change. The following sections explain this work.

Note that Ofwat includes financial and corporate resilience in its definition of resilience, but these are outside the scope of the DWMP at present.

It is recommended that most options follow the process outlined above. A distinction is made for options to improve resilience: *'The resilience assessment will have identified key areas that will be required to be addressed. Given the hazards/consequences included in the assessment it is likely that many of the options will be non-specific (but, for example, sized to the specific catchment needs); as such, it is not considered necessary for the resilience options to undergo the same level of development and appraisal. Costs should be developed* *based on companies' existing costing practices. It is recommended that the options are collated at L2, to demonstrate that 'local' resilience issues have been addressed, and in the L1 DWMP documentation to demonstrate a company's overall resilience position.'* Whilst the whole DWMP assesses resilience of our network, we have focussed on specific aspects of resilience in this section and 5.3.2 – 'Environmental Resilience'.

5.2.3.2 Pipe Capacity

Under the Environment Bill (Parliament, 2021) DWMPs require sewerage undertakers to develop a DWMP that addresses '*the capacity of the drainage system and sewerage system*'. Hydraulic models are one means of assessing capacity. However, at the start of this project, we only had hydraulic models for 226 of 876 catchments. Constructing new models for the 650 unmodelled catchments was not feasible within cycle 1 of the DWMP. As such, we used industry network asset management software called InfoAsset Manager (hereafter 'InfoAsset') as a means of rapidly assessing which pipes might lack hydraulic capacity.

For every pipe, we have assessed headroom in peak and average dry weather flow conditions, and under three and six-times dry weather flow scenarios. The latter two scenarios are approximations for peak dry weather and small storms occurring in the network.

An InfoAsset database was created comprising all pipes in our network. Our GIS sewer records were imported into the database and key missing data, such as pipe invert levels, were inferred. Using scripts in GIS and SQL codes within InfoAsset, we assigned cumulative dry weather flows to every pipe. We then calculated how much pipes would need to be upsized by to ensure that they have adequate capacity.

The results are summarised in Table 49, which shows the total length of pipe to be upsized in each river basin under dry weather, three times dry weather and six times dry weather flow scenarios. The results can be used to inform more detailed investigations into areas with insufficient capacity. They also indicate, at a strategic level, the investment required to bring our networks up to certain basic levels of service (i.e., so they can cope with approximately 'Formula A' flows).

In addition, the InfoAsset database provides a basis for assessments of asset health and consequence of failure, an example being the pumping station resilience assessment described in the following section.

Table 49 - Summary of pipe capacity assessment project results

River basin region	Total length of pipes to upsize in dry weather flow (m)	Total length of pipes to upsize in 3x dry weather flow (m)	Total length of pipes to upsize in 6x dry weather flow (m)
Wye	554	2,718	12,006
Usk	40	1,902	4,568
Teifi and North Ceredigion	5	712	2,306
Cleddau and Pembrokeshire Coastal Rivers	636	2,438	5,165
Carmarthen Bay and the Gower	444	2,157	13,087
Llyn and Eryri	37	686	7,899
Clwyd	852	2,145	3,599
Conwy	42	684	2,614
Meirionnydd	0	408	915
South-East Valleys	2,183	14,333	78,722
Tawe to Cadoxton	1,437	3,996	18,975
Dee	2,490	17,528	48,887
Ynys Mon	442	1,660	3,178
TOTAL	8,721	49,707	198,743

5.2.3.3 Pumping Station and Rising Main Capacity

The InfoAsset database created for the pipe capacity project has further been used to understand resilience of all 2,463 pumping stations across our network.

The dry weather flows assigned to each pipe have been adjusted based on DWMP-estimated future populations in 2050. Each pumping station that we own has then been added to the InfoAsset database, allowing us to understand dry weather flows arriving now, and estimated flows for 2050. Using industry guidance on the design of pumping stations, we can use the dry weather flow data to assess how much flow our pumps should be able to pass forward now and in 2050, and how big the associated rising mains should be.

As for the pipe capacity project, this is a step change from previous plans, which have focused on known high-risk locations, and not our entire asset base. Our goal is to compare these required capacities with performance data for our pumping stations during Cycle 2; this will help us to drive pumping station capacity assessments and to adjust that capacity with investment in line with the environmental and customer destinations planned, going forward.

5.2.4 Setting the Catchment Strategy

5.2.4.1 Modelled Network Assessments

Hydraulic model tests were undertaken to assess which of the generic sub-options were likely to benefit a given treatment works catchment. These tests focused on the whole catchment, not localised risks, and enabled us to see which options should form part of the strategy for an individual catchment – termed its ‘pathway’.

To achieve this, the feasible options were grouped into option ‘bins’, based on the model test required. Six bins were created to cover all the options on the unconstrained options list:

- Additional storage;
- Contributing area/inflow removal;
- Increased conveyance;
- Smart networks;
- Bespoke tests – not covered by other bins; and
- No modelling (not feasible to model using current decision support tools).

Table 50 shows which bin each generic sub-option fits into.

Table 50 - Mapping Generic Sub-Options to Option Bins

Name	No Modelling	Contributing Area Removal / inflow removal	Increase Conveyance	Smart Networks	Bespoke
Smart network operation				Y	
Increase the capacity of foul and combined sewers (infra)			y		
Increase the capacity of non-infrastructure assets, for example, SPSs (excluding WwTW)			Y		
Transfer flows between catchments (inter-company)					Y
Proactive non-infra maintenance	Y				
Proactive infra maintenance	Y				
Rehabilitation (to enhance) sewers	Y				
Above ground PLR (property)	Y				
Below ground PLR (property/properties)					Y
Customer Alerts	y				Y
Enhanced operational maintenance (infra)	Y				
Enhanced operational maintenance (non-infra, excluding WWTWs)	Y				
Attenuation					
Rehabilitation of sewers					

Name	No Modelling	Contributing Area Removal / inflow removal	Increase Conveyance	Smart Networks	Bespoke
Transfer flows between catchments (intra-company)					Y
Cross Boundary Transfer to Neighbouring WASC catchment or internationally					Y
New gravity foul sewer			Y		
New pumped foul sewer			Y		
New vacuum foul sewer					Y
Water efficient appliances – domestic					Y
Water efficiency measures – commercial					Y
Water efficiency measures - industrial					Y
Rainwater Harvesting for External Use – household		Y			
Rainwater Harvesting for internal Use – household		Y			
Rainwater Harvesting for Internal Use – community		Y			
Rainwater Harvesting for External Use – community		Y			
Residential/Domestic Customer Incentive - potable water	Y				
Residential/Domestic Customer Incentive - runoff reduction		Y			
Commercial/Industrial Customer	Y				

Name	No Modelling	Contributing Area Removal / inflow removal	Increase Conveyance	Smart Networks	Bespoke
Incentive - potable water.					
Commercial/Industrial Customer Incentive - runoff.		Y			
Domestic –customer - Education		Y			
Business (commercial/industrial) customer education		Y			
Water efficiency - domestic					Y
Water efficiency - commercial/industrial					Y
Greywater treatment at catchment or sub-catchment level	Y				
Influencing policy	Y				
Engage with council to inform planning	Y				
Investigate and Monitor		Y			
Future technology		Y			
Community Level Source Control for re-use		Y			
Community Level Source Control for SuDS		Y	Y		
Highway Source Control - i.e., SuDS		Y			
Traditional conveyance	Y				
Sustainable conveyance				Y	
Flow diversion to traditional retention		Y	Y		
Flow diversion to Smart or Sustainable Storage		Y	Y		
Smart Source Control (attenuation rather than removal)	Y				
Connect Roofs to surface water systems	Y				

Name	No Modelling	Contributing Area Removal / inflow removal	Increase Conveyance	Smart Networks	Bespoke
Connect Paved areas to surface water systems					Y
Property level mitigation	Y				
Customer Alerts	Y				
Sustainable conveyance	Y				
Treat/pre-treat in network	Y				
Upgrade existing assets to provide additional treatment capacity or improved quality	Y				
Increase quality by introducing new process (within existing WwTW site footprint)	Y				
Increase capacity by introducing new assets (within existing WwTW site footprint)					Y
Increase quality by introducing new process (by expanding current WwTW site footprint)					Y
Increase capacity by introducing new assets (by expanding current WwTW site footprint)					Y
Construct new wastewater treatment works	Y				
Rationalisation/centralisation	Y				
De-centralisation	Y				
Review flow to full treatment consent	Y				
Review storage consent	Y				
Review chemical and/or water quality consents	Y				

Name	No Modelling	Contributing Area Removal / inflow removal	Increase Conveyance	Smart Networks	Bespoke
Incentivise treatment of non-domestic flows	Y				
Catchment-sensitive farming	Y				
Improve efficiency of existing assets to provide additional treatment capacity at existing WwTW sites.	Y				
Wastewater treatment works enhanced maintenance					Y
Strategies to increase low flows	Y				
Internal catchment transfer of flows - more efficient use of existing capacity - rationalising existing network (i.e. abandoning CSOs).					Y
Intelligent network operation	Y				
Sewer rehab					Y
Water efficient appliances					Y
Water efficient appliances					Y
Water efficient measures (property/community /industrial)					Y
Customer incentive		Y			
Strategic blue/green corridors	Y				

These bins were further reduced to a list which could be rapidly tested using hydraulic models. The tests were as follows:

- **10% impermeable area removal** - Reducing modelled contributing area by 10% is considered a reasonable catchment-wide representation, equivalent to feasible commercial or public building roof removal. The option is considered suitable for application in the short term as it is likely there will only be one stakeholder (local authority).

- **25% impermeable area removal** - Reducing modelled contributing area by 25% is considered a reasonable catchment-wide strategy equivalent to feasible highway removal. The option is considered suitable for application in the short term (2030 scenario) as it is possible there will only be one stakeholder (for example, county council or Highways Agency). The allocation of 25% is in recognition that only a few opportunities will be realistic to achieve in the short term.
- **50% impermeable area removal** - Reducing modelled contributing area by 50% is considered a challenging catchment-wide representation equivalent to wider highway removal and private residential runoff separation. The option is considered suitable for application in the long term (2050 scenario) as it is likely there will be multiple stakeholders to liaise with.
- **50% base flow removal** - Reducing modelled baseflow by 50% is considered the maximum reduction which could be achieved by relining the public sewer network. The 50% allowance is to allow for contribution from lateral connections that will likely occur, but not be feasible to reline.
- **Per capita consumption (PCC) reduction** - The reduction is applicable to long-term planning only due to the time taken to implement widescale water efficiency measures. A target value of 100l/head/day by 2050 is set in DCWW's most recent business plan.
- **25% trade flow reduction** - The reduction is applicable to long term planning only. A realistic target of 25% reduction by 2050 achieved by application of water efficient measures.

An option model was created for each of the above listed bin tests and 30-year return period design storms were run using the 2030 and 2050 'growth, creep and climate change' scenario. These tests demonstrated the impact these options would have on observed flooding in the catchment. In addition, a spreadsheet-based approach (Rainscape and storage n+1 spill estimator) to identify the potential impact of these options on CSO performance was developed.

A bespoke tool has been developed to identify the effectiveness of options against a range of service measures, the Feasible Options Impact Assessment Tool. The tool provides an overview of the impact of the proposed option bins on the catchment's performance against objectives for flooding and pollution. The graph in Figure 63 provides an example showing that, in this catchment PCC, 25% trade flow and 50% base flow reductions have negligible impact on the predicted number of flooding incidents that could cause pollution. Removing 10-50% of the impermeable area draining to the wastewater network could, however, reduce the risk of these incidents occurring.

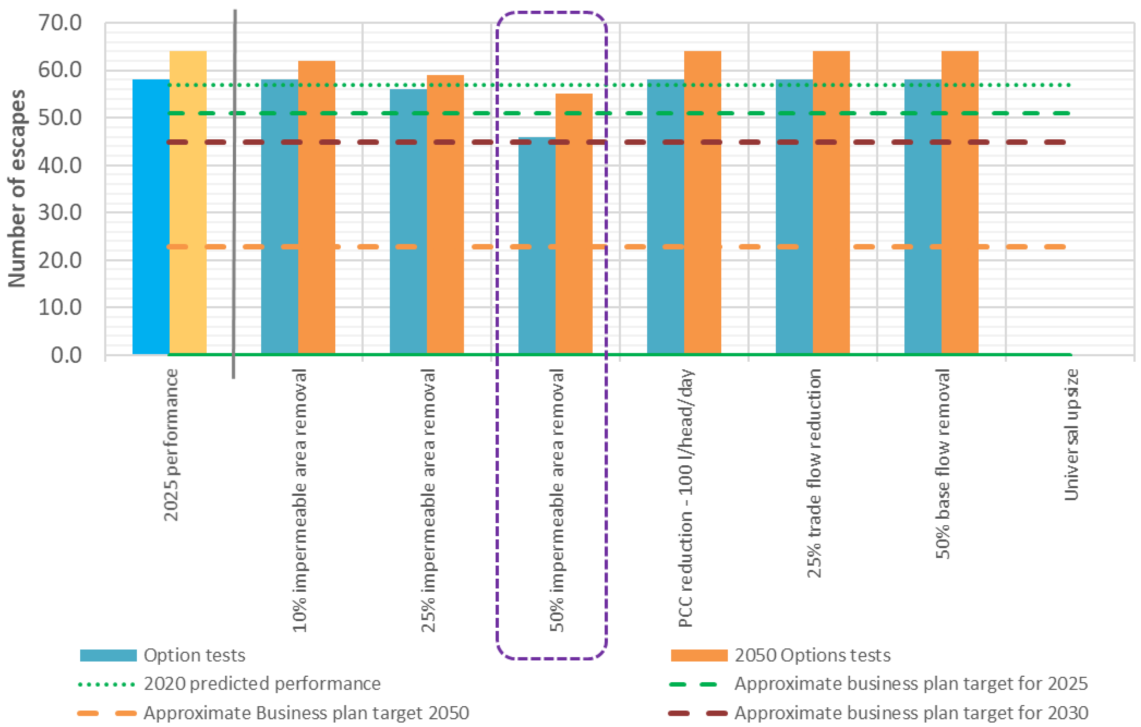


Figure 63 - Assessment of option bin impact on potential pollution risk for an example catchment.

The following scoring matrix in was assigned for each catchment:

Table 51 - Scoring assigned to option bins

Each option is rated from 1 to 5 against each metric and is given a 2050 and 2025 score	
5 - option eliminates problem	
4 - option achieves or exceeds target	
3 - option partially achieves target	
2 - option makes a difference	
1 - option has no effect or negative effect	
Weighting of objectives are as follows	
2050 flooding of a worst-served customer (WSC) or pollution of a Special Area of Conservation (SAC)	10
2025 WSC/SAC	9
2050 internal flooding or pollution of a Site of Special Scientific Interest (SSSI)	8
2025 internal flooding/SSSI	7
2050 external flooding or pollution of bathing waters	6
2025 external/bathing	5
2050 pollution/ pollution of a high amenity waterbody	4
2025 pollution/ high amenity	3
2050 other flooding	2
2025 other flooding	1

The scores against each of the listed metrics are added together and normalised to provide a score between 1 and 5. Scores of below 1 can be assigned to an option and this is indicative of a catchment not experiencing any issue against several of the service measures, for example, no overflows that spill to SACs. Table 52 is an example of the output from the feasible options impact assessment. The options are ranked based on these scores to set out the overarching strategy for the catchment, which shapes the development of tactical options.

Table 52 - Example of a 'bin' tests score outcome

Scenario description	Description	Assessed?	Catchment Example area Score	Rationale
bin1	10% impermeable area removal	Yes	0.77	Take bin forward for further testing
bin2	25% impermeable area removal	Yes	0.85	Take bin forward for further testing
bin3	50% impermeable area removal	Yes	1.17	Take bin forward for further testing
bin4	PCC reduction - 100 l/head/day	Yes	0.55	No significant impact
bin5	25% trade flow reduction	Yes	0.55	No significant impact
bin6	50% base flow removal	Yes	0.73	No significant impact
bin7	Universal upsize	No	Not Assessed	Not assessed

The option bin effectiveness scores have helped to define a pathway for each catchment over the next 30 years. During detailed option testing, options which rank highly were tested first, and subsequent options were built upon those until the objective was achieved.

These catchment level strategies are also used to define the company strategy. Option bin tests have been carried out across 141 high priority catchments across the whole DCWW region and the option scores and rankings have been collated to define what the overall strategy for the region could look like. This is summarised in Figure 64.

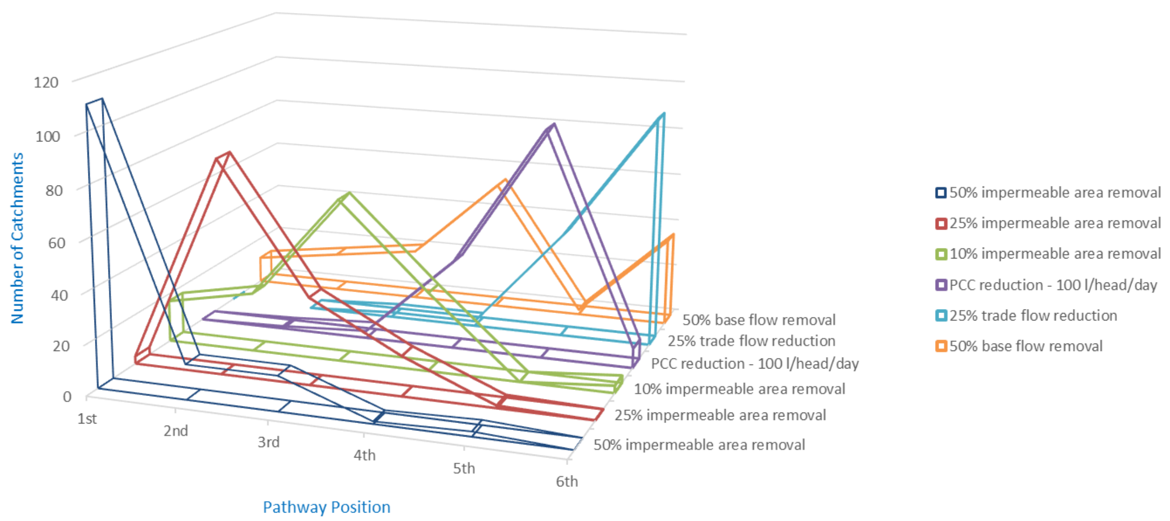


Figure 64 - Preferred pathway counts for specific options

5.2.4.2 Non-Modelled Network Assessments

A limitation to the above was the requirement for a suitable model to exist and be analysed within the timeframe available. To ascertain the benefits tested by the bin tests in all catchments, a non-modelled approach was developed. The non-modelled approach was used on all catchments, irrespective of whether the catchment had been included in the modelled analysis.

This analysis has included data from 835 WwTW catchments, of which 391 have MCERT flow to full treatment data available. The infiltration reduction estimate is based on the 391 catchments which have available MCERT data. The volume of infiltration calculated for each catchment with MCERT data was inferred to catchments without MCERT data, normalised by catchment population.

The MCERT data was analysed to determine the components of flow based on a series of available datasets including:

- Theoretical Load (Population Equivalent) - Ofwat Definition / June return;
- Theoretical Load (Population Equivalent) - Urban Waste Peak Month;
- Consent details;
- Annual measured billed Trade Effluent volume (m3/year) & Metered Commercial volume;
- DWF Permit headroom; and
- Catchment infiltration assessment.

The analysis presented in this study combined data recorded by the MCERT monitors at the WwTW inlets and theoretical demands on the network. It is therefore expected that there will be variations between this assessment and the full modelled assessments undertaken as part of the DWMP.

The data presented has been calculated for 2050 utilising rainfall inclusive of climate change. For the non-modelled analysis, a straight-line regression of the 2050 results or 2025 has been assessed.

The analysis considered the reduction in runoff built up from theoretical impermeable area values for each catchment taken from the 'all catchments area take-off' completed as part of the operating area wide programme of work. As the non-modelled approach applies a percentage reduction to the total area the volumetric reduction will always reflect the level of impermeable area removed.

The reduction in PCC was calculated based on the impact on the MCERT data rather than the impact on the flood volume, which was the analysis undertaken in the modelled catchments. The reduction in DWF because of PCC reduction should therefore be viewed as an increase in capacity which will likely result in a decrease in escape volume, however this was not assessed as part of the desktop exercise. The modelled approach assessed the impact on escapes and is therefore not directly comparable.

Table 53 shows the theoretical volumetric reduction, by applying each set of options. All results have been shown as per day volume, assuming one storm per day (a standard 1 in 1 year 60-minute design event volume was used).

Table 53 - Theoretical Volumetric Reductions for BIN Options

Epoch	Highway area disconn-ection (m3/day)	50% base flow removal (m3/day)	Commercial & paved area removal (m3/day)	Residential Area Removal (m3/day	PCC reduction target 100 l/head/day (m3/day)	Trade flow reduction target 25% (m3/day)
2030	109221	32482				
2035	218443	64963	87377			
2040	327664	974471	131066	655328	79660	21156
2045	436885	129927	174754	873771	106213	28208
2050	546107	162412	218443	1092213	132766	35260

Based on this information, a cumulative graph has been developed (Figure 65) which shows the best case overall volumetric reduction which could be achieved across the operating region by implementation of each option test. The AMP lead in time for each set of options has been shown on the graph. The below should be considered as a visual guide to the most effective option types at any given epoch up to 2050.

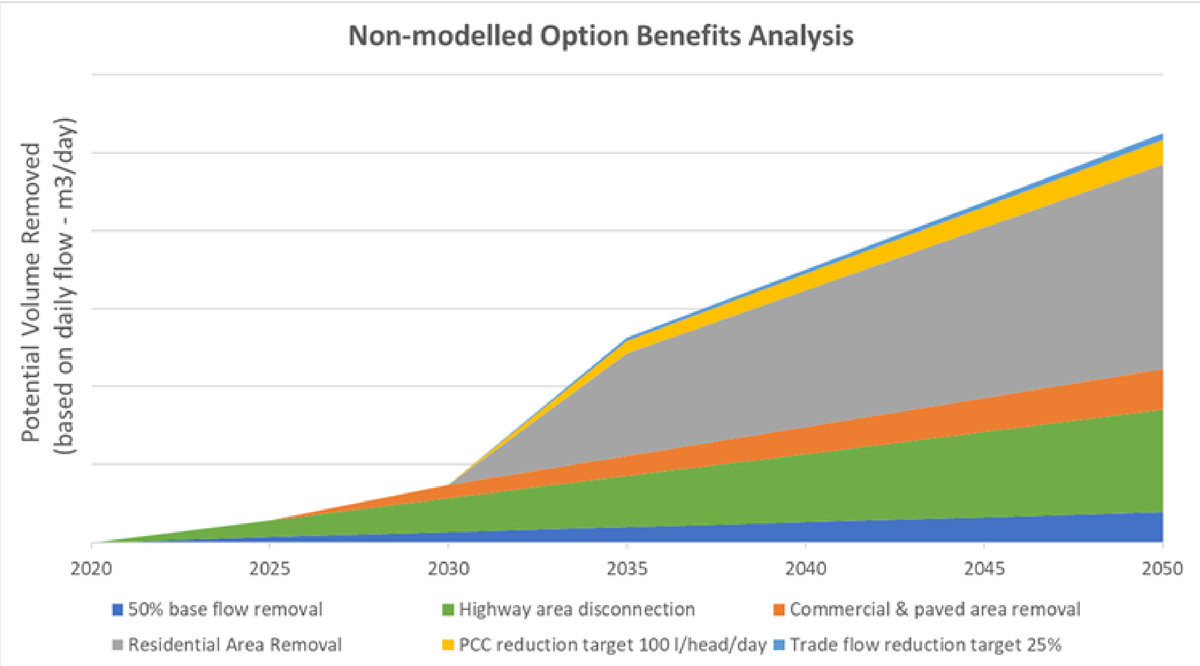


Figure 65 - Non-modelled Options Benefits Analysis

5.2.5 Strategic Planning Journey Plan

'Solve' is a key concept for the options development stage of the plan.

We have looked at the word 'Solve', and what this means in terms of both wastewater and drainage planning. We have concluded that 'Solve' means a policy direction from government, and we are aware that during the production of this plan 'Solve' is likely to mean something different by the final production stage, due to discussions, government consultations and investigations around storm overflows. We have incorporated scenarios of 'Solve' to investigate what the impact could be to this plan if that policy changed between the publication of the draft and final plan.

We have also found that there is a distinct difference in terms of 'Solve' and in the types of assessments required for each system type. These are linked to the idealised graph in Figure 66. The impacts from different storms play a greater part in managing these distinct types of systems.

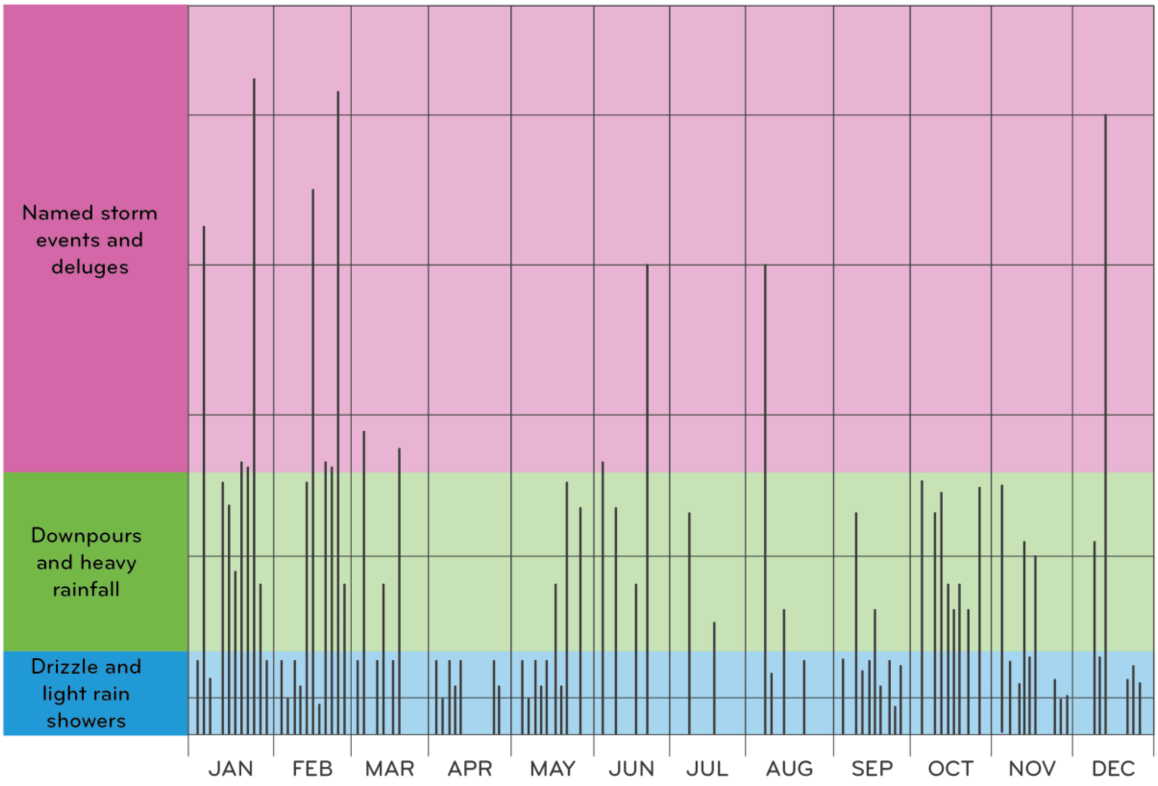


Figure 66 - Idealised graph of rainfall intensity and milestone zones of planning

It was important to learn what the word 'Solve' meant as options can be created to suit any variation. However, options need to be created which are also deliverable, feasible and do not cause environmental harm. 'Solve' is simply part of the process but there are other important areas to consider.

As such, we considered what the environmental and customer 'final destination' would be, before moving onto the option development and assessment phase:

We assumed that, for customers, 'solve' would be to not have any capacity driven flooding.

We assume that, for the environment, 'solve' would be to not have any spills.

This does though, still leave the question under 'Solve' for both customers and the environment, Under What circumstances should 'Solve' be achieved?

Options need to be created in a way that they can be delivered in reality, constructable, do not cause environmental harm, and be affordable to customers and solve the problem.

So, before we moved into the option development assessment phase, we considered what the environmental and customer final destination would be. We assumed that customers would request that solve for them was not to have any capacity driven flooding and that the right thing to do for the environment would be not to spill under defined storm conditions.

Subsequently the Better Rivers Taskforce added a milestone to the final destination for the environment which is not to spill where water quality would be adversely impacted.

After establishing the ‘final destination’, we next investigated whether we could afford to achieve this in the next 25 years. We estimated the cost to be somewhere between £18bn and £28bn. We found that this cost was not affordable, and that it would take not just decades, but a century, to achieve this at the current rate of investment.

Following on from that informative research, we began the company level options development assessment approach. We took the long list of solutions from the framework and considered a few more alongside.

We continued with the assessments in a handful of trial sites at first and confirmed that the answers grouped into actions to be undertaken at a strategic level. The Company DWMP strategy driven from the process is within the graph in Figure 67. The approach lists a hierarchy of actions.

- Starting with repairing and renewing pipes to manage infiltration, for example the water from groundwater that gets into sewers through cracks in the pipes;
- Prioritising communicating with customers to reduce blockages caused by fats oils and grease and non-flushable items like wet wipes, and supporting the message for water efficiency by educating customers on how to reduce run-off caused by paving over gardens and driveways;
- Then to support sewage planning - building bigger to manage future developments and population changes.
- This is where the difference between sewage planning, and drainage planning become pronounced. We need to change national policy to remove surface water from the sewer and find a more sustainable green and natural approach to integrated drainage management;
- Then and only then make plans to build bigger sewers that continue to have a dual purpose because we know that either of the two following points will be true in the future:
    - Surface water is removed from the sewer and the bigger capacity network built to contain it will no longer required at a point in the future and becomes redundant; or
    - In the future at some point, we will need to build a bigger sewer again and again to keep up with climate change because we didn’t start to remove surface water from the sewer in time to manage the impact from climate change.
- Prevent harm to the environment by preventing poor quality water from entering our rivers and beaches;
- Help suppliers divert rainwater away from sewers by helping them change surfaces that are not good at absorbing water and re-directing rainwater away from roads and driveways back into the environment;
- Communicate with homes and businesses to help reduce water use;
- Where possible, protect our assets during periods of extreme flooding, and ensuring our service can get back to normal as soon as possible;
- If we still cannot meet our goals with other options, consider storage of wastewater as a last option. There may be innovations in future which mean this may not be needed.

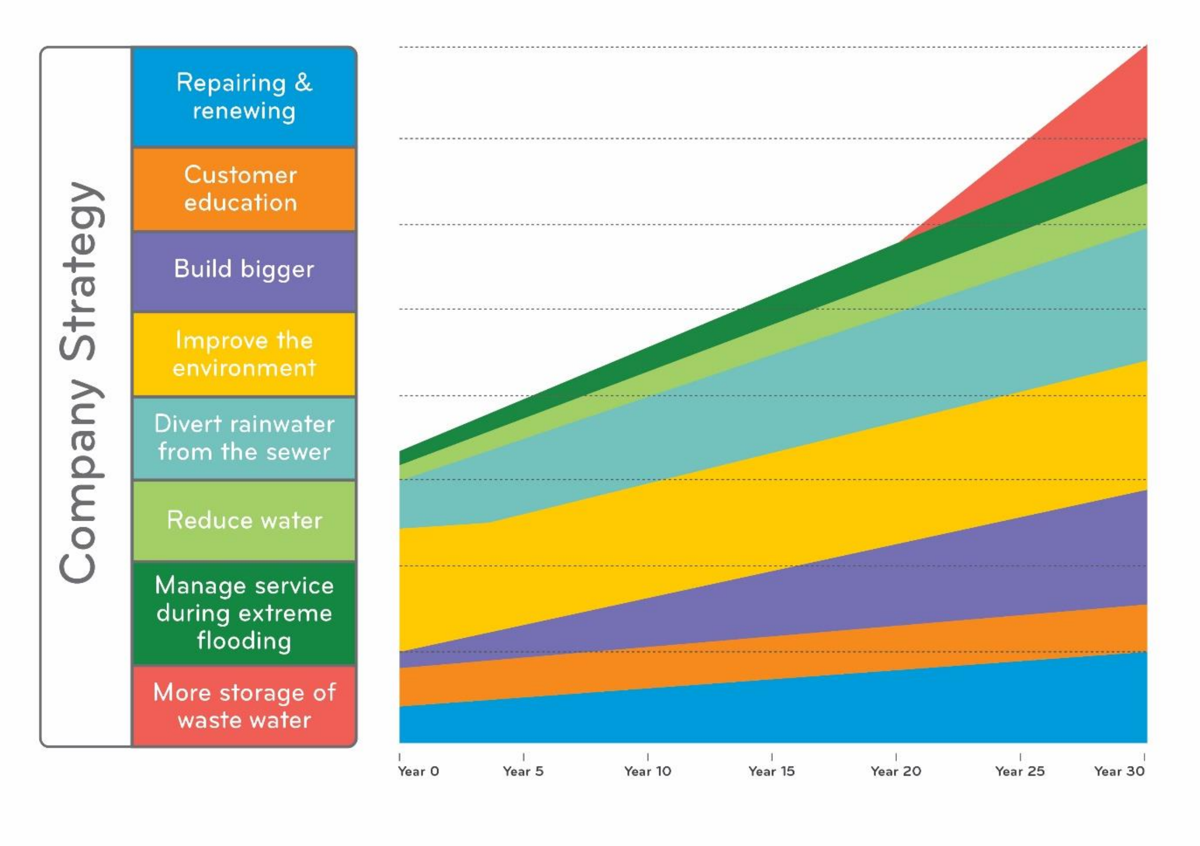


Figure 67 - Strategic Planning Journey Plan

Blockages and the relationship with the items being flushed down the loo
In general, a sewer is there to take away the 3 p's. Pee, Poo and Paper. Over time as our sewerage system developed, kitchens were added, and sewers were then considered as a bin from kitchen waste too. The pipework struggles to keep these non-flushable items moving in the pipes and they gather together and clog like a plug and stop the 3 p's flowing. Eventually a person has to physically remove the plug. This is what is happening today. A short list of non-flushable items are fat, oil, grease, wet wipes*, nappies. *Wet wipes even those marked as flushable still cause and contribute to blockages.

5.2.6 Localised Options

Having determined the broad pathway for the catchment it was necessary to develop options for specific, high priority risk areas containing either worst-served customers or overflows spilling to SACs. It was agreed that option development at the tactical level would be steered by the pathway but not constrained by it. Engineering judgement could be used to deviate from the overarching strategy; catchment knowledge could be used to identify a more feasible or beneficial approach in a specific zone. However, the catchment pathway guides the order of option testing.

Tactical option development was completed for all priority '1' catchments.

5.2.6.1 Definition of catchment risk zones

Options have been developed to resolve flooding at all worst served customer locations as well as eliminate any spills above 40 in a typical year at all overflows which discharge to SACs.

Risk zones have been defined around areas containing either a WSC or a CSO discharging to an SAC. These areas have been defined to comprise all issues that are likely a result of the same root cause or would benefit from the development of a single scheme. As such many of the risk zones contain flooding of a lesser severity or frequency.

5.2.6.2 Options for flooding worst served customers

Options have been developed to resolve model-predicted flooding from all nodes within a 50m radius of the WSC location, up to a 30-year return period, whilst ensuring no detriment is caused elsewhere. Where possible options that also resolve flooding in the vicinity of the WSC of a lesser severity have been pursued but these are not the primary driver of the option, so this has not been achieved everywhere. The initial aim of the option has been to resolve flooding in the 2030 ‘growth, creep and climate change’ scenario.

At least 2 options have been developed for each risk zone, a catchment strategy option or sustainable approach, which aligns with the overall catchment strategy as much as possible, and a second more traditional option, which relies primarily on hard engineering, for example, building detention tanks. Where the sustainable approach has not been sufficient to resolve the issue given the agreed delivery constraints (see 5.2.4.1 – ‘Modelled Network Assessments’) and zone-specific issues, a mixed approach has been developed which comprises elements of sustainable engineering and hard engineering. Building upon the options for 2030 growth, creep and climate change, options to resolve any future detriment have been developed for the 2050 growth, creep, and climate change scenario. Where possible these options are sustainable options which follow the strategy for the catchment. Otherwise, a traditional approach has been adopted. Where there is very little difference between the extent of the 2030 option and the 2050 option, modellers have offered a recommendation that the option be delivered as a single scheme rather than a phased scheme. For all schemes multiple phased delivery schedules options are progressed to facilitate optimisation on a catchment and regionwide basis.

SuDS Studio, a company wide data set generated prior to the DWMP delivery, showing potentially feasible SuDS solutions across Wales, was used to identify the potential opportunities for implementing a range of SuDS solutions to address flooding, so that sustainable options could be rapidly quantified (for example, hectares of swales that could be implemented), costed, and assessed in terms of benefits.

5.2.6.3 Options for spills to SACs

Options have been developed to eliminate discharges above 40 in a typical year from any CSOs which discharge to SACs, whilst ensuring that no detriment is caused elsewhere. Where CSOs already spill less frequently than 40 times per typical year, no option has been developed. Options have initially been developed for the 2030 growth, creep, and climate change scenario.

As with flooding, at least 2 options have been developed for each risk zone containing at least 1 CSO discharging to an SAC more than 40 times in a typical year, a catchment strategy option, and a traditional option. The development of these options follows the same conventions used in the development of the WSC tactical options. Options have been optimised as much as possible, such that they just bring CSOs in line with the performance target of 40 spills per annum in the 2030 horizon, bringing spill frequencies just below the threshold and not significantly further.

Building upon the options for 2030 growth, creep and climate change, options to resolve any future detriment have been developed for the 2050 growth, creep, and climate change scenario. In this context, future detriment is considered relevant if a CSO once again exceeds the 40-spill threshold. Where possible these options are sustainable options which follow the strategy for the catchment. Otherwise, a traditional approach has been adopted. Where there is very little difference between the extent of the 2030 option and the 2050 option, modellers have offered a recommendation that the option be delivered as a single scheme rather than a phased scheme. For all schemes multiple phased delivery schedules options are progressed to facilitate optimisation on a catchment and regionwide basis.

Where it was possible to get details of options that have previously been developed by DCWW, these were included in the option testing.

5.2.7 Maintenance

Maintenance of our assets is generally a ‘business as usual’ activity. Our goal for the DWMP is to identify where additional spending may be needed in future (enhancement of our current maintenance activities). Enhancement spend may be required to ensure hydraulic capacity is maintained to facilitate future pressures on headroom.

DCWW undertakes a range of projects to improve our maintenance planning, and the DWMP has sought to complement these rather than duplicate ongoing work. DCWW’s PR19 Investment Case for Wastewater Network Maintenance (DCWW, PR19 Investment Case: Wastewater Network Maintenance, 2018), for example, lists around 19 innovations to be trialled in AMP7 to reduce blockage/OC risk.

There are four ways that the DWMP has contributed to long-term asset maintenance planning projects in DCWW:

Our network resilience project generated an InfoAsset database including almost every pipe in our wastewater network. For every pipe, if invert levels, pipe sizes or ground levels were missing, we inferred the missing values. We also estimated dry weather flows and peak weather flows for every pipe in the database (example in Figure 68). The data generated through this project has subsequently fed into a deterioration modelling project, led by DCWW’s Asset Planning team, and delivered by ICS Consulting, to calculate likely blockage and collapse risk for every pipe.

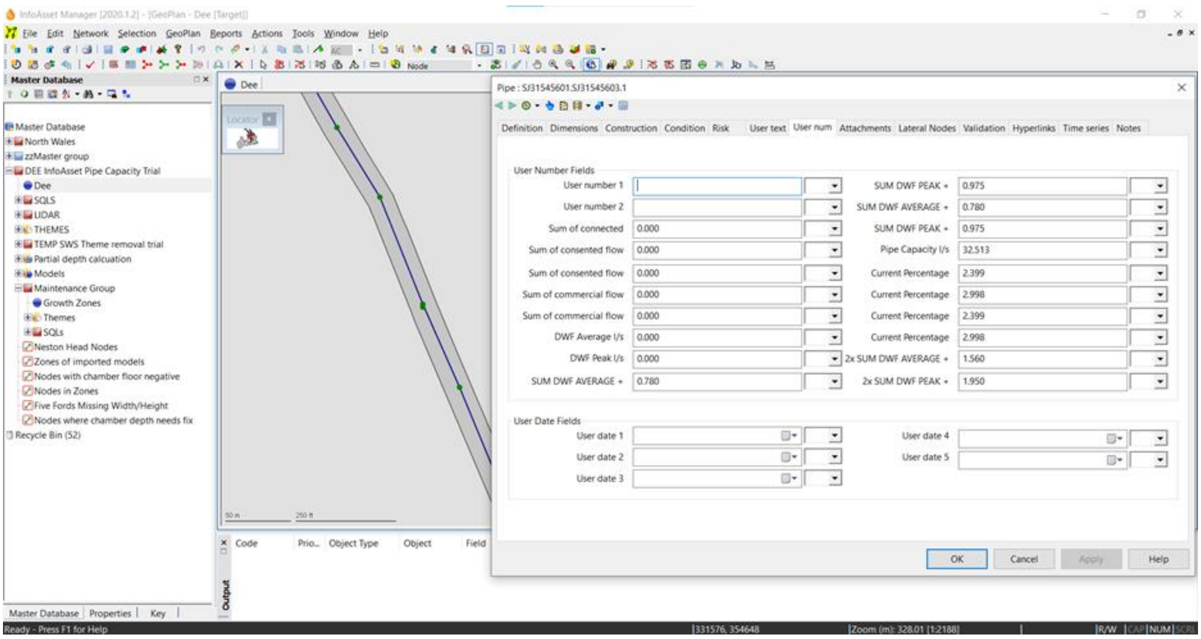


Figure 68 - Screenshot of the InfoAsset database created for the DWMP, which indicates likely dry weather flows (DWF) in every pipe.

The InfoAsset database furthermore indicates how much silt a pipe might be able to cope with before desilting is needed – see Figure 69. Since we know what proportion of a pipe is ‘full’ in dry weather flows (or three- or six-times dry weather flows), we can provide operators with an indication of how much silt might be acceptable in each pipe. This is a conceptual, potential approach at present, but data generated through the DWMP allows us to further develop this idea with asset managers.

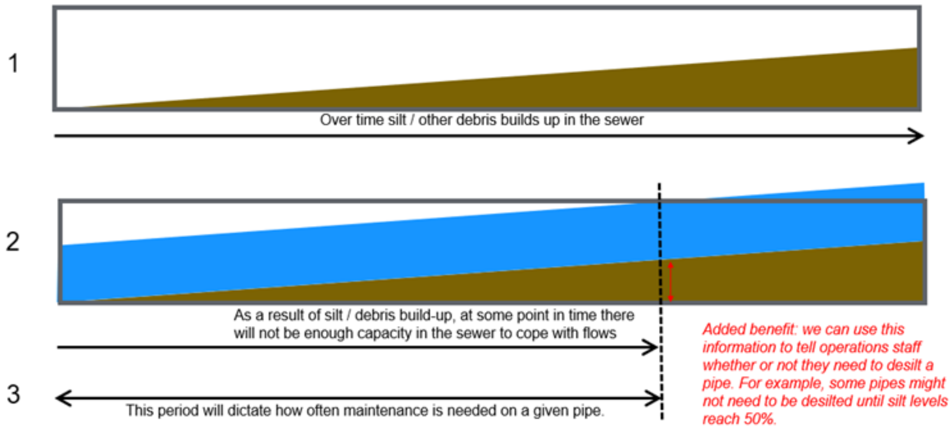


Figure 69 - Schematic indicating how much silt is acceptable in a pipe before desilting is required.

The pumping station capacity project has formed the basis of a consequence of failure study that has recently been commissioned by DCWW's Asset Planning team. This project will ultimately help us to understand importance of maintenance at each of the 2,000+ pumping stations in our network, and forms part of the ongoing DCWW/ICS deterioration modelling study.

Finally, the InfoAsset database created for the DWMP is being used to assess consequence of failure for critical assets in our wastewater network (those that cross major roads and railways).

5.2.7.1 DCWW operational strategies

Outside of the DWMP process we have a series of internal strategy documents which seek to translate our long-term corporate vision into meaningful plans of action. Whilst many of the measures contained within the strategies are shorter-term actions, we have sought to build on existing data and approaches used to support these strategies as part of the DWMP Plan Development stages. The following strategies have been considered in the development of the DWMP:

- Flooding;
- Pollution Reduction;
- Combined Storm Overflows;
- Final Effluent Compliance;
- Biodiversity; and
- RainScape (management of surface water in our sewer networks).

We intend the outcomes of this first cycle of the plan to inform the refinement of those operational strategies at the next opportunity for their revision.

5.2.8 Blockages, collapses and Water Efficiency Measures

The company has a baseline programme of customer engagement that provides company level and sometime more local level information programmes. The DWMP has recognised that more targeted or enhanced messages could be required in the future and work has been undertaken to assess the cost of additional more regular information packages. The water efficiency programme driven by the company from a water perspective has also been considered and where localised messaging is indicated in the journey plans talks will commence to bring greater opportunities to customers to take up the water efficiency products offered.

Water efficiency measures were reviewed, and it was decided that at this point the current base activities are sufficient. Water efficiency communications and solutions are available to all customers. No enhanced solutions have been put forward during this stage of development of the DWMP. We will collaborate with Water Resources West to manage water efficiency.

There are a number of activities that are carried out that do not relate to the capacity of the network but do have customer impacts. These are 'other cause' escapes, what this means is that the escape was not related to a hydraulic constraint in the network. We have mentioned blockages already as this is also classed as an 'other cause escape. Collapsed sewers are also an 'other cause' of flooding. We have looked at the deterioration of our network to see how fast our network is aging and whether there needs to be a substantial investment in pipe relaying. For this plan we know that investment is needed to repair when things go wrong. Our initial view of this suggests that we need a continuous fund which we would agree as part of our business plan. There is a relationship with Infiltration and collapses as once a section is weakened there is more likely that the ground around the pipe would be dislodged, and a future possible collapse could be the result. So, investment in infiltration reduction should also help the reduction of collapses going forward.

5.2.8.1 Assessing future capacity requirements of Pumps and Rising Mains

Pumps and rising mains are different to other assets as these are used to full capacity but only when they are being used. What this means is that a pump contains an element of storage and when that storage is full the pumps turn on and the rising main it is attached to is used for the length of time the pump is on. The assessment of the pump set up, storage and the size of the rising main then need to be assessed as one component.

In our assessment of these location, we have used Info asset manager to advise whether the assets are currently sized for the future flow arriving at the site. Where the future flow is outside of the efficient use of the pump. Our approach indicates where to carry out an investigation. A number of investigations will be carried out verify the risk being indicated. We will build in the ability to contain multiples of dry weather flow until the area is resilient to our customer desired level of service.

5.2.8.2 Educational programmes

Educational programmes are considered especially when customers need to understand the consequence of disposal of FOG. We have calculated these options using the following information.

The topics relevant to these informative sessions are:

- Reduction of water demand during the whole year and not only during a drought to support a reduction in the volume returned to the sewer.
- The impact of continual disposal of wet wipes, fats oils and grease through a sewer system that still continues to escape into our rivers and seas.

- Understanding the consequences of building over sewers on land owned by customers and businesses.
- Understanding ownerships of culverted watercourses and how to maintain them.
- Information to understand plumbing and misconnections and the consequences to the environment of those connections.

The cost of developing material cost for these sessions is low and can be classed as similar for each topic.

The cost of the delivery mechanism at the level to inform the audience is another suite of costs.

Costs are derived using a simple permutation approach.

The cost of the topic material	X	The delivery mechanism (TV, social media)	X	Population Reach

The programme of sessions to provide information is currently part of business-as-usual activities such as company level campaigns relating to stop the block. There is also benefit when combining messaging from other areas of the business such as water demand programmes and leakage programmes.

We have considered that at this time the benefit derived is not ready for use in this calculation and we will continue with our business as usual approach but merge our messaging into additional opportunities to make more efficient programmes.

5.2.9 Strategic Assessments

5.2.9.1 Sewer Overflows Discharge Reduction Plan

Welsh Water, DEFRA and Welsh Government are currently assessing the scale of the costs required to mitigate impact from sewer overflows, it is therefore important to note that our estimate is just one estimate being produced. Defra ran a project (The Storm Overflow Evidence Project) to inform their understanding, and Welsh Government are doing the same too and we are following a similar approach. The figures quoted below includes investment for both storm overflows and customer flooding service improvements.

We then set about building a policy information table, one that could support investment decisions by the business, but also to help Government to prioritise where to make improvements first.

The Table 54 below shows 3 of the 4 estimates we created. It shows the company level estimated investment needed over a century to reach the joint destination of customer flooding and storm overflow escapes. The cost is based on the assumption that there is a volume of water that is forecast into the future that cannot be contained by the current size of the sewer system. It assumes that either a traditional or green intervention could be required but, in every case, a traditional solution is possible and therefore the cost has been estimated on a traditional approach alone. The estimate includes all customer and highway flooding and any escape to the environment. The costs were created using a very simple approach. The volume of escapes was obtained from our modelled areas and similarly assumptions associated for our non-modelled areas. This provided a total volume predicted to escape. This was then multiplied by a cost to store that volume in tanks and pipes taken from our database of average costs per volume stored. These have also been estimated for each Level 2 area which can be found in the Level 2 summaries.

Table 54 - Cost of environmental and customer Destination

	Zero storm overflow spills and no sewage flooding in customers' homes due to lack of capacity	Remove environmental Harm from storm overflow and no sewage flooding in customers' homes due to lack of capacity	10 spills per year from storm overflows and no sewage flooding in customers' homes due to lack of capacity	40 spills per year from storm overflows and no sewage flooding in customers' homes due to a lack of capacity
Cost of Customer Service improvements	£5.508 Billion	£5.508 Billion	£5.508 Billion	£5.508 Billion
Cost of Drainage Service improvements	£8.477 Billion	£5.160 Billion	£3.206 Billion	£1.175 Billion
Total	£13.985 Billion	£10.668 Billion	£8.714Billion	£6.683 Billion

5.3 Methodology - Wastewater Treatment Works Assessment

As part of assessing resilience of our wastewater treatment works to future change, we have undertaken three types of assessments as part of the DWMP. The first is a high-level analysis of treatment works capacity for every WwTW and is covered in section 5.3.1– 'Supply/Demand balance'. The second is a more in-depth analysis of the capacity of individual treatment streams within a WwTW and is covered in section 5.3.1.3– 'Wastewater Treatment works capacity assessment tool'. Finally, we have started to examine the resilience of the receiving water environment; this is discussed in section 5.3.2 – 'Environmental Resilience'.

5.3.1 WwTW Supply/Demand balance

We have developed the 'supply-demand' balance approach to readily assess whether our wastewater treatment works have adequate capacity.

The supply-demand approach assumes that the consented flow at the treatment works is equal to its capacity. By comparing the consented flow with estimated flows arriving at each treatment works from now until 2050, we have identified potential issues with treatment works capacity that require further investigation. This also helps us to identify areas where flow reductions could improve treatment works performance – reducing infiltration, reducing storm flows, reducing *per capita* consumption, or reducing trade flows.

Each wastewater treatment works generally has two consents – one for dry weather conditions, and one for wet weather (storm) conditions in a typical year. Therefore, two supply-demand assessments have been undertaken.

The methodology presented below summarises the individual catchment methodology. An equivalent assessment has also been compiled for the larger-scale Tactical Planning Units and Strategic Planning Units (L3 and L2). Each L3 or L2 supply demand assessment is comprised of the sum of the catchment assessments, therefore, the methodology for these largely follows the one below.

5.3.1.1 Dry Weather Flow Assessment

The dry weather flow consent is the volume that a treatment works is required to pass forward on a dry day.

To understand whether a treatment works might fail its dry weather consent, the dry weather flow inputs (demand) were therefore compared against the consent (supply). The inputs can broadly be summarised as residential foul flow, trade flow, and infiltration. DCWW Supply Demand Balance Technical Note describes how these parameters have been calculated now and in future as part of the supply-demand process.

5.3.1.2 Wet Weather

Assessing the risk to a treatment works during dry weather is only one part of the supply and demand assessment. In Wales, there are on average 173 rainy days per year (MetOffice, UK Climate Averages, 2022) and therefore, an assessment of how a treatment works responds to rainfall is key to understanding current and future risk.

A treatment work's ability to cope with rain and the resulting run-off is related to its maximum capacity. The designed maximum capacity (flow to full treatment, FFT) of treatment works varies from site to site, but at treatment works with a storm tank, current government guidelines (EA, 2018) suggest that FFT should be calculated through the following equation: $3PG+I_{max}+3E$, where PG = foul flow, I_{max} is maximum ground infiltration on a dry day when the preceding day was also dry, and E is trade flow. This type of consent is sometimes known as '3DWF'. Flow to full treatment allows a treatment works to deal with some rainfall, but more extreme events will cause the sewers to convey flow more than the treatment work capacity, at which point they will spill to the environment.

A hydraulic model is often considered to be the gold standard in understanding how a catchment will react to rainfall. However, building and calibrating a hydraulic model is a considerable undertaking, so a more time-efficient and repeatable process was required to assess a catchment's response to rainfall. Therefore, the rainfall supply-demand assessment we developed for the DWMP does not use a hydraulic model. Rainfall is taken from a 'typical year' which excludes rainfall events which might only occur once every few years. The impermeable area connected to the combined sewer network has been estimated based on the sewer and property ages and types. The foul flows reaching the treatment works are based on the most recent population, trade, and infiltration estimates.

Using these data and the FFT estimate, we can approximate the amount of rainfall that a treatment works would be able to treat before spilling, and the volume of flow arriving at the works when this capacity is exceeded gives us an indicative volume treated and untreated across a 'typical' year.

This approach has limitations. It does not consider storm tanks at the WwTW, or any storage in the network. This can impact the 'spill' volume significantly. Secondly, it assumes that any rainfall falling on the catchment instantaneously arrives at the treatment works when flows are attenuated in the network. However, this approach is considered a pragmatic method of assessing the risk to our wastewater assets and it will help us understand where we need to prioritise further investigation.

A sample of the wet weather supply-demand assessment is given below in Table 55 for an example catchment, showing that at present the catchment can treat 75% of flow arriving at the treatment works across the course of the year, whereas by 2040, the catchment would only be able to treat 70%.

Table 55 - Example supply-demand balance for a typical year

Catchment	Assessment Scenario	2020	2025	2030	2035	2040	2045	2050
Enghraifft	70 %							
	75 %							
	80 %							

5.3.1.3 Wastewater Treatment Works capacity assessment tool

The consents used for the supply-demand assessment are an indication of what a treatment works *should* be able to treat, but do not tell us how much each process unit can treat. A more detailed assessment of treatment works capacity has therefore been undertaken for priority 1 catchments, involving a comparison of the capacity of each part of the treatment stream with incoming flows to the works.

The capacity of a wastewater treatment works is defined in two parts: the amount of contaminant load they can process to the required standard and the amount of flow that can pass through the site without compromising process efficiency. There is no lower bound on treatment load, only an upper limit which is expressed as a population equivalent. Flow presents both an upper and lower constraint on treatment processes.

A Python-based tool has been developed to assess the contaminant load and flow capacity of our treatment works. A user guide explaining how to run the tool and the outputs has been produced. Data on WwTW process units is generally held by DCWW's process scientists, and they have been consulted to obtain data required for the treatment works capacity assessments.

5.3.2 WwTW Environmental Resilience

5.3.2.1 SAGIS forecast targeting Methodology

This study set out to explore how scenario modelling using the SAGIS modelling system could be used to help decide on the type(s) of future to be planning for. The study developed a methodology to identify catchments and wastewater infrastructure whose management may be sensitive to environmental changes over the longer term, along with analysis, reporting and data visualisation protocols. The study focused on phosphorus, ammonia, BOD, and nitrate.

SAGIS (Source Apportionment GIS) is most usefully conceptualised as a 'system' of interconnected tools and processes made up of mathematical models (such as SIMCAT), a GIS interface, data on discharge and water quality, river network and hydrology data, and data on chemical inputs to rivers and lakes from different sectors. SAGIS provides a source apportionment breakdown of in-river chemical concentrations arising from inputs from different contributing sectors. SAGIS is primarily used for modelling rivers and evolved from earlier modelling approaches that have been in use in the UK for several decades.

The study entailed using SAGIS to develop a virtual representation of river catchments in DCWW's operating area, see Figure 70, with modifications applied to reflect conditions as they might become within the DWMP planning horizon. Model parameters were modified to approximate the effect of changes to river flow (that might arise due to climate change), diffuse pollution (that might arise due to land use change), effluent discharge flow (that might arise due to population growth), and effluent quality (that might arise due to changes in asset performance).

The model parameters controlling these characteristics were modified in a variety of combinations to generate an ensemble of alternate water quality futures for all DCWW's operating region. Whereas the extent to which any individual future might occur is difficult to predict, the range of results were expected to provide an indication of the 'envelope' of probable conditions downstream of individual DCWW assets. The possible need for investment to improve discharge quality at individual DCWW assets could therefore be assessed on the extent to which the range of receiving water concentrations is found to exceed regulatory standards.

Results were generated for a range of scenarios, spanning optimistic (best case) and pessimistic (worst case) futures. These demonstrated that the proportion of treatment works where downstream concentrations exceed the EQS in the current (baseline) and future scenarios is greatest for phosphate. The implication is that phosphate is likely to drive the most significant level of investment in programmes of measures to improve water quality over the longer term. The differences between the proportion of treatment works where downstream concentrations exceed the EQS under the optimistic and pessimistic scenario variants was greatest for phosphate (followed by BOD, ammonia, and nitrate), indicating that the uncertainty around future conditions is of relatively greater significance for phosphate than the other determinants.

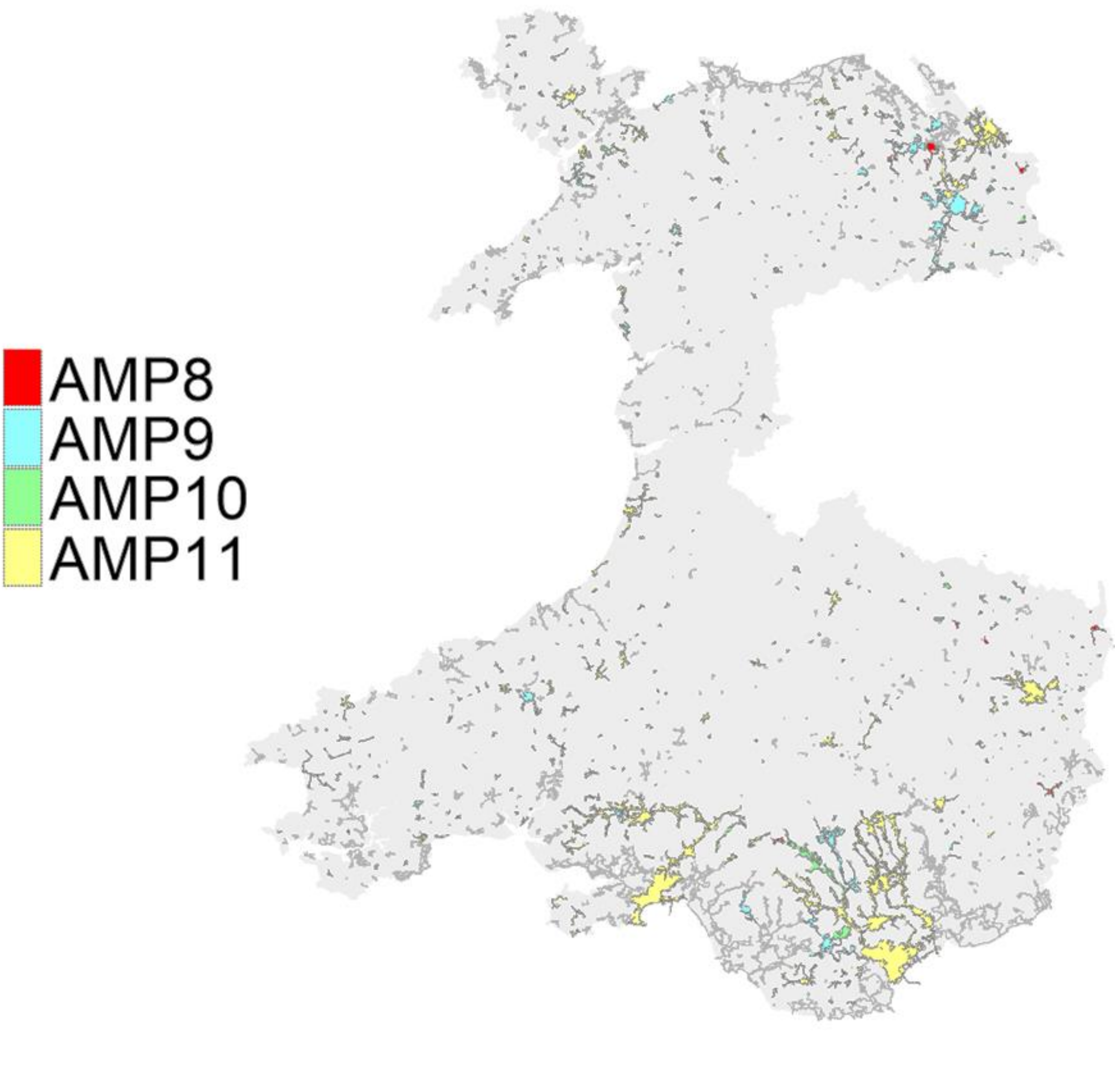


Figure 70 - Water Quality River Targeting Priority

5.3.2.2 Catchment level results summary

The results from the scenario modelling are provided as a series of Excel spreadsheet tools that include both high level and site-specific results. The summary data included in the spreadsheet tools were generated by statistical tools that extracted critical information from the numerous SAGIS scenario outputs.

Site-specific results are provided in four spreadsheet tools, one each for phosphate, ammonia, BOD, and nitrate. They provide summary information on water quality conditions upstream and downstream of all DCWW assets included in the SAGIS model. An example model output for phosphate at a L2 site is illustrated in Figure 71 below.

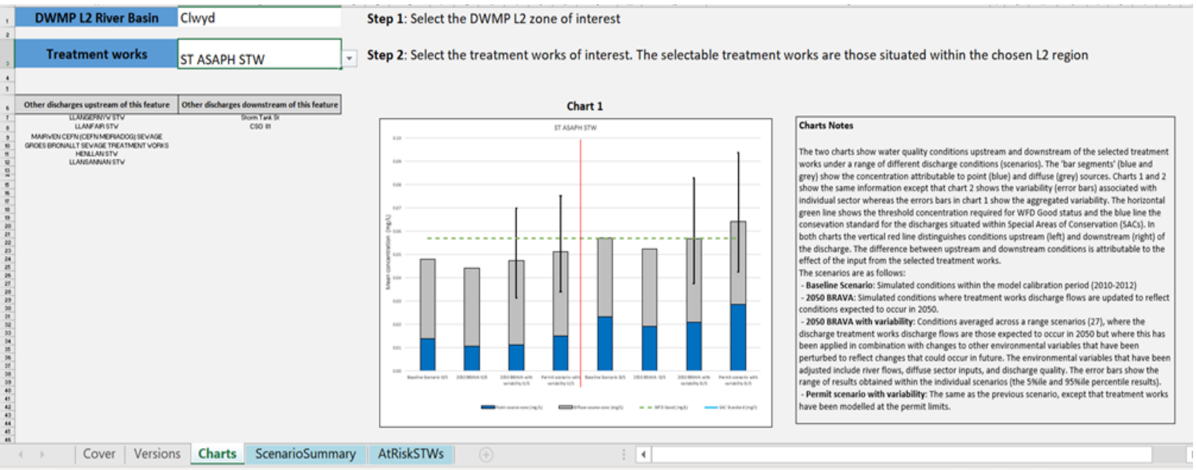


Figure 71 - Example of SAGIS model output for a specific point on a river in this case Clwyd L2 Level site for Phosphate

This tool allows us to look at a treatment works against the water framework directive limit or SAC river limit and analyse whether an intervention is required. Or if there could be a benefit to support nutrient trading.

The graph in Figure 71 shows that in this example at this point at the river The BRAVA future water quality at the discharge point could within a range of 35 to 60% but expected to be below the EQS limit. And for the permit future water quality could be within the range of 30-55% but this time expected to be greater than the EQS limit suggesting a need to investigate a solution.

The results for each DCWW asset are presented in bar chart form, with two 'sets' of four bars provided for each discharge. The 'sets' relate to upstream (left) and downstream (right) conditions. The height of the bar represents a mean concentration. The bar segments show the concentration apportionment (contribution from point and diffuse sources), and the horizontal line the water quality objective for the river on which each discharge is situated.

The difference between the 'sets' will be because of the effect of the input from the selected treatment works. The tool also lists discharges upstream and downstream of the selected feature. This enables users to track other upstream or downstream inputs. This is useful because a target exceedance downstream of any individual treatment works might be substantially attributable to other upstream discharges. The primary scenario results include:

Baseline Scenario: Simulated conditions within the model calibration period (2010-2012)

2050 BRAVA: As in the baseline scenario except that treatment works discharge flows are updated to reflect conditions expected to occur in 2050 (based on DCWW's BRAVA).

2050 BRAVA with variability: Conditions averaged across a range of scenarios (based on an ensemble of 27 individual scenarios), where the discharge treatment works discharge flows are those expected to occur in 2050 but where this has been applied in combination with changes to other environmental variables that could occur in future, with error bars showing the range of results (the 5 percentile and 95 percentile results), meaning the alternate futures.

Permit scenario with variability: The same as the previous scenario (also based on an ensemble of 27 scenarios), except that treatment works have been modelled at the permit limit (flow and quality).

The error bar range represents the uncertainty around future conditions ranging from a lower or 'optimistic' perspective on future conditions, to an upper 'pessimistic' perspective.

5.3.2.3 Strategic Summaries

The information for individual treatment works has been aggregated for phosphate, ammonia, BOD, and nitrate and presented in bar chart form, as per Figure 72 below, which shows an example for phosphate, for a range of modelled scenarios from baseline conditions to 'pessimistic' worst-case conditions.

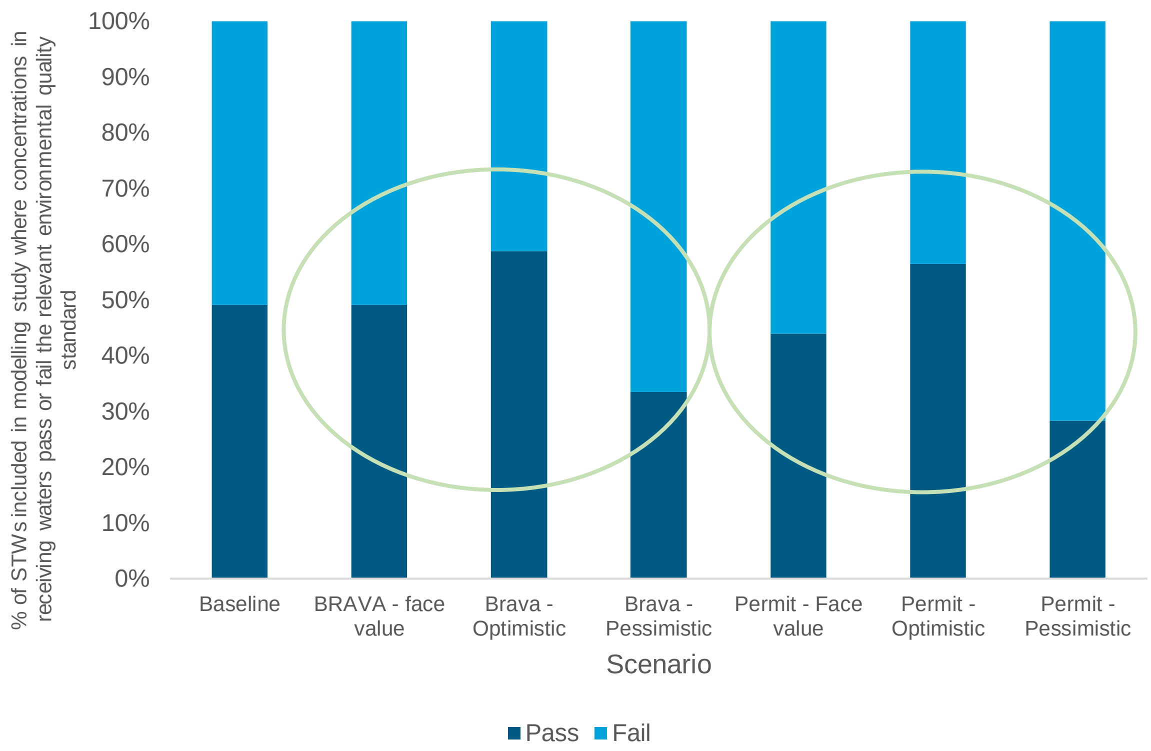


Figure 72 - Scenario results for phosphate for all DCWW treatment works included in SAGIS

These charts show, at a high level, the proportion of DCWW treatment works where downstream concentrations are likely to exceed ('fail') or not exceed ('pass') relevant environmental quality standards (EQS). This illustrates the proportion of treatment works that might potentially become eligible for some form of control on discharge quality. Site-specific summaries provide a tangible illustration of the implications of the changes that might occur in the future, that can usefully engage planners and stakeholders in the practical challenges associated with planning to mitigate longer term impacts.

In the figures, results for the 'pessimistic' scenario indicate the proportion of treatment works based on the theoretical worst case and vice versa for the 'optimistic' scenario results. Differences between the 'face value', 'optimistic' and 'pessimistic' scenario results (meaning the proportion of treatment works where downstream concentrations exceed the EQS) usefully illustrate the sensitivity of future investment to the uncertainty in future conditions. Differences between 'baseline' and other scenario results also illustrate the adequacy of current conditions as a basis for protecting the environment from changes that might occur in future.

Arguably the most useful perspective is provided by comparing the different permit variant scenario results (‘face value’, ‘optimistic’ and ‘pessimistic’) because the need for investment at individual sites is usually based on the impact on receiving water quality that could occur at the discharge permit limit. Overestimating the need for future investment might withhold resources that might usefully address other needs, whereas underestimating the need for investment could result in environmental harm. The methodology provides a basis for DCWW and its stakeholders to evaluate and quantify these risks before they materialise, and therefore an opportunity to agree a(the) future(s) that will form the basis for planning.

What this allows us to do is to start to investigate the locations within the river that have more than one nutrient driver, and which appear in both BRAVA and Permit scenarios as a prioritisation. We can then combine the NEP/WINEP for PR24 with the outcome from our future risk assessment of nutrients and consider where greater pressures could increase the risk of another solution.

Figure 73 and Figure 74 present results visualisation examples, that highlight regions where concentrations might exceed regulatory standards for multiple determinants. In the figures, the green points indicate where the concentrations are within target values for all the determinants, blue where there are exceedances for one determinant, yellow for two, orange for three, and red for four. The left-hand figure shows the baseline scenario whereas the right-hand figure shows the BRAVA face value scenario (treatment works discharging at the level expected to occur in 2050). The figures quickly highlight regions at most risk for multiple determinants. In these examples, the blue points predominate (other than the green points of course), indicating that the greatest length of river tends to be impacted by only a single determinant (typically phosphate). The differences between these scenarios are expected to be smaller than between other scenarios. The key point is, however, that the model outputs generated as part of the methodology can be deployed to communicate information to non-technical stakeholders.

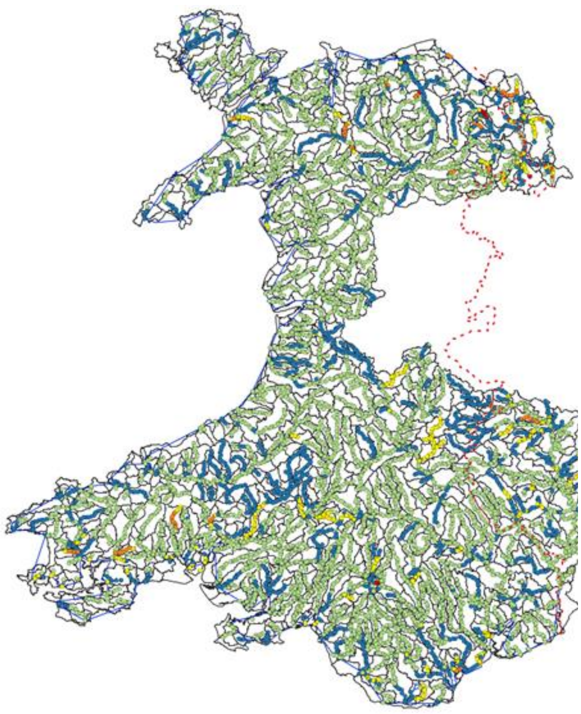


Figure 73 - Baseline Map showing locations where concentrations for multiple determinants exceed environmental quality standards (green = 0, blue = 1, yellow = 2, orange = 3, red = 4)

Figure 74 - BRAVA Map showing locations where concentrations for multiple determinants exceed environmental quality standards (green = 0, blue = 1, yellow = 2, orange = 3, red = 4)

The key conclusions and recommendations from the SAGIS study and the high-level summaries are:

The proportion of treatment works where downstream concentrations exceed the EQS is greatest for phosphate in the current (baseline) and future scenarios. The implication is that phosphate is likely to drive the most significant level of investment.

The results show that the ‘optimistic’ and ‘pessimistic’ futures entail significant differences in the number of WwTWs at which investment may be required. The differences are most extreme for phosphate (142), followed by BOD (56), ammonia (41) and nitrate (25). The values in brackets indicate the differences between the most optimistic and pessimistic futures in the number of WwTW where receiving water concentrations might exceed environmental quality standards. This does not, however, necessarily imply that the treatment works are themselves the cause of the exceedance.

The results show that in the ‘pessimistic’ future scenario, the number of WwTW at which investment may be required is substantially greater than in the baseline scenario. The differences are most extreme for phosphate (105), followed by ammonia (50), BOD (46) and nitrate (19). This illustrates that the uncertainty around future conditions is of relatively greater significance for phosphate than the other determinants, and therefore also a need to specifically account for the environmental changes that could occur within the DWMP planning horizon as plans based on current conditions are unlikely to offer adequate protection.

The results also highlight the importance of understanding the contributions from other sectors, such as agriculture, and developing approaches that allow all sectors to contribute to meeting and maintaining water quality in our rivers and streams.

The assessments may be repeated following business-as-usual updates and other improvements to SAGIS models and software. The implication is that DWMP planning could easily become an extension of the current shorter term planning processes.

The data visualisation tools developed provide a tangible illustration of the implications of the environmental changes that might occur within the DWMP planning horizon and can therefore support DCWW’s efforts to engage stakeholders in the process of defining the future(s) DCWW should be planning for. Further work to better refine the alternative futures undertaken in conjunction with DCWW planners, stakeholders, and customers could help shape a common vision for the future, with these criteria considered in future modelling.

The specific treatment works associated with each scenario are listed within the modelling spreadsheet. This may therefore be used as a basis to develop an investment program that spans multiple asset management planning (AMP) cycles, with consideration for how environmental conditions might change in future.

5.3.2.4 Factors that affect capacity

A new consideration that we need to include in the development of our plans and is gaining focus and understanding in 2022 is the possible trade of nutrients. It is possible that as a company we could deliver a high nutrient target and then sell that additional benefit to another organisation who is struggling to achieve their reduction plan. We can focus on ecosystem services and or focus on nutrient reduction plans more development is required in these areas and we will continue trialling into the next plan.

5.3.2.5 Payment for ecosystem services consideration

Wales faces many challenges, such as securing energy, adapting to climate change, and improving people's health and well-being. Meeting these challenges needs fresh ideas, and new ways of working. One example of a new way of working is an innovative approach called 'payments for ecosystem services' (PES). PES provides a framework of different ecosystem services (or environmental benefits) to be recognised, quantified, and 'traded' between those who can *provide* the benefit and those who *need* the benefit to offset their impact in the catchment. An example of an ecosystem service benefit that can be traded, is habitat creation. Where 1 organisation may have land available, capacity and skills to improve habitat for native wildlife, they can undertake a programme of work, and then 'sell' the benefit to others. Another example of a tradable benefit is nutrient reduction; a water company is well equipped to 'overengineer' the water quality improvement provided by a scheme, so that the benefit can be offered to a local landowner who maybe struggling to improve their water quality impacts. PES schemes involve a financing mechanism, a payment mechanism and an overarching governance structure. Broadly defined, PES systems are drivers and depend on the 'benefit' being traded. PES approaches require a registry that allows trades to be tracked and monitored to ensure governance and consistent standards. We will be developing our approach to PES as opportunities become known.

5.3.2.6 Nutrient Trading consideration

The over-enrichment of water bodies by high levels of nutrients, for example phosphorus, is an increasing threat to aquatic life and an ongoing water quality problem for most river catchments. Innovative solutions are needed to advance the pace of improvements from all sectors to reduce nutrients entering the river, particularly for some sectors whose 'diffuse' pollution is difficult to reduce, to monitor and to regulate. One innovative solution is 'nutrient trading'. Nutrient Trading involves setting a target reduction of nutrients entering the watercourse and allows organisations to buy nutrient reduction 'credits' from another organisation who are overperforming, to meet the local and regional water quality goals.

To facilitate the establishment of these markets, we aim to work with partners to develop an on-line marketplace. This 'nutrient trading marketplace' would allow for sectors to understand their nutrient loads and quantify the *value* of solutions, based on achievable nutrient reductions. Organisations can then 'buy and sell' these environmental benefits. Trading approaches require a registry that allows trades to be tracked and monitored to ensure governance and consistent standards. Nutrient trading is being explored and implemented as a viable mechanism to reduce nutrient pollution in various catchments across the UK and internationally.

We are working with other stakeholders along the river Wye currently to support our obligation under the National environment programme to improve the status of the river. An example of a solution being delivered is shown in Figure 75.

Figure 75 - An example of a nature-based solution being delivered on the River Wye

5.3.2.7 Amenity Value

The value of our natural environment has never been as high as it is currently. As a society one of the noted changes due to the impact of Covid 19 is the need to have time outside. It is also being noted by the health industry that time with nature has a positive effect on people's wellbeing. We were asked to include within our plan the Well-being of Future Generations (Wales) Act and we have included within our investigations how to incorporate a mechanism to prioritise areas with the greatest demand by the people. These considerations are included in our prioritisation of areas and is used within the option development phase.

5.3.2.8 Water Quality forecast

We have used the Source Apportionment Graphical Interface System (SAGIS) in a scenario planning approach to investigate how possible futures river quality could show us given several different variables. The aim was to achieve an envelope in which the future could either be drier or the future could be wetter. We added a number of different changing parameters into the assessment such as discharge permit conditions now, the volume of returned to sewer due to future growth and creep and changes to land use upstream such as moving from sheep farming to arable farming. We wanted to know what the future could be for 4 determinants. These were ammonia, nitrate, biological oxygen demand, and phosphate.

The tool provided more than expected and Figure 76 below shows the display at a WWTW discharge point and the forecast upstream and downstream components.

The tool allows us to:

- look up a treatment works against the Water framework directive limit or the SAC river limit and analyse whether an intervention is required.

or

- if a bigger intervention should be carried now or in the future or even if there would be sufficient nutrient benefit to support a nutrient trade.

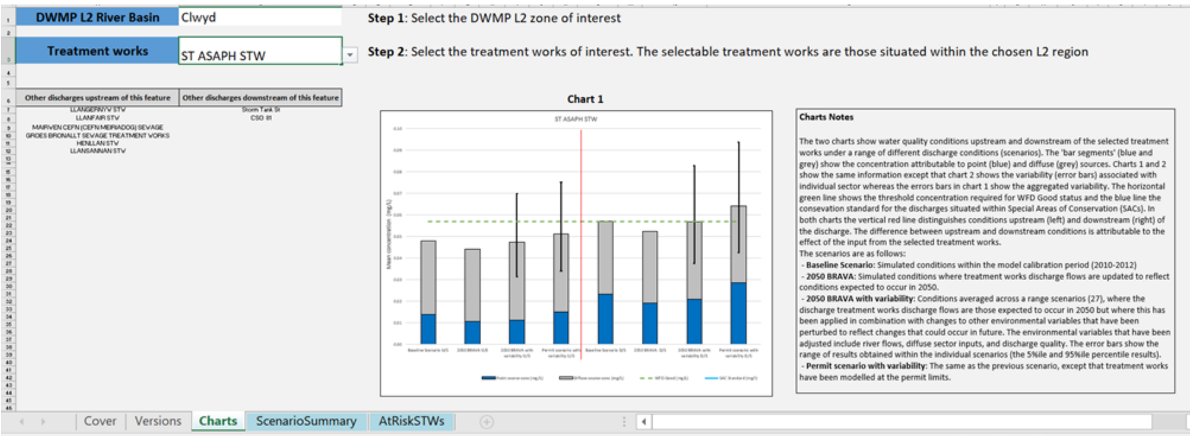


Figure 76 - Shows an example of one determinant using the SAGIS WWTW Water Quality tool

The graph in Figure 77 shows the percentage of WWTW that are affected by two scenarios the results from BRAVA suing growth and creep and the permit conditions at current use. There are also three alternative futures. These are 'face value', 'optimistic' and 'pessimistic' based on weather conditions. These are compared to the Ecological Quality Status (EQS) of the river. What can be seen in each of the green circles are:

For the BRAVA future Water Quality at the discharge point could be within a range of 35-60%.

For the Permit future Water Quality at the discharge point could be within a range of 30-55%.

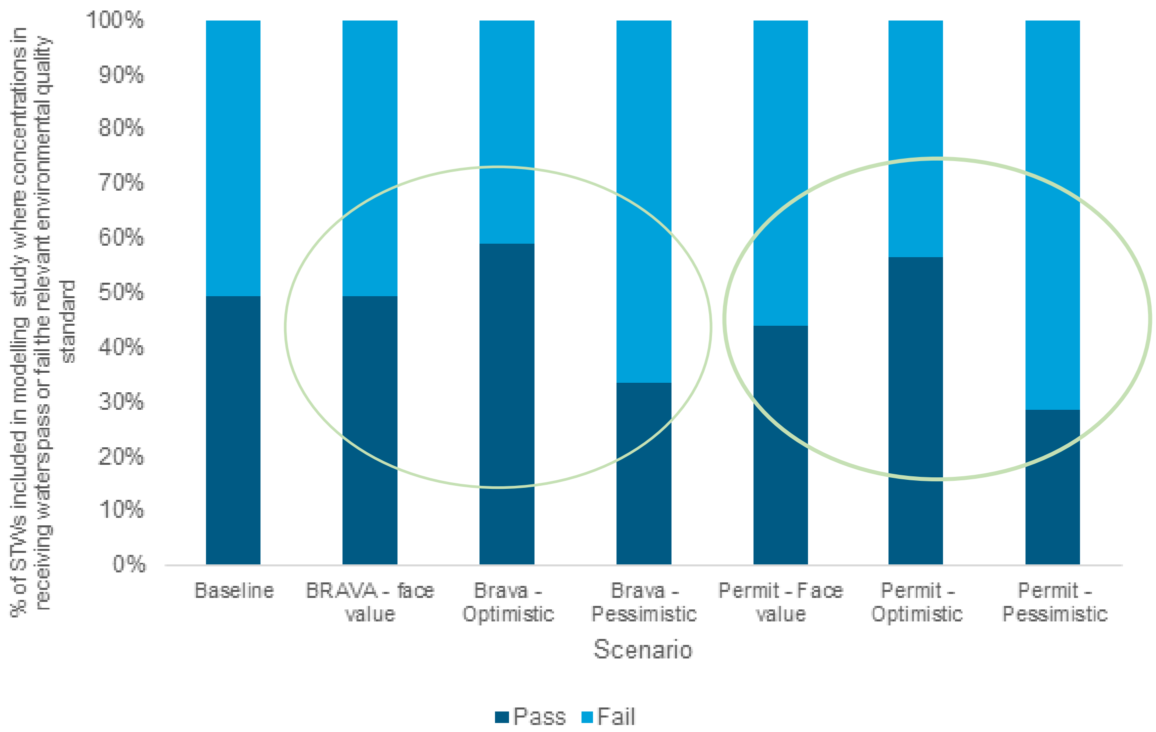


Figure 77 - Showing the percentage of WWTW likely to pass or fail the EQS in the future compared to the current baseline.

What this allows us to do with these results is to start to investigate the locations within a river that have more than one driver and which appear in both BRAVA and permit scenarios as a prioritisation.

The majority of areas in Wales do not fail EQS in the future scenario but there could be pockets of areas where there either 1, 2 ,3 or 4 determinants higher than the EQS limit. This look at the possible future will allow us to cross reference the areas in our National Environmental Programme (WINEP and NEP) for this cycle and ensure that we take the future conditions into account if we have to deliver a solution in Figure 78 below.

<table>
<tr><td></td><td></td></tr>
<tr><td>Baseline Map showing locations where concentrations for multiple determinants exceed environmental quality standards</td><td>BRAVA Map showing locations where concentrations for multiple determinants exceed environmental quality standards</td></tr>
<tr><td colspan="2">(green = 0, blue = 1, yellow = 2, orange = 3, red = 4)</td></tr>
</table>

Figure 78 - SAGIS output of Wales showing areas and the number of determinants that could fail EQS using the scenario approach.

5.3.2.9 Sea Level Rise

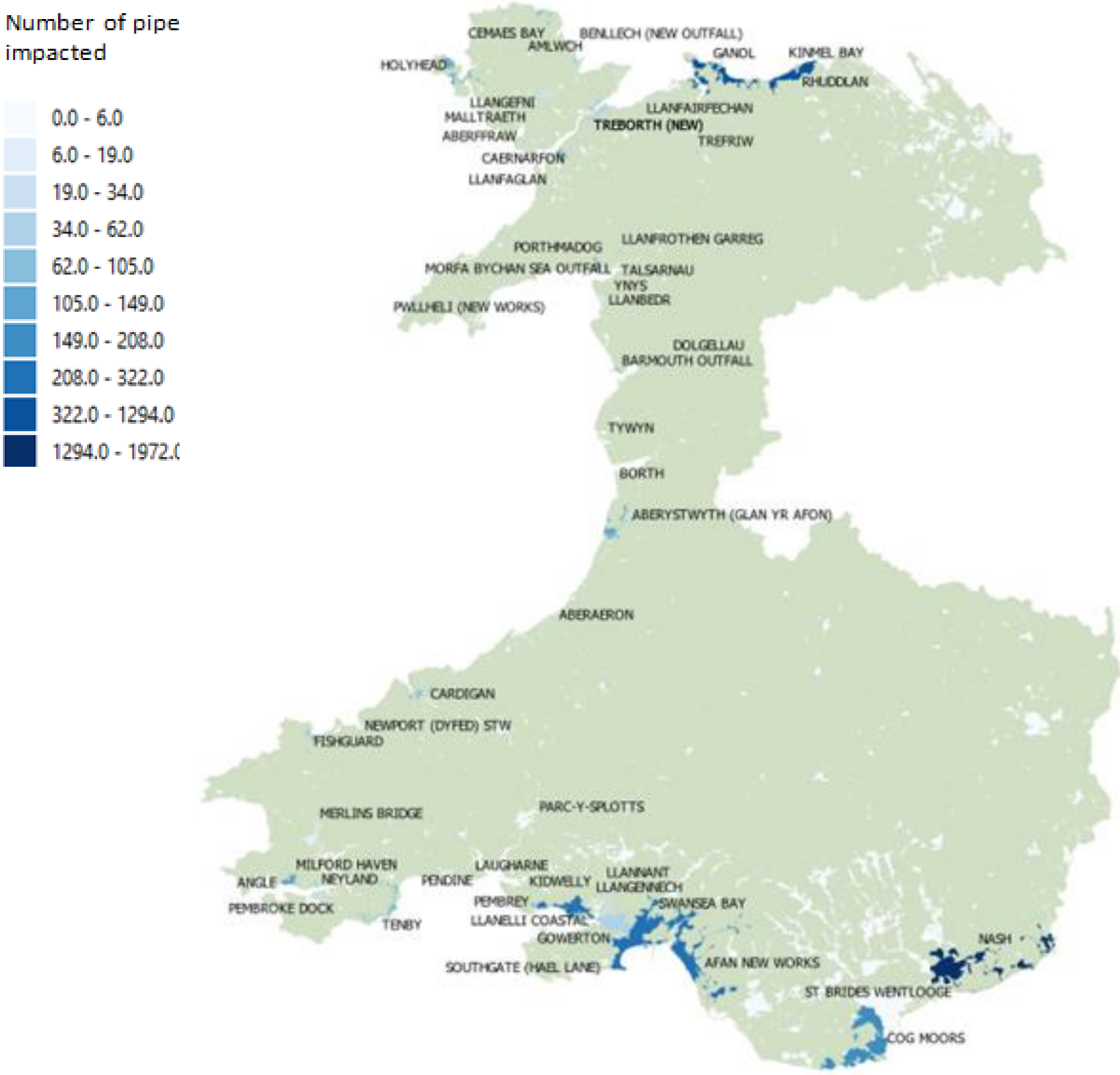


Figure 79 - Sea Level rise future risk

The map in Figure 79 shows the areas with more than 20 pipes or chambers that are impacted by a sea level rise scenario of 1.25m. The darker shading reflects more pipes being affected by the assessment and highlight the areas that are most vulnerable to the impacts of sea level rises. These areas highlight the need for sea defences plus consideration how these areas would drain in the future if the current assets were submerged for long periods of time.

5.4 Opportunities to develop National Programmes

It is noted that rain has a great impact on us as a society from how it falls (intensity), where it falls (for example, the hills), and when it falls (frequency). We all recognise from articles in the news that it’s the extreme events gain the greatest notoriety and then greatest focus when stakeholders comment. Focus needs to be maintained and solutions to each type of event combining intensity, frequency and location to ensure that rainfall is managed in the built environment as it would be done naturally by mother nature. To do this logically starting not from the extreme event which is managed by natural resource Wales through the flood and coastal erosion programme. We are supporting the need to fill in the gap between that programme and the sewage programme with a National Drainage Programme. This is because it is during the events that lead up to the out of bank episode that we as a society can manage the extreme event more easily and logically.

Our approach to this has been to consider programme of opportunities but we don't want to limit these opportunities to locations that overlap with sewer flooding which is the normal approach. We want to work together with others, such as risk management authorities, and those that own the land, so that we together consider the opportunity, priorities the opportunity into when the opportunity can be investigated, and we prioritised the outcome from that investigation into a supported programme of work for the benefit of the community.

The first two programmes for consideration are public spaces and schools, The majority of which will be maintained by local government, for example local councils. From our initial review there are 993 possible schools with an estimated 385 hectares of land that could see rainwater rerouted back to the environment. The estimated societal cost could be in the regional of £322 million if delivered as a specific scheme. However, if this work were coordinated along with other school development programmes the cost would be reduced. What the national drainage programme would need to do is work through the opportunities and prepare the case in readiness for the most efficient opportunity for its delivery.

These opportunities will need to be work collaboratively along with councils so that we understand the contribution to drainage better and that we understand how the rerouting will benefit the environment and the community and demonstrate the cost to deliver the project in isolation and in combination with a school improvement project. What this means is that we need to develop each opportunity into proposals in readiness to be put forward for funding. Similarly, the programme for public spaces show there to be 807 possible opportunities that could cover 219 hectares of land and if delivered in isolation could cost £178 million. Again, if coordinated the cost to society would be reduced. Again, each opportunity would need to be progresses and put forward for funding.

We are expecting our stakeholder strategy to support the ongoing opportunity development work and with the formalised process for so many opportunities encouraging the need for the national drainage programme, the impetus for government to support the planning phase to drive the change indicated by climate change and support for sustainable development and net-carbon futures.

5.5 Options development focus

The standard approach has been applied across the company for AMP8 investment. The DWMP has concentrated on two planning objectives: our worst-served customers, as well as internal sewer flooding and storm overflow escapes. This has provided focused investment needs and choices to the planning objectives in the extended and complex Level 4s.

We trialled the same approach for a small number of standard catchments and found the approach worked well. Our assessment approach trialled in Cardiff and the Valley's however, highlighted that the same approach did not work over a larger and more complex area. The size of the solutions in this area were so large in comparison to the other level 4 catchments, that the solutions were not affordable. This has driven us to rethink how we construct options in the future into smaller distinct risk zones, so that each risk can be addressed rather than amalgamating at a catchment scale.

Categorising areas for Options Assessment

Standard Options Approach – Our approach to the majority of areas has been to consider these for investigation and continue to develop our understanding in these areas in terms of capacity at a river catchment level using the area zonal journey plans from the Level 3 summary. Proactively prepare opportunities to reroute rainwater to nature where there are schools or publicly owned spaces such as carparks.

Extended and Complex Approach – Our approach has been to understand how much investment would be required to increase the resilience locally to stop customers being repeatedly flooded with sewage and to reduce storm overflows in that same area down to zero by 2050.

5.6 Improving our understanding to produce better solutions

One area that is not discussed in the framework is the development and delivery of a programme of investigations. The plan has been developed and the consultation questions with this continuous development approach in mind. Investment is required to make more certain the choice taken in the programme of work. In many instances the delivery of the solutions is going to be in a decade or two. For these areas it is wise to include a programme that continuously evidence the assumptions made when the solution was originally developed. There are a number of assumptions made during the planning process that isn't known and the investigation programme works through the assumptions clarifying those that become known and improving the assumption with more information as time goes by.

5.7 Outputs - The Programme

5.7.1 The Reference level programme

Our plan considers two destinations within our strategic level assessment these are how to reach a variation of spill numbers and how to remove internal sewer flooding caused by hydraulic overload. Subsequently we have assumed that to meet a milestone of zero environmental harm caused by the operation of a storm overflow would without further analyse need to be a subset of once of the spill reference level. This is because harm is linked to the river environment, such as the volume of the river compared to the volume in the discharge, which is the dilution capability of a watercourse. We know that only some of our discharge permits interact with small water courses in designated river systems. We can conclude that not all storm overflows would meet these criteria and have until this work has concluded used the 20 spill reference level to equal this milestone. We believe this to be an overestimate but can be used in the meantime until further analysis is delivered.

This analysis has provided the business with strategic and tactical costs to make decisions as part of the better rivers task force and the business plan. Our customers would prefer a programme to be prepared that delivers both storm overflows and internal sewer flooding but allowing internal sewer flooding to be achieved earlier as customers thought that was a higher priority.

The costs to achieve differing levels of spills and customer flooding reduction is in

Table 56.

Table 56 - Costs to achieve differing levels of spills and customer flooding reduction.

		2030	2050
Storm Overflow	**Environmental Harm**	£5.160bn	£5.160bn
	40 Spills	£1.125bn	£1.175bn
	10 Spills	£2.944bn	£3.206bn
	0 Spills	£8.286bn	£8.477bn
Customer Flooding	**0 escapes hydraulically**	£2.814bn	£5.508bn

5.7.2 The extended and complex programme

Figure 80 below shows how the detailed assessment at a risk zone level to achieve the environment destination and customer destination translates into a decision tree. In our approach we have combined the individual changes required to achieve the destination in 2030- and 2050-time horizons into suites of solutions in a catchment. This is so that we can strategically conclude a tradition grey approach versus a more sustainable blue/green approach or mixed approach and how these would compare to prove the least cost programme, the most sustainable programme, and after comparison derive the best value preferred programme.

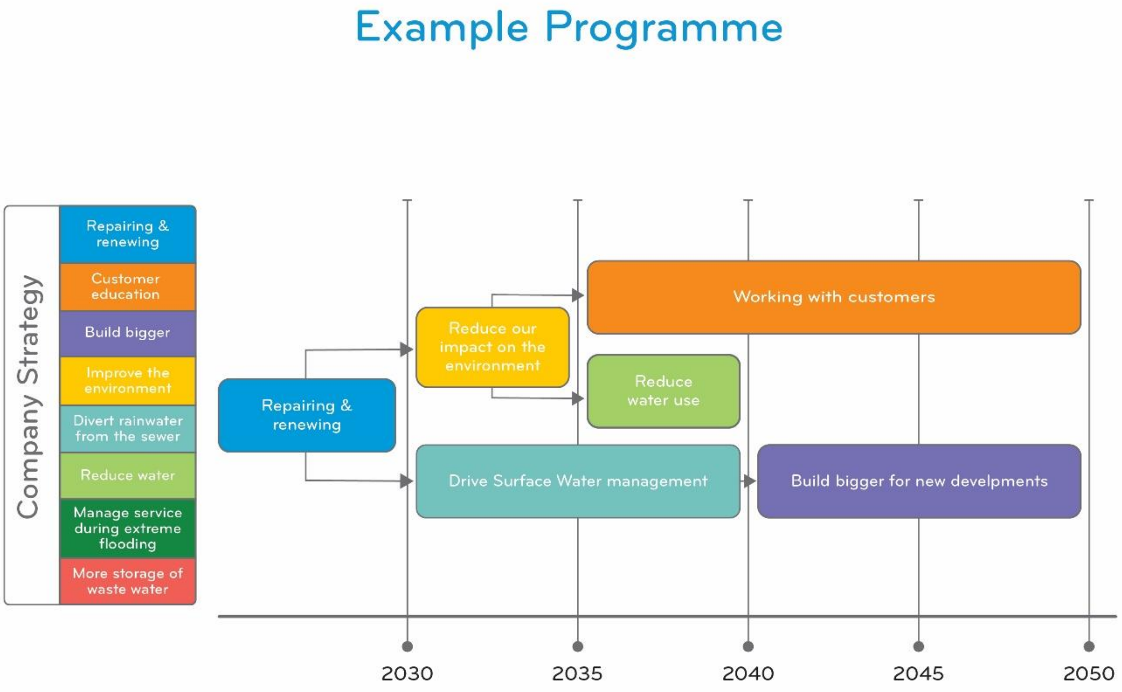


Figure 80 - Delivery Programme for the example catchment 1 of 5

To explain Figure 80 in more detail, the plan of action for his idealised location would be to start with making sure that the size of the assets are the correct size for the amount returned to the sewer. This could include increasing the size of sections of pipework or lining sections that have water leaking into them. This work would need to be carried out before 2030 so that the next actions could be carried out. The top line follows an environmental and customer education improvement approach which would gain the same results as the bottom approach of surface water separation and building bigger pipework to meet future growth. Both are looking at the capacity of the systems and until further information is known both future scenarios are possible. With our customers direction the preferred choice would be to follow the top scenario of environmental improvements followed by PCC and customer education programmes.

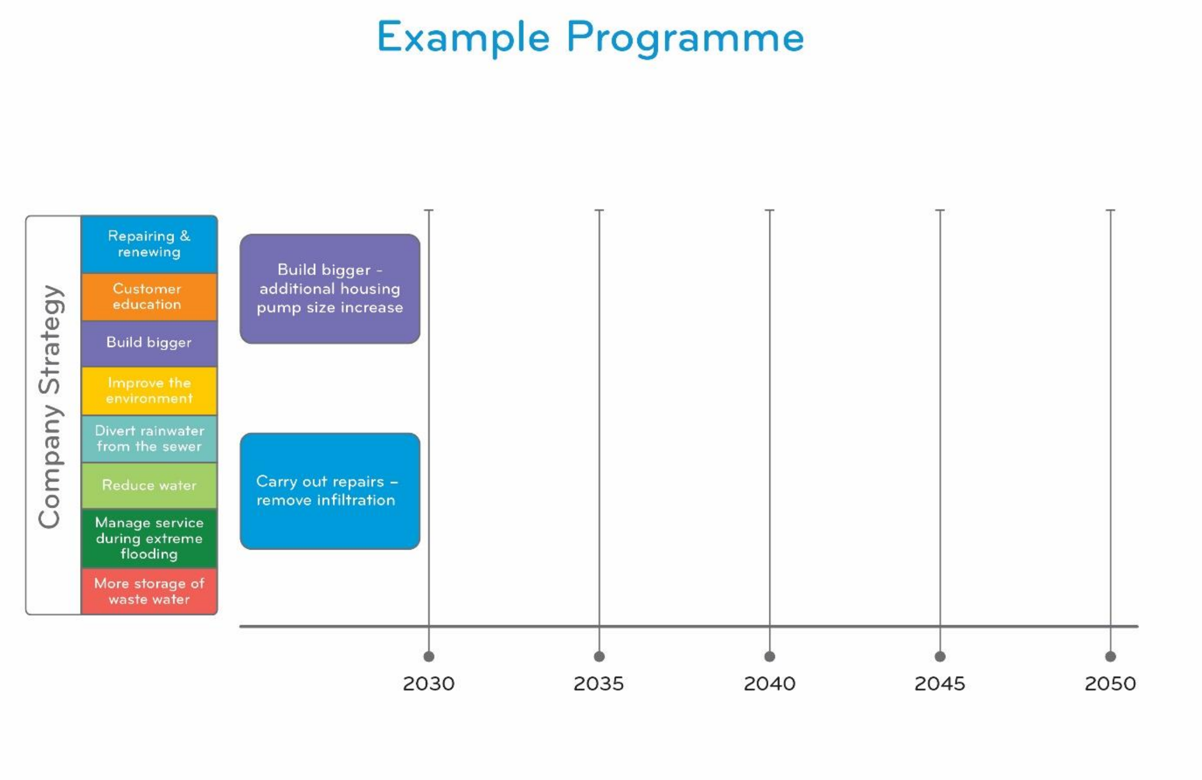


Figure 81 - Delivery Programme for the example catchment 5 of 5

A simpler action plan is shown in Figure 81. What this is demonstrating is that not all catchments will need to have ongoing detailed work, and some could just need one or two actions to sort out any need for the next 25 years. In this case during the first five years there is a choice of either carrying our repairs to remove infiltration, for example cracks that are allowing leaking water into the pipe so that new housing can connect to the areas but with the consequence that future resilience driven by a future infiltration solutions would no longer be possible or drive the increase to the pipes and assets that keep the same level of resilience. We would do this without also removing the infiltration. To do the right thing, both solutions should be put together to provide the capacity for the new development, but also the removal of the cracks to restore the system resilience that has been lost through the deterioration of the pipework overtime.

5.7.3 Opportunities to support future plans.

In addition to the tactical programme which passes forward to options appraisal, there are other elements that inform the business of strategic improvements.

There is a need to ensure that the minimum DWF pipe capacity is maintained going forward and the info asset work discussed earlier has highlighted that there could be as many as 9 km of pipes that will be under DWF capacity by 2050 and a further 51 km of pipes if that standard were to increase to Formula A due to the future impact from storm overflow policy. The cost to the company for both these changes would be £72 million however in reality the cost to carry out this work would be much higher as the delivery set up cost for the number of individual locations would more than double the estimated cost. This is because there would be project costs, highway planning, road closures, customer engagement costs etc for each location which has not been estimated here as the above is a simple cost multiplied by a single pipe size increase. It's this strategic look that will indicate where our tactical programme will investigate and develop solutions.

The National Drainage Programme is also in addition to those put forward to the programme appraisal stage. To summaries the two programmes would make up 1800 opportunities with an estimated societal cost of £502.4m. It will likely take several decades to work through these programmes.

6 Options Appraisal

6.1 Introduction

The Water UK Framework outlines the following key area for **Options Appraisal**:

An **appraisal** process to define **preferred options** based on **'best value'** and incorporating ecosystem services assessments / natural capital approaches.

A key principle in developing options is the need to work in collaboration with customers and stakeholders (including third parties) in their identification, co-creation, and assessment.

This section sets out the method utilised to demonstrate the options appraisal process and goes on to discuss the analysis of the examples calculated within the plan and makes recommendations for improvements in Cycle 2.

This section then explains how we have estimated the cost of the options described in the Options Development section. It also explains how we have quantified the benefit that each option is likely to have.

6.2 Options Costing

The basis for costing options for the DWMP has been the Unit Cost Database (UCD). The UCD holds the historical costs associated with delivering projects in the current and previous investment programmes (AMP 4 through to and including AMP6). The UCD generates cost models using the industry standard 'Engineering Estimating System' package, the capture mechanism for historical costs and subsequent statistical cost analysis (utilising 'Engineering Statistical Services Limited' software).

There is an interface between a project's scope and the UCD that allows us to produce costs in our Solution Target Pricing Tool (STPT). This tool has all the current approved cost models held within UCD embedded within it, along with cost algorithms to determine the appropriate on-costs (indirect costs) associated with the scope. All cost models are updated annually at the beginning of the new financial year and inflated using the Construction Output Price Indices (COPI).

Projects are costed using a comprehensive scope list containing civil, mechanical, electrical and instrumentation and control elements (the direct costs). For those infrequent elements not held within the cost models, a manual user entry (subject to approval) can be entered into the STPT to allow for the direct cost of the activity. The indirect costs are allocated to the project automatically as a function of the model, based on the investment area and the items selected under the direct costs / embedded cost models.

The OPEX models have been produced in line with the CAPEX models and will calculate the change in OPEX costs that the scheme will deliver over its operating life. To determine the OPEX cost impact from the scope (direct elements), our SAP financial reports on historical OPEX costs are aligned to UCD CAPEX models to generate a Total Expenditure (TOTEX) cost from the processed scope detail.

The CAPEX cost models account for:

- All new, enhanced, replaced, refurbished, and decommissioned construction items;
- Site specifics;

- Construction management;
- Risk;
- Design; and
- On-costs.

In addition, carbon models have been developed that calculate the embodied carbon (in tonnes) that the project will produce. These models have also been produced in line with the CAPEX models.

To ensure consistency between consultants and DCWW staff working on options for the DWMP, we developed templates and guidance for all 81 of the generic sub-options that form part of our DWMP process.

6.3 Options Benefits

6.3.1 Volumetric Benefit

Scheme benefit is required to provide a comparative assessment of individual options and options for different risk locations to quantify the least cost and Average Incremental Cost (AIC) when delivering the optimisation to identify the scheme to progress forward. The cumulative net present value, including CAPEX, OPEX, Carbon, is divided by the benefit to arrive at the AIC.

The Water Resource Management Plan (WRMP) uses a benefit unit of Ml/d as this is a consistent unit that can be measured across all scheme types.

Assessment was made of the available methods of quantification of benefit for DWMP options: incidents or volume of escape reduced. It was determined that the assessment would be made based on the volume of sewerage escapes stopped by a scheme as this could be quantified across all flooding and storm overflow schemes.

There is greater complexity to the calculation of volumetric benefit for wastewater as there are several factors influencing how to quantify:

- Method of escape from the sewer network – whether the scheme is developed to address flooding or storm overflow discharge;
- Storm intensity – what return period the benefit is to be calculated for as this will vary the volume quantified, 1-in-1-year return period storms will discharge a smaller quantity of flow than a 1-in-30-year storm event; and
- Storm duration – volumetric discharge will vary based on the storm event duration assessed. A 60-minute flash storm may result in a different volume of discharge from some risk locations than a 480-minute duration event which will have a flatter prolonged profile.

To provide a method that would be comparable across both flooding and storm overflow schemes, as well as consistent across all schemes, it was determined to assess the volumetric benefit based on a 1-in-30-year 60-minute storm event, as current DCWW design specifications recommend schemes be designed to protect against a 1-in-30-year storm event for flooding.

It is noted that although the approach used for benefit quantification for Cycle One is usable for schemes that directly reduce sewerage discharge, there may be additional scheme types that address measures of service that do not directly reduce discharge, for instance WwTW schemes or collapse maintenance programmes for resilience. For those scheme types we expect to review the benefit quantification method in Cycle 2.

It is realised that the volumetric benefit for a storm overflow intervention over the course of a year would be much greater than the discharge from a 1-in-30-year event as spills would be reduced on all spill events across the year. There is currently no methodology to directly compare storm overflow typical year discharge to flooding design event discharge.

The volumetric benefit has been quantified for each individual option and identified for the design horizon the option has been developed for, either up to the 2030 horizon or the 2050 horizon. This has then been included in the calculations of the Net Present Value tool.

At present there is no discount rate applied to the volumetric benefit through the Net Present Value tool, however the benefit has been applied taking into account both the scheme life cycle and the return period of the events assessed against. As the volumetric benefit has been calculated for the 1-in-30-year storm the annual probability of the occurrence is 0.033, therefore the volumetric benefit has been multiplied by this factor for each year of the full implementation of the scheme.

To implement the volumetric benefit across the full life cycle of the scheme, there was a change based on when the scheme would become fully utilised, as the schemes were developed to address the drivers on either the 2030 or 2050 horizons. If the scheme were constructed before this date, it would not be fully utilised. The impact of creep, growth and climate change anticipated in 2030 for the intervention to address would not be realised if the scheme were constructed now.

To address this issue the application of volumetric benefit prior to the scheme, full utilisation has been applied for half of the horizon up to the full utilisation time point, referring to the 82, Figure 83 and Figure 84. For a scheme developed for 2030 the benefit has been applied from 2027.5 (2027 plus six months) onwards at full utilisation. Although this would not actually be the case, mathematically this could be seen as 50% of the total potential utilisation, increasing from the construction year to the full implementation horizon. The number of years of full utilisation will vary depending on the scheme development horizon and the phasing of the scheme. There are three scenarios that may occur:

- Scheme for full utilisation from 2030 (Parent);
- Scheme for full utilisation from 2050, but delivered in one phase (Cousin); and
- Scheme developed for 2050 but delivered in two phases, first to 2030 then for 2050 (Parent + Child).

A visualisation of the application of benefit in each of these three scenarios is represented below.

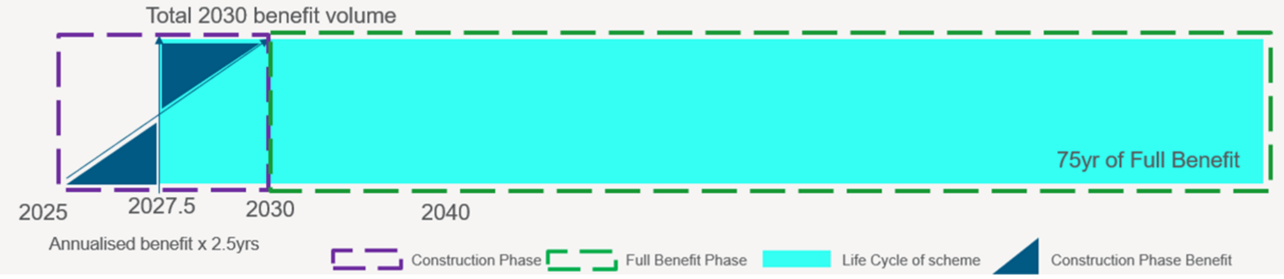


Figure 82 - Scheme for full utilisation from 2030 (Parent)

In the example of Figure 82, the scheme is designed to address flooding up to a 2030 horizon. The scheme would be constructed between 2025 and 2030 in a 5-year window (construction phase) therefore benefit is applied at mid-point 2.5 years (2027.5). The scheme's life cycle is 80 years, as the scheme gains full utilisation in 2030 there are therefore 75 years of full utilisation benefit. This approach follows for the ‘Cousin’ and ‘Parent and Child’ scheme benefits highlighted below.

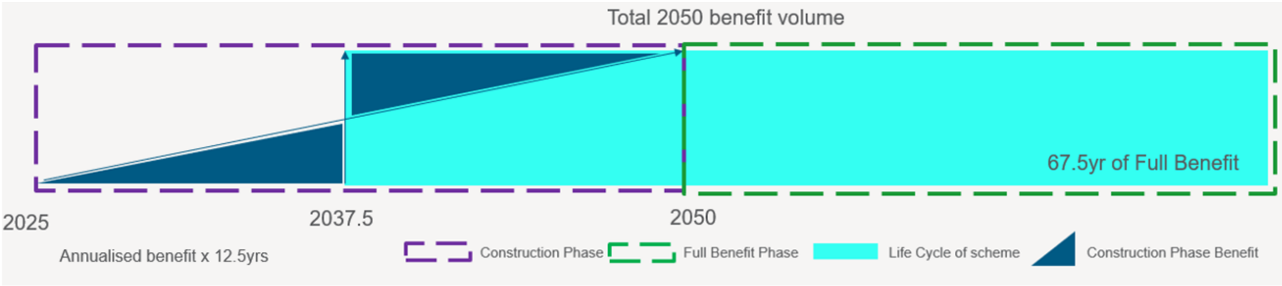


Figure 83 - Scheme for full utilisation from 2050, but delivered in one phase (Cousin)

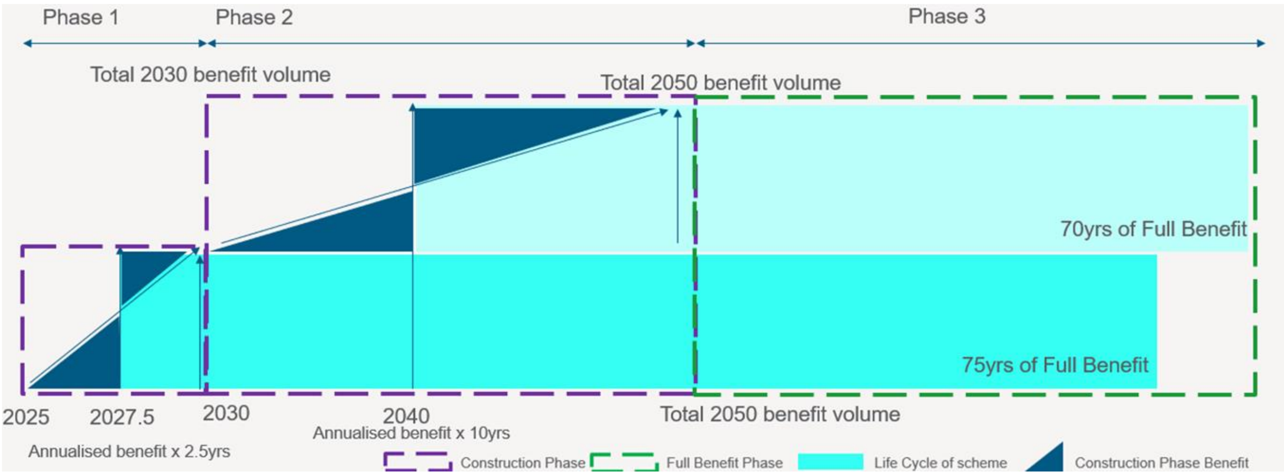


Figure 84 - Scheme developed for 2050 but delivered in 2 phases, first to 2030 then for 2050 (Parent + Child)

In addition to quantifying reductions in the volume of wastewater entering the water environment or causing flooding, we have estimated the wider benefits that solutions may deliver. Creation of new blue-green spaces may deliver increased amenity or reduce air pollution, for example.

6.3.2 Natural Capital Principles for the Water Industry

The Water Industry Forum (WIF) has developed a set of common Natural Capital Principles for the water industry to ensure consistency of approaches as good practice is still evolving.

Natural capital refers to the ‘stocks’ of the living and non-living aspects of ecosystems that provide flows of benefits, or ‘ecosystem services’, that have value for businesses and society. Examples of stocks include forests, fisheries, rivers, biodiversity, land, and minerals. Examples of the ecosystem services they provide include water purification, water flow regulation, carbon storage and sequestration, and opportunities for recreation and tourism.

Ecosystem services are classified in the following categories:

- *Bundled Services* (also known as ‘supporting services’): services which support the provision of other ecosystem services for example, pollination assisting food provision, soil formation improving flood management and nutrient cycling preventing leaching.

- *Cultural Services*: intangible benefits to society including amenity value, recreational space, education, religious attachments, tourism, art, outdoor sports, and the overall enjoyment of nature.
- *Regulating Services*: management of environmental systems preventing negative impacts like pollution, toxification, flooding, climate change and disease control.
- *Provisioning Services*: production of raw materials for example, food, fuel, medicine, construction materials, fertilizer and ornaments.

The water industry not only depends on these benefits (ecosystem services) to meet regulatory requirements and deliver a reliable and sustainable water supply to customers but can also generate a net gain in environmental quality. Through investments in nature-based solutions and catchment management initiatives, we can deliver multiple additional benefits. The value of the benefits nature provides is not recognised in traditional cost benefit accounting or fully recognised through formal regulatory targets for all companies. This means decision processes such as long-term water resource and drainage planning and options appraisals for catchment management interventions often underestimate the risks and opportunities that arise from the damage to, or protection of, our shared natural assets (Water Industry Forum, 2020).

6.3.3 Using the Principles

For Guidance Only - Recognised that not all are necessarily practicable, or even appropriate in terms of applying such an approach to all investment decisions. They are a best practice guide for companies and regulators to help design and apply 'natural capital' type tools - ultimately with the aim of making more sustainable investment decisions.

Need For Evidence - Assessment approach should be well-evidenced, highlighting the social, economic, and environmental wellbeing of communities as well as aligned with national policy. Such an approach can then be used to engage with customers and stakeholders, so that they understand and can support the broader value the industry's investment will provide.

Some Trade-Offs Required - It is accepted that any such systems based decision-making approach will result in some difficult trade-offs being required by the sector.

The principles are presented in Figure 85.

The principles

Facilitate balanced decisions that will meet the needs of the present without compromising the ability of future generations to meet their own needs.

Create benefits across a broad range of outcomes beyond individual targets, for environment and society.

Offer best value options for environment, and stakeholders.

Promote, engage, and enable the co design and production of solutions with communities, regulators and stakeholders through public participation and local engagement.

Protect and improve biodiversity including connectivity.

Prevent significant damage to ecosystems downstream or elsewhere.

Respect the 'polluter pays', 'producer responsibility', and 'control at source' principles enshrined in relevant legislation.

Enable the transparent sharing of information between stakeholders and joint management of risks and opportunities between different parties.

Support…

- Robustly with evidence the economic and social wellbeing of communities
- Greater resilience of ecosystems
- Nature-based solutions and a transition to low carbon society
- The circular economy - by reducing or recycling/reusing materials - and where not possible use materials from sustainable sources
- Broader sustainable solutions which take a systems approach, whether rural or urban, for example at catchment level

Be…

- Measurable and reportable against relevant regulatory frameworks, guidance and standards supporting natural capital approaches, not precluding trialling novel, modified or innovative applications of an NCA.
- Resilient and robust particularly in climate change terms, so taking into account the short, medium, and longer-term.
- Simple to understand and operate, be replicable, and engaging for stakeholders.
- Well-evidenced including that to understand any uncertainties and risks.

Figure 85 - The Principles

6.3.4 UKWIR - WRMP Best Value Framework

The UKWIR research project *'Deriving a best value Water Resources Management Plan'* (UKWIR, 2020) offers a framework and guidance to enable organisations to develop water resource plans which meets the requirements for 'best value' as defined by the governments WRMP guidance. The framework, although not specifically designed for wastewater planning, provides an equally valid and robust basis for demonstrating 'best value' in wastewater/drainage planning. The framework incorporates technical, economic, environmental, and legal perspectives, to ensure a 'best value plan' is developed with sufficient rigor to withstand potential scrutiny, while demonstrating compliance with statutory obligations, policy requirements and the expectations of regulators.

Five key principles of a best value WRMP are identified:

- A range of factors must be considered that offer an additional or superior level of benefit that exceeds the minimum requirements in order meet supply duty obligations.
- The plan must be presented so that it is clear how and where those factors have been considered.
- The plan must clearly state the objectives and explain how those objectives are met with robust justifications for decision-making.
- The plan must show that there was meaningful engagement with regulators, stakeholders, and customers and to what extent findings have influenced the plan; and
- The plan must be deliverable.

The framework recommends that plan development is based upon multi-criteria decision analysis (MCDA) to demonstrate 'best value'. As a widely adopted approach, MCDA can be used in either qualitative or quantitative ways depending on preference and availability of data. The MCDA process has been split by the framework into five steps that are consistent with the Water Resources Planning Guidelines:

- Problem structuring
- Define value criteria and constraints
- Determine performance and alternatives against criteria
- Determine scores and weights
- Evaluate and compare alternatives plans

The main recommendations of the framework are:

- That the framework be used in conjunction with the Water Resources Planning Guideline (WRPG) (EA/NRW/OWS, 2020) and the related regulator guidance;
- That stakeholders and customers be informed of the approaches used in the development of the best value plan;
- That new legislation, regulation, policy, or other significantly influential factors be included in future implementations of the best value WRMP; and
- That the industry continues to find innovative ways to develop future best value WRMPs and looks for more applications of MCDA approach in resource planning generally.

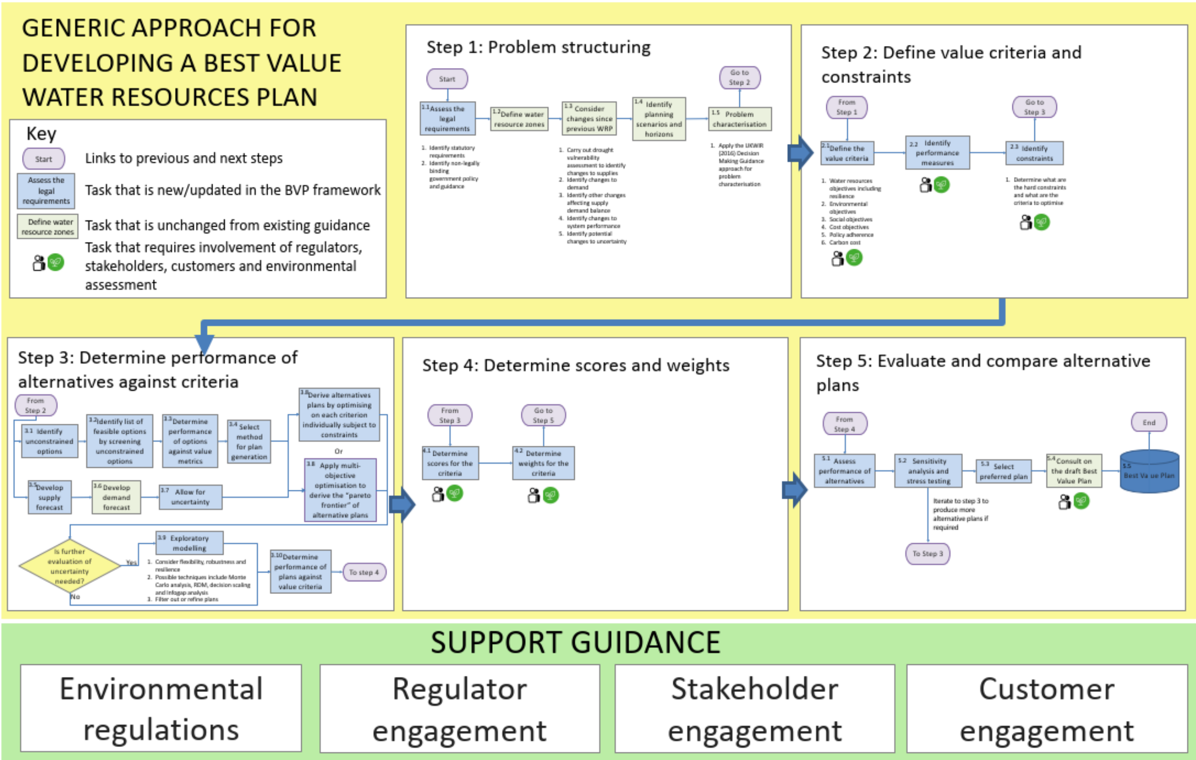


Figure 86 - Generic Approach for Developing a Best Value Plan

The framework's main goal is to allow organisations to create a best-value resource plan that is supported by consideration of technical, economic, environmental, and legal viewpoints. A generic approach is presented in Figure 86. It is applicable in England, Wales, Scotland, Northern Ireland, and the Republic of Ireland. The term ‘best value plan’ includes non-monetised influences such as the views of customers, users and other stakeholders and the effects on the environment, water resource resilience, and/or other factors over the long term. The definition of a best value plan, as applied in the context of the framework, aligns with the WRPG.

Under the framework a company needs to defend its actions and show that its resource plan is appropriate for its purpose and fulfils statutory standards. Adherence to the framework structure may assist in giving added credibility to any other arguments presented, rather than automatically proving ‘best value’.

DCWW recognise the value of the best value framework and have used it as part of developing our water resource management plan. The principles outlined in the framework have also been applied to the optioneering stage of the DWMP as a demonstration of best available practice through the following key steps:

- We have considered environmental and social costs (B£ST) to determine which of the localised options tested offers best value (AISC);
- We have considered any technical constraints, as part of option testing;
- We have considered our stakeholder comments relating to options, and our customer views have considered as part of the Willingness to support survey while building the long list of options; and
- We have considered multi-criteria optimisation and sensitivity testing and will work to develop our approach further in later plan cycles.

6.3.5 Best Value – Natural capital and ecosystem services

Natural capital accounting is one approach to incorporating the value of natural assets into decision making processes. It usually involves making physical accounts that describe and measure natural assets, quantifying the flow of benefits they generate over time, and where practicable monetary values of the assets are calculated. Natural capital approaches therefore support a more integrated approach to decision making by providing evidence and supporting the business case for both environmental protection and enhancement. Water companies who recognise the value of natural capital can make more cost-effective decisions to deliver net benefits for the natural environment, customers, and regulators (Water Industry Forum, 2020).

As part of the Water UK DWMP framework, natural capital and ecosystem services approaches are recommended as part of the options development and appraisal stage to help define preferred options based on 'best value'. Natural capital and ecosystem services are relevant within the context of the DWMP and the options to be developed because these options have the potential to enhance or degrade natural capital stocks: for example, SuDS options may include 'green' or 'blue' elements such as introducing vegetation and soils to previously impermeable surfaces, while purchase of land to extend or build new sewage treatment works could entail the loss of natural capital or replacement with other sources of natural capital, such as reedbeds. The DWMP options therefore have the potential to alter the flows of benefits nature provides and their value to people, and consideration of this value in decision making can help to identify 'best value' options alongside cost and other aspects of feasibility.

Although seeking to address different objectives, water resources planning is an established mechanism for strategic plan-making which offers useful parallels in terms of priorities, approaches, and metrics. For example, natural capital approaches are now required to inform investment modelling and development of a best value plan in both England and Wales. Section 9.4 of the Water Resources Planning Guidelines (EA/NRW/OWS, 2020) refers to 'Supplementary Guidance: Environment and Society in decision-making', which sets out 'minimum' and 'best practice' approaches to assessing for the following metrics as a minimum: biodiversity and habitat, climate regulation (carbon storage and sequestration), water regulation, natural hazard regulation and water purification (plus recreation and tourism in Wales).

Consideration of natural capital and ecosystem services would support alignment of the DWMP with WIF Principles, in particular: 2 "Create benefits across a broad range of outcomes […]" and 3 "Offer best value options […]"

6.3.6 Evaluating Natural Capital Accounting Tools

DCWW commissioned a 'Natural Capital Approach' study of a range of existing natural capital accounting tools (RPS, 2021) to determine their appropriateness for assessing the multiple benefits of DWMP 'options'. The DWMP options are classified into the following five option categories:

- Combined and foul sewer systems;
- Customer side management;
- Indirect measures (for example investigating and monitoring);
- Surface water management; and
- Wastewater treatment.

To various extents, many of these interventions have impacts on environmental, human/intellectual, and social capital, which are not currently captured in DCWW's option valuations. For example, a SuDS rain garden may improve local air quality, biodiversity, and amenity for society. It is therefore important for DCWW to understand the benefits associated with all DWMP interventions.

The initial scope of the Natural Capital accounting study was to evaluate currently available accounting tools. These tools have been developed to attempt to estimate the value of environmental stocks and flows in multiple contexts. For example, the general valuation of ecosystem services or more specialised tools for specific industries like the water industry. These tools have varying suitability in terms of ecosystem services focus, different accessibility, and level of previous use or accountability. It was therefore necessary to determine which tools are most appropriate for DCWW to use to evaluate the value of each DWMP option.

6.3.7 Methodology

The basis of our assessment is to understand which ecosystem services the defined DWMP options are most likely to affect and therefore the tools that are most appropriate to estimate their impact. To ensure this assessment is objective the UK government's guidance documentation: Enabling a Natural Capital Approach (ENCA) was used for Cycle 1 as a structure to define ecosystem services and select tools (Defra, Enabling a Natural Capital Approach, 2020).

The following Table 57 of 19 ENCA defined ecosystem services are used to evaluate both DWMP options and tool appropriateness.

Table 57 - ENCA defined ecosystem services

ENCA Service 'Group'	19 ENCA Ecosystem Services
Bundled/Supporting	Local Environmental Amenity, Biodiversity, Soil health, Water quality, Landscape
Cultural	Recreation/Tourism, Health, Educational, Volunteering
Regulating	Air Pollutant Removal, Carbon Reduction, Flood Regulation, Noise Reduction, Temperature Regulation
Provisioning	Food, Timber, Water Supply, Fish, Renewable Energy

It is recognised that there are a wide range of existing tools available to use. For this assessment, the tools have been restricted to those listed in the ENCA tool summaries and those that provide a quantitative output.

The following three stage methodology was followed:

Stage 1 - DWMP Options Screening - A first pass assessment of DWMP options against the 19 ENCA ecosystem services. Identify the top ecosystem services which are likely to be impacted by each DWMP option group.

The list of DWMP options at the time of writing was reviewed against the 19 ecosystem services listed within the ENCA services data book. For ease, the DWMP options were reviewed against the ecosystem services using the five predefined options categories. The ecosystem services were subdivided into the four ENCA groupings shown in the table above.

As part of the study. 77 generic options were assessed. The number of options later expanded to 86 though the additional options did not change the report conclusions.

Each of the 77 DWMP options was assessed individually against each of the ecosystem services using three criteria. Firstly, it was established if there was a relationship with the ecosystem service (✓). Secondly, the direction of relationship was determined (+, -). Finally, the option was assessed as to whether it was deemed a nature-based solution or non-nature based (‘Nature’, ’Non’). An example of this analysis is shown in Table 58.

Table 58- An example of the DWMP option appraisal against ENCA ecosystem services

SW (Surface Water Management)			*SW01-002: Community Level Source Control for SuDS* Installation of SuDS in public land - not responsibility of consumer.		
			Relation	Direction of relation	Nature or non nature based
ENCA Defined Ecosystem Services	*Provisioning*	Food	✓	+	Nature
		Timber	✓	+	Nature
		Water Supply			
		Fish			
		Renewable Energy			
	Regulating	Air Pollutant Removal	✓	+	Nature
		Carbon Reduction	✓	+	Nature
		Flood Regulation	✓	+	Nature
		Noise Reduction			
		Temperature Regulation			
	Cultural	Recreation/Tourism	✓	+	Nature
		Health	✓	+	Nature
		Educational	✓	+	Nature
		Volunteering	✓	+	Nature
	Bundled	Local Environmental Amenity	✓	+	Nature
		Biodiversity	✓	+	Nature
		Soil health	✓	+	Nature
		Water quality	✓	+	Nature
		Landscape	✓	+	Nature

Key		
Relation:	✓ *Associated with with this ecosystems*	
Direction of relation:	+ *Positive impact on the ecosystem service*	- *Negative impact on the ecosystem service*
Nature or Non-nature based	Nature *A nature-based (blue-green) intervention option*	Non *A non nature-based (technological/ hard engineering) intervention option*

Once each DWMP option had been assessed, the top ecosystem services from each DWMP option grouping were identified. For each ecosystem service the number of relations was summed and divided by the total number of options in the grouping to give a percentage. From the selection of related ecosystem services, the proportion that would be impacted positively was calculated. Lastly it was stated if the option was a natural or non-natural intervention. The purpose of calculating percentages was to make it easy to identify which ecosystem services were the most relevant for each DWMP option group and which option group used nature-based solutions.

These calculations were grouped into each DWMP option category to identify the most related ecosystem services. An example of this, using the Surface Water Management DWMP option category, is shown below in Table 59. Considering the water quality entries, 64.3% of the options in this category could impact water quality if implemented. Of those options, 88.9% are likely to have a positive impact on water quality. Additionally, 33.3% of the options are a nature-based/blue-green intervention.

Table 59 - An example of the options screening summary, using the SW management DWMP options category

Summary			DWMP options		
			SW (Surface Water)		
			Relation	Direction of relation	Nature or non nature based
ENCA Defined Ecosystem Services	***Provisioning***	Food	14.3%	100.0%	100.0%
		Timber	14.3%	100.0%	100.0%
		Water Supply	42.9%	100.0%	16.7%
		Fish/ Aquatic Life	14.3%	50.0%	50.0%
		Renewable Energy	-	-	-
	Regulating	Air Pollutant Removal	21.4%	66.7%	66.7%
		Carbon Reduction	21.4%	66.7%	66.7%
		Flood Regulation	85.7%	100.0%	25.0%
		Noise Reduction	7.1%	0.0%	0.0%
		Temperature Reg	-	-	-
	Cultural	Recreation/Tourism	21.4%	100.0%	66.7%
		Health	14.3%	100.0%	100.0%
		Education	50.0%	100.0%	28.6%
		Volunteering	42.9%	100.0%	33.3%
	Bundled	Local Env Amenity	28.6%	100.0%	50.0%
		Biodiversity	57.1%	87.5%	37.5%
		Soil health	28.6%	100.0%	50.0%
		Water quality	64.3%	88.9%	33.3%
		Landscape	21.4%	66.7%	66.7%

Stage 2 – Tool Assessment - Assessment of tool suitability against the Stage 1 identified ecosystem services and overall quality. Rank the tools according to overall appropriateness.

The tool assessment is broken down into four stages (shown below in Figure 87) designed to identify the three tools best suited for DCWW's purposes. A longlist of 16 available tools was produced for a desk-based review. Tools were selected due to their inclusion in the ENCA guidance, providing initial confidence in their quality.

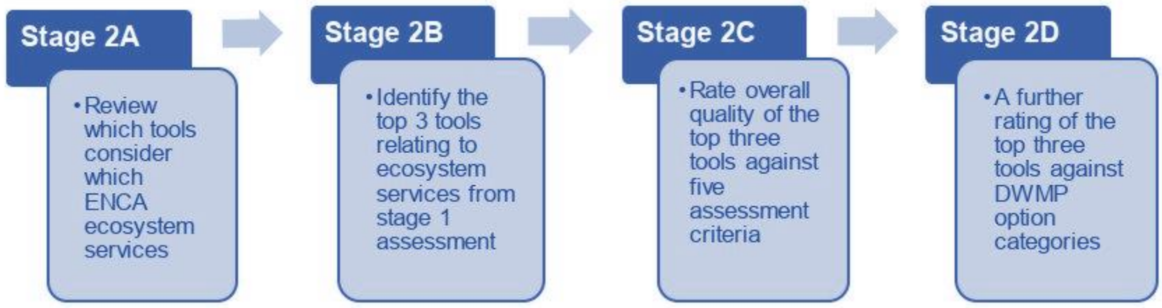


Figure 87 - Tool Assessment Stages

Stage 2A: For continuity, tools were assessed against the same 19 ecosystem services as the DWMP options. Using the tool summaries, it was determined which ecosystem services were measured by each tool.

Stage 2B: Using the top eight ecosystem services identified at the end of Stage 1 (options screening), the tools were assessed on their suitability. A percentage coverage of the tool was determined using the number of ecosystem services measured by the tool divided by the total number of ecosystem services. From this, the top three tools were identified as the most suitable.

Stage 2C: The top three tools were assessed against five criteria: suitability, scalability, reliability, popularity, and accessibility. These criteria were determined from RPS experience of the tools, to ensure all the pros/cons were fully reflected in the assessment. Each criterion is assigned a rating from 0-5. The ratings are summed to produce an overall quality score.

Stage 2D: Uses a similar process to stage 2C whereby, the top three tools are rated on a scale from 0-5 based on their suitability to assess the top ecosystem services identified for each DWMP option grouping. The individual rating applied to the tool for each DWMP option grouping is converted into a percentage to provide a category rating used in Stage 3.

Stage 3: Tool allocation Identify the top 3 tools and assess them against user criteria. Rank the tools based on DWMP option grouping.

Stage 3 uses the outputs from stage 2 to calculate an overall suitability score for each tool by DWMP option grouping. The overall score is calculated by multiplying the stage 2B (ecosystem service percentage coverage), stage 2C (tool quality rating) and stage 2D (category suitability) scores together.

Category score = ES coverage (stage 2B) x Tool quality rating (stage 2C) x Category rating (stage 2D).

6.3.8 Findings

Stage– 2A and 2B - The options assessment summary identified the most relevant ecosystem services within each option grouping. Overall, there are nine key ecosystem services: fish/aquatic life, flood regulation, recreation/tourism, health, education, biodiversity, carbon reduction, water supply and water quality (see Table 60).

A total of 16 tools were compared against the 19 ENCA ecosystem services. The top three tools from this assessment were identified as **B£ST, Eco-Metric** and **TESSA**. These were taken forward to stage 2C and stage 2D assessments.

Table 60 - Ecosystem Services covered by the 16 assessed tools

Tool Assessment	DWMP Options Ecosystem Services									
	P		R		C			B		
	Water Supply	Fish/ Aquatic Life	Flood Regulation	Carbon Reduction	Recreation/Tourism	Health	Education	Biodiversity	Water quality	% Coverage by Tool
Biodiversity Metric								✓		11%
ARIES	✓	✓	✓	✓	✓					56%
B£ST	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
Costing Nature	✓	✓		✓	✓			✓	✓	67%
ECOServ-GIS				✓	✓	✓	✓		✓	56%
Green Infrastructure Valuation T	✓			✓	✓	✓		✓		56%
i-Tree Eco	✓			✓		✓				33%
InVEST		✓	✓	✓	✓			✓	✓	67%
NCPT			✓	✓				✓	✓	44%
ORVal					✓					11%
PGIS					✓			✓		22%
SENCE		✓	✓	✓	✓			✓	✓	67%
TESSA	✓	✓	✓	✓	✓			✓	✓	78%
Viridian			✓	✓	✓			✓		44%
Eco-Metric	✓	✓	✓	✓	✓		✓	✓	✓	89%
NEVO					✓			✓	✓	33%

Stage 2C - The assessment identified the **B£ST** tool as having the highest overall score. However, it is important to consider the type of option being proposed as the highest rated tool may not be the most appropriate tool to use. Table 61 presents the justification for use of the B£ST Tool.

Table 61 - Stage 2C Justification for use of the B£ST Tool

Stage 2C Category	Tool–usefulness - B£ST Justification	Rating
Suitability	Developed with funding from UK water companies. B£ST is specialised to estimate ecosystem services from BGI, SuDS and NFM. Used by Yorkshire Water in reducing use of C/F sewers, however not main purpose. B£ST has been used across the UK, Europe and Australasia.	4/5
Scalability	A coarse assessment can be made with basic knowledge of a DWMP solution giving value range. Several levels of more detailed analysis to refine the valuation.	5/5
Reliability	The tool was developed by CIRIA, a leading industry research and information association for SuDS, BGI and NFM. The tool development was funded by UK water companies; hence the structure and terminology will be well adapted for DCWW use.	5/5
Popularity	Used in other water companies' projects and other industries for Environmental Impact Assessments. B£ST has been used for AMP7 framework across the UK, Europe, and Australasia.	4/5
Accessibility	The tool is free and available to order from CIRIA website with an email link. The output can be exported in reports/ready-made figures to use in reporting material.	5/5

Stage 2D - The purpose of stage 2D was to assess the suitability of each tool against each DWMP option group This was to understand if each tool was appropriate for each DWMP option category. The results highlighted the variation in tool choice based on the type of DWMP option being considered. For example, TESSA and Eco-Metric marginally outperform B£ST in the 'Combined and Foul Sewer Systems' and 'Customer Side Management' DWMP Options categories. Table 62 presents the justification for use of the B£ST Tool.

Table 62 - Stage 2D Justification for use of the B£ST Tool

Stage 2D Category	Tool–usefulness - B£ST Justification	Rating
Combined and Foul Sewer Systems	Although used by Yorkshire Water in a C/F project, the tool is heavily focused towards natural interventions (BGI, SuDS and NFM).	2/5
Customer Side Management	Consumer incentives are mostly non-natural interventions; however, the tool still covers the relevant ecosystem services.	2/5
Indirect Measures (for example, investigating and monitoring)	DWMP options include several policy improvements to protecting, improving, and creating flood regulating land.	4/5
Surface Water Management	Specialised for natural surface water inventions stated within this category.	5/5
Wastewater Treatment	There are some natural invention options within the WT category for which could be appropriate to use this tool.	4/5

Stage 3 – Tool Selection

An overall score was calculated by multiplying the Ecosystem Service Coverage score in Stage 2B with the Tool Quality Rating score in Stage 2C.

B£ST was the highest scoring Tool with a score of 92% (TESSA 49.8%, Eco-Metric 67.6%).

The B£ST tool is specialised to value BGI interventions, which are frequently represented in DCWW's DWMP options. The study concluded that the B£ST tool is the most appropriate to be used for 'Nature Based' options regardless of their DWMP category. This tool is so specific to natural flood regulation options. However, that it is less appropriate for estimating the ecosystem services resulting from non-natural 'hard' engineering' or demand management interventions.

In parallel with established guidance in water resources planning, B£ST enables consideration of all of the following ecosystem services required as a minimum: biodiversity and habitat, climate regulation (carbon storage and sequestration, parallel to carbon reduction, water regulation (description in the guidance is the parallel to water supply in the ecosystem services typology used), natural hazard regulation (including flood regulation), water purification (parallel to water quality) and recreation and tourism (direct parallel to Wales-specific guidelines). Although water resources planning addresses different objectives to the DWMP, it is a parallel process with established best practice guidance, approaches, and metrics which in this non-statutory Cycle 1 is advantageous to align with.

6.3.9 The B£ST Assessment

During the DWMP optioneering stage, multiple interventions are being considered. It is therefore important for the tool to be used efficiently. At this stage of the process the study recommended that the Coarse Assessment section of B£ST should be used to provide a timely and comparable multi-benefit estimate. At a later stage of option consideration, the full B£ST tool could then be used to evaluate ecosystem services in greater detail. Given the timescales for cycle one of the DWMP, and how much detail was available for both tactical and strategic solutions, only the B£ST coarse assessment was used. This uses six questions to monetise the benefits that a scheme might deliver, as summarised in Table 63.

Table 63 - B£ST Coarse assessment questions

Question no.	Question	Assumption	Evidence
1	How many trees are being planted in urban and suburban areas (not as woodland)?	One tree per tree pit	Only tree pits are assumed to have trees.
2	How many trees are being planted as woodland?	None	Trees are only used in tree pits, and these are not woodland.
3	How many people will benefit from the improvements to green space? Insert the number of people who live or work within 500m of the green space improvement.	See right	Counted number of residential properties within 500m of the proposed SuDS scheme. We have assumed that more traditional solutions such as crate storage, water butts and permeable paving offer no improvement to green space, as there is no additional green space.
4	How many properties are likely to flood less frequently/severely?	See right	Count of properties reported to be at risk of flooding in area (from DFL) for current benefit. Future benefit uses model-predictions. Since models can tend to over-predict flooding, only the change in predicted number of properties at risk from present-future scenarios is counted.
5	What area of land is being enhanced that improves biodiversity?	See right	% of the total area of the scheme: Assumptions formed from WSP Engineering experience/ judgements and reviewed by Atkins. This is not derived from formal guidance, however WSP consistently uses these figures which have been based on completed drainage projects. Grey Infrastructure: 0% Rainwater Harvesting: 75% Green Roofs: 90% Infiltration Strips: 35% Filter Strips: 50% Filter Drains: 45% Swales: 80% Bioretention Systems: 80%

			Tree Planting: 65% Pervious Pavement: 0% Storage Tanks: 0% Detention Basins: 85% Ponds and wetland (Including reed beds): 90% Natural Flood Management: 80% Other Green Interventions: 70%
6	What length of watercourse (km) or area of water (km^2) is being improved? Insert the length or area (1km also equals $1km^2$) which will potentially change in ecological (WFD) status.	0km	Assumed change in WFD status unlikely to occur because of a scheme to improve a single CSO. EA's WFD Reasons for Not Achieving Good database generally indicates that reasons for waterbodies failing targets are generally complex and not linked to a single asset. Water quality models to confirm this could be developed for future DWMP cycles.

A user guide for the B£ST Coarse Assessment was subsequently written to ensure consistency across DWMP option valuations. This was subsequently embedded into a SuDS benefit valuation tool, developed by Atkins, the benefits assumptions of which are presented in Table 64.

Table 64 - Assumptions for wider benefits associated with each SuDS type

SuDS type	Total B£ST benefit (per hectare of SuDS feature, excluding amenity)	Trees (per hectare @ £198/ hectare)	Forest (per hectare @ £19,043/ hectare)	Area of land enhanced (per hectare of SuDS feature £823/ha)	Customer benefit (people within 500m of SuDS benefiting from enhanced amenity, etc @ £411/hectare)	Kg CO2e stored (per unit per hectare)
Swales	£33	0	0	0.80	Yes	20450
Wetland	£106	0	0	0.90	Yes	113714
Attenuation Pond	£37	0	0	0.90	Yes	28300
Disconnect Downpipes	£0	0	0	0.00	No	36222
Attenuating Rain Gardens	£41	0	0	0.90	Yes	3166
Soakaway	£0	0	0	0.00	No	32600
Filter Drains	£0	0	0	0.00	No	322333
Rain Gardens (Surface)	£106	0	0	0.90	Yes	8142

Water Butts	£0	0	0	0.00	No	1428
Tree pit	£66,092	333	0	0.65	Yes	8142
Rain Garden Box	£82	0	0	0.90	Yes	6333
Green Roof	£2,470	0	0	0.75	Yes	190000
Permeable Block Paving	£0	0	0	0.00	No	109944
Gravel Paving	£0	0	0	0.00	No	329833
Bioretention	£94	0	0	0.80	Yes	142500

6.3.10 Carbon equivalent costs for interventions

The carbon impact and equivalent carbon cost of interventions has been calculated for each option.

The option costing approach uses DCWWs STPT, and the carbon equivalent ($KgCO_2e$) associated with each item is available within the STPT where the carbon cost model is available. There are currently no OPEX or variable CAPEX models available within the STPT for carbon equivalent, therefore this is a limitation within the plan.

Where the STPT tool was not utilised for the options costing, in the case of the SuDS Tool, the carbon was calculated by assessing similar components from the STPT to generate carbon multipliers that were then applied to the SuDS Studio output. This approach utilised the swale, geo-cellular, permeable paving and bioretention carbon models.

The SuDS Tool currently only includes the calculation of carbon equivalent for the fixed CAPEX, this is a result of no OPEX or variable CAPEX carbon models being available for SuDS schemes.

The calculations of the carbon cost of each scheme have then been collated into the Net Present Value Tool Raw data sheet of the NPV Tool.

The Raw Data Input Carbon values are in KgCO2e as output by the STPTs in the scheme cost calculation, to convert this into a currency value for application in the NPV calculation the $KgCO_2e$ have been multiplied by a carbon value.

The carbon value has been taken from the latest national government guidance, 'Valuation of greenhouse gas emissions: for policy appraisal and evaluation' (Defra, 2021), page 10. The Central Series 2021 value of £245 per tonnes CO_2 from this report has been utilised to provide a present value of Carbon equivalent cost to assign to the KgCO2e calculated from the STPT, which are calculated in present value. Within the NPV Tool the KgCO2e is input and when calculating the NPV of Carbon this is converted to £ per tonnes CO_2.

The carbon value is present as a variable in the 'User Guidance' tab of the NPV Tool should future users of the tool wish to update the carbon value.

6.3.11 Construction costs and programme impacts

To identify the number of years of benefit that can be attained from a scheme so that it can be applied effectively within the net present value optimisation, design and construction costs have been generated for each scheme. This incorporates the scheme development time from the start of design to the completion of construction and has been split into those two phases: design and construction.

Scheme design can take a longer time than construction, and the design aspect includes any further enhancements to the hydraulic models and further surveying, if required, to provide the high level of confidence required before the scheme is implemented.

As part of the DWMP, the full scopes of design and construction for options proposed have not been scoped in detail as they would be in a capital project; due to the number of scheme types available there was potential for a significantly high number of combinations of design and construction durations. Due to the time constraints and the level of detail required for the DWMP this was simplified into a banding of years based on the fixed CAPEX cost. This assumes that the greater the CAPEX the greater complexity the option is and would therefore require more design and construction time. It is assumed that all options will be deliverable with one AMP and therefore have a maximum delivery time of five years.

The construction timeline for each scheme has been set via a formula within the NPV Tool, based on the fixed capex cost of the scheme, as per Table 65 below:

Table 65 - Construction timeline of fixed cost schemes

Scheme Capex Cost	No. of Years	
	Design	Construction
£0 - £500,000	1	1
£500,000 - £5,000,000	2	1
£5,000,000+	3	2

6.4 Selecting the preferred option

The selection of preferred options has been carried out at the Wastewater Treatment Works (WwTW) catchment level. The interventions that have been developed for each risk cluster within the catchment have all been collated and the Net Present Value (NPV) for the following aspects been calculated for the intervention to calculate the TOTEX of the intervention for the life cycle of the schemes.

- CAPEX;
- OPEX;
- Repeat CAPEX;
- Variable OPEX;
- Carbon; and
- Benefit.

In addition to the costs of intervention, the NPV of the benefits calculated through B£ST have been calculated for the life cycle of the intervention; this provides a 'negative' cost, representing the wider benefits of the scheme.

The preferred interventions for each risk cluster have seen selected based on the Average Incremental Cost (AIC) over the lifecycle of the scheme, this is the least cost programme. We combine the costs and benefit together into a tool where the net present value is calculated. Combinations of NPV are combined to produce an AIC and an Average Incremental and Social Cost (AISC). The rank of AIC produces the least cost benefit programme and the rank of the AISC produces the best environmental benefit. The options that score highest on both rankings are automatically put forward as preferred, as they are both least cost and best environmental benefit, and therefore best value. Those remaining are manually reviewed, and the highest rank of either is put forward as best value.

The HRA and SEA is applied to the solutions, and those that are positive are progressed as best value. Those that may have a negative impact are returned through the cycle to establish if any improvement can be carried out. This is described in Figure 88.

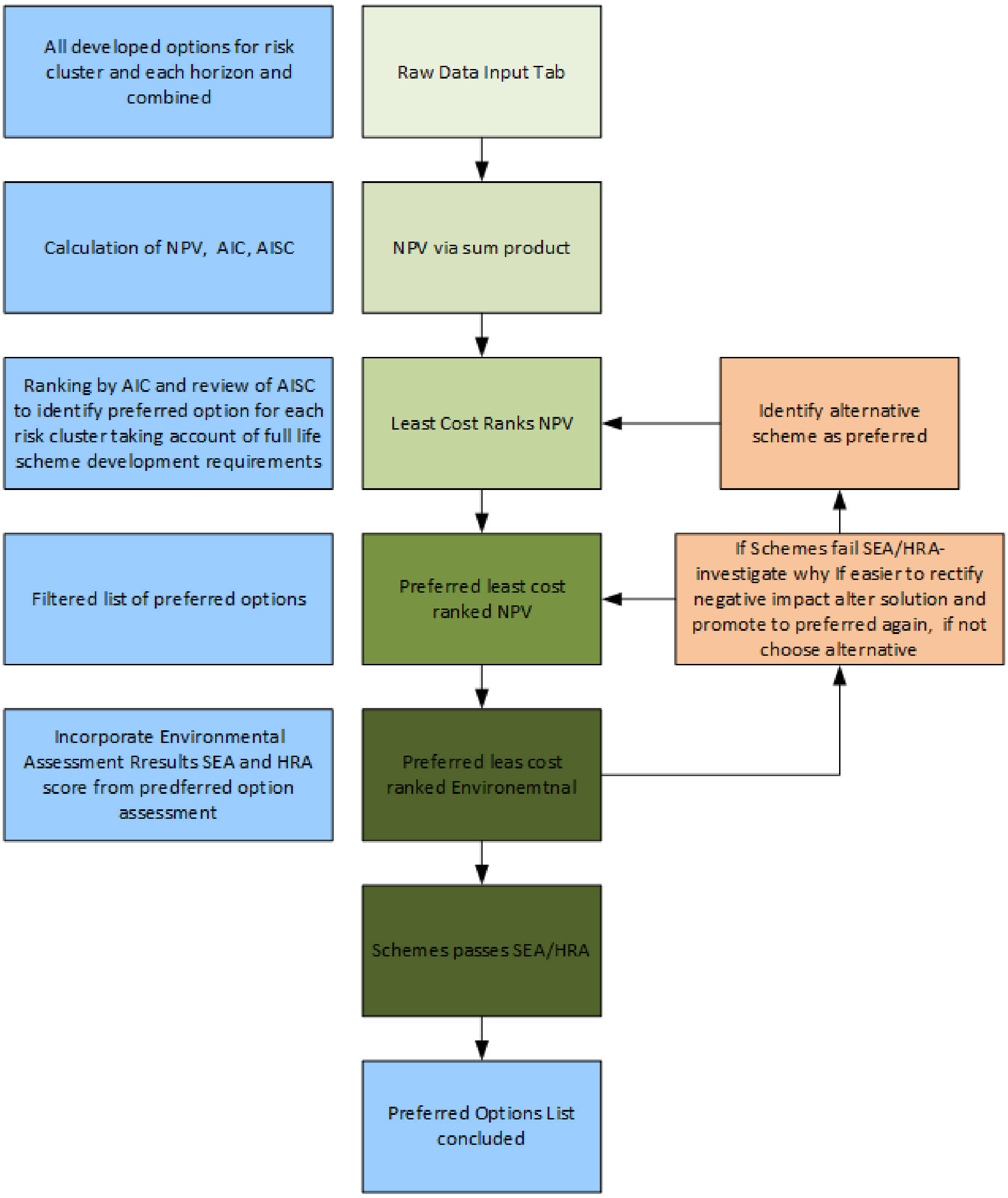


Figure 88 - Process chart for the derivation of a Preferred Options List

6.4.1 Hybrid Solutions

A part of the options development process, there was a requirement to develop a traditional solution, as well as a priority sustainable solution. The sustainable solution was the preferred approach wherever this was possible, and the requirement performance improvements could be achieved.

However, where the sustainable solution did not fully deliver the required performance improvements within the catchment, hybrid solutions were developed, which were based on the core sustainable solution, with a traditional component included locally to ensure that the performance improvements were met. For example, to mitigate flooding within a catchment a raft of sustainable drainage solutions might provide 75% of the required flood reduction and an additional local asset upsizing to provide additional storage may provide the additional 25%.

6.4.2 Opportunities for working together

For Cycle 1 of the DWMP we have undertaken mini projects to identify our best opportunities to work with others. These are explained in the following sections and will be used as part of our DWMP consultation.

Retrofitting SuDS in schools and public places

Schools and public places, such as the public highway, often have large areas of impermeable surfaces connected into the sewerage network to convey and direct the impact of storm events away from urbanised areas. As these are public sites, they provide opportunities for DCWW to engage with councils. First by supporting the council to empower themselves to improve flood routing on land their manage. While other opportunities can be jointly supported to progress through to development and delivery in a shorter timeframe than other opportunities such as residential or commercial property schemes because of the effort upfront to gain agreement to carry out the scheme with so many multiple landowners. In addition, these schemes can often enhance the aesthetic and amenity value of the sites as well as increase customer education.

An assessment has been carried out as part of the DWMP to identify and cost opportunities for SuDS schemes within schools and public spaces across the DCWW operating area. This process utilised the SuDS Studio Tool to identify each SuDS opportunity on a school or public space and aggregate the costs for each site to deliver a list of opportunities across each L3 optimised on £/Hectare removed.

This programme of works will directly contribute to the offsetting of the long-term impacts of climate change. The cost of these interventions is already included within the reference option, as the reference options indicative nature is meant to represent a blend of investment in nature-based options such as SuDS and more traditional options such as storage, and therefore this programme of works can be considered as a more detailed tactical solution that infills the detail of the reference option.

Education - Water efficiency and water consumption information

We also recognise that the climate emergency highlights the need for greater efficiency with the volume of water we use. The company already provides water efficiency advice and the opportunity to reuse water saving products that not only reduce your water consumption but also helps somewhat to reduce your energy consumption (see Martin Lewis Money Show Special March 2022). In wastewater terms we too support more efficient consumption and as an industry will work with industries such as white goods and bathroom products manufacturers to continue to make improvements with the volumes of water they use.

We have not costed any water efficiency education as part of the DWMP and consider this to be part of maintenance activity during this first cycle of the plan.

Education – Blockages, Fats, Oils and Greases and non-flushable products

The company will continue to provide company-wide messaging on the impact from and disposal of non-flushable products. Campaigns covering these topics are run regularly. The company will from time to time where clusters are found and are shown to be on the increase will carry out localised engagement to provide an informed position.

These products include:

- Wet wipes
- Sanitary products
- Nappies
- Fat oil and grease from cooking

We have separately costed educational promotion as part of the DWMP but the estimate of benefit needs further work before further progression as a DWMP directed solutions in the mean time we consider this programme to be part of maintenance activity during this first cycle of the plan.

6.4.2.1 Misconnections

In many cases the separation of surface water flows from our combined sewer network will involve advanced works to identify and disconnect misconnections of foul water into any surface water or land drainage inflows communicating with our sewers. The legal powers available to WaSCs to undertake this disconnection work are limited and so close working with the environmental regulators and with local authority environmental health, to support with any enforcement work, will be needed. The scale of misconnections likely to exist has not been evaluated as part of the DWMP but will affect the pace of delivery of surface water management (SuDS) options being presented. As we the underlying principle is not to redirect the misconnected surface water system to a surface water system without ensuring that all of the misconnections are removed first.

As a result, we have not costed any misconnections activity separately as part of this first cycle of the plan but consider this as part of our proposals for increased collaborative working, and the introduction of appropriate governance arrangements in Wales to support this work.

6.4.2.2 Sea Level Rise

To continue building a picture of resilience across our network, we wanted to understand how resilient our wastewater assets are to sea level rise.

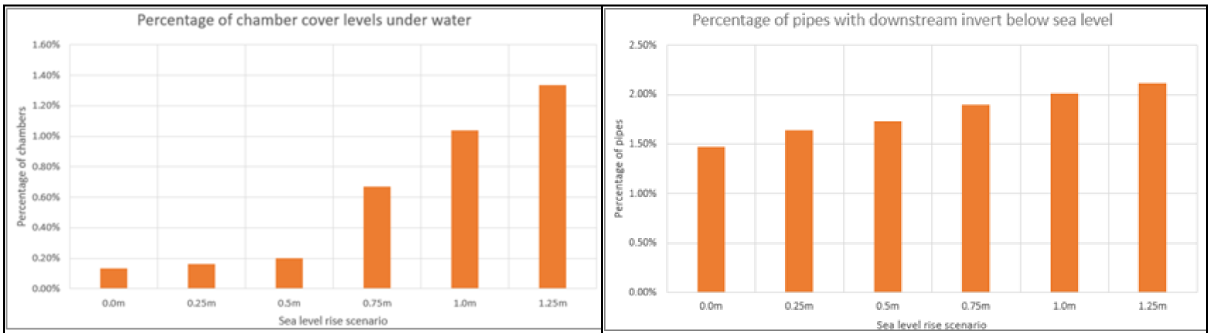
UKCP18 forecasts suggest that time-mean sea level for Cardiff in 2100 could rise by 0.27m for a low emissions scenario to 1.13m for a high emissions scenario (MetOffice, UKCP18 Marine Report, 2018). Global mean sea levels are predicted to be impacted based on thermal expansion, glaciers, land water storage and ice sheet changes. There are regional effects caused by ocean circulation and density, land ice or water storage and glacial isostatic adjustment. Locally, sea levels can be impacted by tides, surges, and waves. Each of these factors has uncertainties associated with the forecast. We have therefore assessed rates of sea level change between 0.25m, 0.50m, 0.75m, 1.00m and 1.25m for this study.

Our approach had two stages:

- Using LiDAR data, analyse which of our assets could be underwater in future, because of sea level change. This assessment was undertaken using GIS software.
- If overflows or wastewater treatment works cannot discharge into the sea as outfalls become ‘locked’ by high water levels, how much of the upstream network could be impacted? How much of the network is below the future time-mean sea level? This

assessment was undertaken using the InfoAsset database created for the pipe capacity project.

The results are summarised in Figure 89. These suggest that any increase in sea level rise will have an impact on our network, but that rises above 0.5m will have a marked impact on the number of our assets that will be underwater without investment in sea defences. This picture of future risk enables us to discuss the need for sea level defences with stakeholders including NRW. They also enable us to start considering whether some assets need to be abandoned or relocated.



(i) (ii)

Figure 89 - Assessment of the extent of our network that could be impacted by sea level rise. (i) percentage of chambers that will be underwater, and (ii) percentage of pipes that will be below tide-mean sea level by 2100.

The map in Figure 90 shows the catchments with more than 20 pipes or chambers that are impacted by a sea level rise scenario of 1.25m. The darker shading reflects more pipes being affected by the assessment and sets out to highlight the areas that are most vulnerable to the impacts of sea level rises.

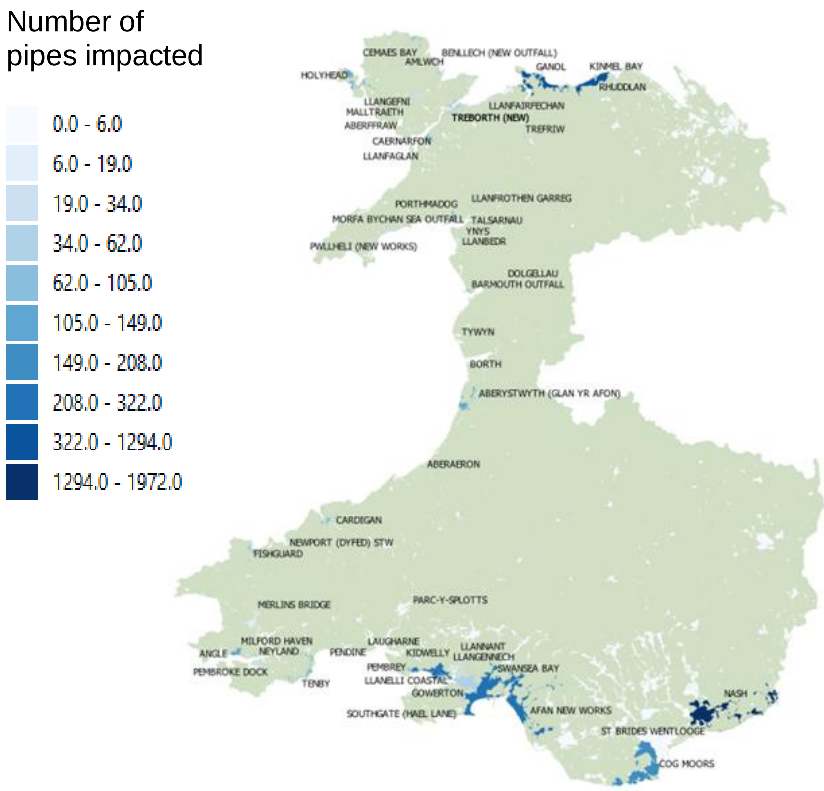


Figure 90 - Map of wastewater treatment work catchments impacted in the 1.25m sea level rise scenario.

6.5 How Have We Identified The Best Options?

We have calculated how much each option is likely to cost and how much 'benefit' it offers. This considers:

- **Capital expenditure cost** – costs for physical assets or 'things' that need to be built such as new tanks or SuDS.
- **Operational expenditure** –day to day costs to maintain an option, for example replacing worn parts at pumping stations.
- **Carbon cost** – we want to prioritise options with lower carbon emissions and have accounted for this by assigning a carbon cost to every option.
- **Environmental and social cost –** we want to prioritise options like SuDS, tree planting and wellbeing, which offer wider benefits to people and the environment and have accounted for this by calculating an 'environmental and social cost benefit' for every option.
- **Volumetric benefit –** the risk of flooding or pollution can be quantified in terms of the volume of wastewater that escapes from our wastewater system, or the volume needed to increase the system capacity to stop an escape. For each option, we have quantified how much wastewater will no longer impact on people and the environment. to do this we have used a common reference level storm so that benefits can be standardised.

The Core plan and Adaptive pathway – one of the main requirements that we were asked to incorporate into this plan was to consider how to sequence investment in an area over 25 years, and where to position the main decision points. What we have put together is an approach that says we can do nothing, or we can develop solutions to improve the worst environmental harm and the worst customer service in either a traditional approach, for example building larger pipes, or installing storage tanks, or nature-based or green solutions. This is shown in Figure 91. This choice is then broken down into two stages:

1) What must happen first.

2) What would need to follow for 'no regrets' investment?

The graph below shows how the paths are planned for a single cycle of a plan. In this plan a two-step adaptive plan has been achieved and in future iterations we intend to increase the number of steps being considered.

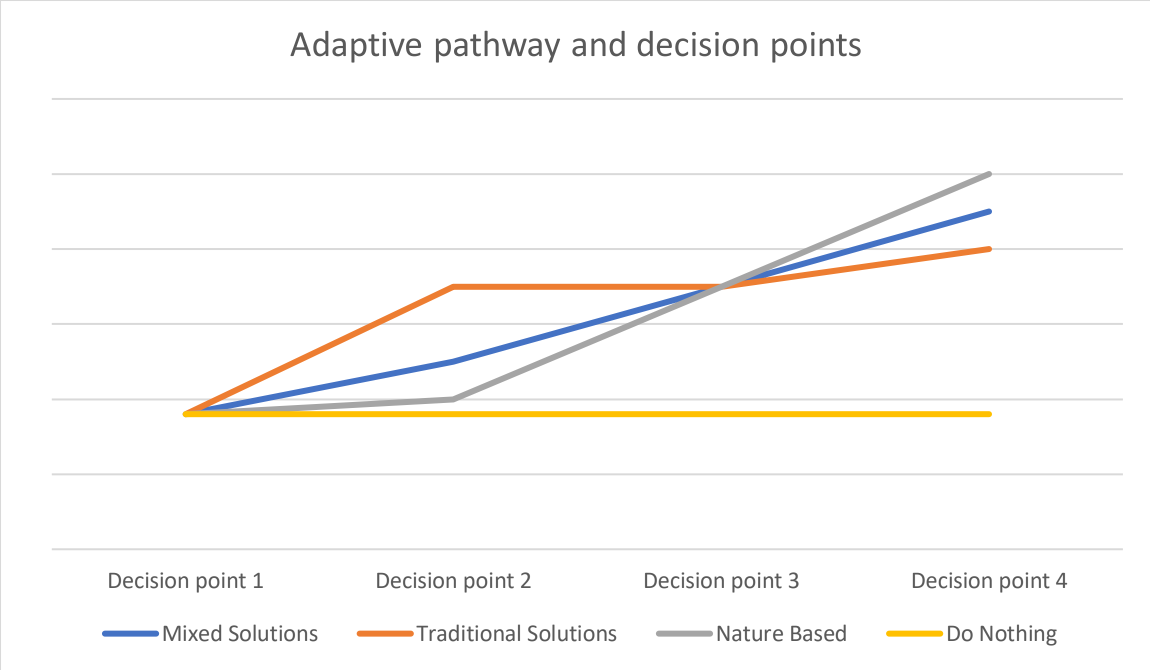


Figure 91 - Is a representation of adaptive planning scenarios with decision points

These costs have been calculated using a company standardised approach in line with Ofwat requirements for every pair of options traditional or sustainable/mixed.

When each pair of options are compared using both the least cost approach and the social and environmental beneficial cost approach, the lowest ranked option is chosen, the preferred solution.

We then carried out additional environmental assessment on the preferred plan based on:

- The SEA (Strategic Environmental Assessment)
- The HRA (Habitat Regulation Assessment)

This final check allows us to demonstrate that the preferred option does not adversely impact the environment or natural habitats, if the option does not score positively, we have then gone back and considered choosing the alternative option which may meet these requirements or redeveloping the option to make it more favourable.

The overall approach summarising how options have been chosen is included in Chapter 5 (Options Development and Appraisal):

By **environmental benefits** we mean anything that relates to the environment – this could include rivers, coastlines, and natural habitats.

By **social benefits** we mean anything that relates to people and people's activities – this could include preventing flooding of homes and businesses or improving the environment in urban areas and assessment of carbon impacts, places where people visit and has tourism value.

We conclude by collating all the preferred solutions together into the best value plan.

In order to account for the uncertainty associated with future pressures impacting levels of environmental performance and customer service, additional scenarios have been applied to detailed options applying +/-30% to growth and urban creep, known as the 'high' and 'low' scenarios respectively, as well as a high emissions scenario for climate change impacts. These scenarios allow us to identify trigger points and confirm that our proposed options will lead to 'low regrets'.

6.6 Future Recommendations

6.6.1 Defining Multi-Capital Benefits

The following section introduces multi-capital benefits with a view to future cycles of the DWMP.

Healthy, well-managed, ecosystems can provide multiple benefits for society. These benefits can include improved air quality, pollution regulation, wellbeing, education and many more. These benefits can be assigned a value using capital accounting tools. The benefits are categorised by what/who they benefit as 'multi-capitals', one of which is natural capital. Capital definitions, and examples of potential Blue-Green Infrastructure (BGI) benefits are stated below.

Social Capital: The networks of relationships among people who live and work in a particular society, enabling that society to function effectively.

BGI may improve this by providing more green space to socialise and exercise together.

Human/Intellectual Capital: The intangible factors which assist economic productivity or businesses and individuals.

BGI may improve this by reducing urban noise, improving the health of workforces, and providing a source of education.

Manufactured Capital: Material goods or fixed assets which contribute to the production process.

BGI may improve this by providing raw materials, regulating temperature and pollution.

Financial Capital: Any economic resource measured in terms of money used by entrepreneurs and businesses to buy what they need to make their products or to provide their services.

BGI may improve this by providing raw materials, regulating temperature and pollution.

Natural Capital: Natural capital has been included within our options assessment of Best Value in Cycle 1 using the B£ST tool. By managing water through enhancing ecosystem services, further sustainable economic benefits can be derived.

Example - Sustainable Drainage Systems (SuDS) is a well-cited technique which delivers Ecosystem Services while managing urban drainage. SuDS can make drainage systems more resilient, improving performance with above-ground natural interventions. The direct benefits of SuDS to water companies include runoff treatment, flood water storage and offsetting asset carbon and energy emissions. However, interventions can have multiple external benefits to the wider society which can be estimated in terms of multi-capitals.

7 Programme appraisal

This is where all the best value options (from the option development phase) are brought together into a plan over time.

After we have developed our lists of best value options we need to plan when these solutions can be delivered, and in which order. They are then all considered across Wales.

This chapter explains in detail the process and outputs we obtained from undertaking the programme appraisal step of the DWMP. We recognise this step is a precursor to the business plan, but it allows us to constrain the programme of work based on affordability. This is so we can supply solutions across our operating area for the business plan process to reassess and incorporate into a further shortlisting process. It is the analysis of the outputs of each of these programmes that determines that there are no regrets from the first stage programme.

7.1 Introduction

In June 2018, the Water UK Programme Steering Group (PSG) Workshop confirmed the need for the programme appraisal to include succinct content, ensuring key principles were outlined. The PSG agreed that the programme appraisal process step considers the formulation of a **portfolio of interventions**, optimised to deliver 'best value', considering drainage and wastewater planning objectives (independent of other planning objectives across other company service areas).

Further detailing of the investment planning processes used to devise the business plan is not required as part of the DWMP, but the plan should outline how the DWMP outputs are likely to transition through the process of business plan development. This is to mitigate against an expectation of the 'stand-alone' DWMP not being integrated within the final business plan submission. The group were keen to see the 'return journey', meaning plan iterations and feedback to stakeholders (strategic planning groups) during the business plan development process.

This first, non-statutory, phase of the DWMP development is very much a learning phase. Throughout the plan, decisions have been made in respect of what is strategic decision making and what is tactical decision making and, as a result, what level of information is required for each section of the plan. This section is no different.

Our strategic (top-down) plan has been developed using an all-Wales approach. This was the only achievable approach that we could take given the available time to complete Cycle 1 and the level of maturity in the risk and option development processes. However, this strategic level information tells us how much, in terms of equivalent traditional storage in the sewer network, the plan could cost.

These assessments are based on deriving the volume that would need to be stored and simply multiplying by the average cost to deliver that storage equivalent, obtained from the corporate unit cost database. The monetary value of environmental and social benefit is not included within this approach. However, the policy decision reflects environmental benefit which is a step towards incorporation of further added benefits that would address the SMNR principles of the Wellbeing of Future Generations Act and Environment (Wales) Act.

In the niche of strategic planning this data goes as far as drawing out the ambition versus pace, so what could be achieved in a defined timescale. The data informing the strategy could also be used to derive the customer and environmental pathway over time. It provides these cost estimates for a range of policy options, with the aim of the first cycle of our plan helping to inform government and regulators on the pace and affordability of those policy options.

Our bottom-up approach is a maturing process. The outputs from this programme appraisal will be included within our PR24 business plan to trial and develop a greater understanding of how a DWMP should integrate with traditional wastewater price review investment planning. There is a need for further trials and open conversations regarding the incremental resilience approach so that all customers receive a benefit at the same time as environmental improvements occur.

7.2 Methodology

7.2.1 Top-Down Appraisal Methodology

During Cycle 1 the ambition was to achieve a strategic view of the scale of the problem that needed to be solved. It became clear that to 'solve' an entire geographical area would require a considerable volume of water to be either stored in the network and treated, or removed from the network and redirected elsewhere. While this approach was being considered, DEFRA had been undertaking its own research into CSO's, the cost to arrive at different policies, and customer support research to understand the ambition. The project was called Storm Overflows Evidence Project (SOEP) (Defra W. E., 2021).

As this research was only being carried out on WaSC's in England we undertook a simple version of the same project to draw our own conclusions, and to support Welsh Government decision makers to develop their own governance approach. By undertaking this assessment, we developed a strategic method of indicating the approximate cost to different policy decisions at a company Level 1 (L1), at a SPU Level 2 (L2) and at a Tactical Level 3 (L3). Those costs are detailed in section 7.3, below. A year later Welsh Government concluded their appraisal with a Storm Overflow Evidence Project SOEP-W (WG 2023). What each analysis showed was that to achieve varying policy aspirations, the cost to society would be more than customers could afford and especially during a cost-of-living crisis.

It is important to note that these strategies are an informative analysis, and not the actual total cost to Welsh Water. It is also important to understand these costs as societal costs.

The strategies required to undertake this work cover not only sewerage planning but drainage planning. Drainage planning, as previously mentioned, will often require rerouting rainfall away from our combined sewers and reusing it, storing it, infiltrating it into the ground or redirecting it to other surface water and land drainage systems. Because many of those inflows, the locations of potential solutions and the drainage systems they are likely to discharge to assets in Welsh Water ownership.

The conclusion from these three analyses has informed our engagement strategy as there is a need for a multi-organisation plan and delivery function to ensure funds from society are spent wisely. We are moving towards a single aspiration, given to all multi-organisations that will enable joint planning and codelivery to happen without any barriers. This multi-organisational plan has been termed as the National Drainage Plan. This is where all organisations can put forward their separate plans in a similar way to the set-up of regional Water Resources programmes, for example, Water Resources West. To see this example please cope the hyperlink into your browser. https://waterresourceswest.co.uk/our-region.

The complexities of urban drainage were one of the main reasons why the concept of the DWMP was set in motion at the turn of this century. The key message to take from the work carried out by DEFRA, Welsh government, and the work we have also undertaken, is that it is going to take time and money to get to the 'solved' position. In the intervening period we are going to need to build in interim steps to ensure that all customers continue to receive improved service while readdressing the legacy from the past. Our top-down plan will help us discuss the scale of the challenge in addressing the legacy of combined sewerage systems and the reliance on storm overflows to protect properties from sewage flooding during rainfall events. Even though the decision to use combined sewers was fit for the public health concerns, climate, and environmental aspirations during the industrial revolution, in today's political and environmental climate. The decision needs to be reversed and a new direction taken.

During our consultation we asked customers and stakeholders how they would like us to 'solve' each catchment, and the consensus just short of 2:1 agreed with our proposal to undertake an interim staged improvement. The solutions we have created in our first DWMP have trialled the 'solve' approach in two steps. This has shown that customers cannot afford to move at a two-step pace in all areas that we need to carry out an improvement. Ultimately what this means is that we must undertake more detailed options development and include more steps to the final destination. We will investigate this in the next round of planning as laid out in the consultation and will likely increase to 4-5 steps.

7.2.1.1 Sewerage planning

The analysis carried out to determine the potential scale of a sewerage plan to meet a range of future outcome scenarios also informed the creation of journey plans to achieve those outcomes. The themes of the DWMP strategic journey plan are listed below and in the L2 and L3 regional summaries each localised journey plan is presented. The actions at a strategic overview cover the following areas:

- Manage the level of infiltration into the network as this increases the available capacity in the system and provides resilience, especially if the system contains combined sewers.
- Maintain education messaging.
    - Management of blockages.
    - Ensure that users of the system realise the impact of fats, oils, and greases on the network.
    - Understand that there are items that are not flushable and what these items are.
    - That water needs to be used wisely to play our part for the climate emergency.
- Continue to understand our impact on the environment and work with our environmental regulators to improve that impact, for example, removing barriers to fish migration and reduce the nutrients discharged in our treated effluent to continue to meet our discharge permit.
- Build in capacity where it is necessary, but in combined systems confirm that growth and reductions in water usage do not indicate the need to build too large as in the future drainage management will overtake the need to build bigger sewers as more sustainable systems are planned and delivered.

7.2.1.2 Drainage planning

The analysis carried out in addition to our sewerage planning, regarding the scale of rainfall that is required to be contained or redirected. This includes the analysis to maintain our storm overflows at the permitted level. The future equivalent storage requirement to reduce the reliance on CSOs and, at the same time, reduce instances of pollution and flood risk demonstrating the reliance on integrated plan development with local authorities and NRW and the EA. Cycle 1 of the DWMP did not offer sufficient time to gather data from all key stakeholders and to develop integrated plans to jointly address localised flood risk, while reducing CSO discharges. Nevertheless, the pilot work we have undertaken with local authorities has shown how actions at a strategic level are needed to address the following areas:

- Develop integrated plans with other organisations on how to adapt our urban areas to represent a more natural environment, for surface water runoff, amenity, and biodiversity.
- Increase the number of areas where rainfall can soak into the local landscape to support a higher groundwater table and support future droughts.
- Reroute water to localised water courses to increase flows in the local streams supporting ecosystems and helping biodiversity.
- Greening villages, towns and cities to aid wellbeing and supporting those features by allowing rainwater to stay local for longer by building leaky dams, SuDS features, tree pits and so on.
- And finally, encouraging innovation to develop alternative storage solutions such a natural flood management, wetlands.

7.2.1.3 Emergency flood planning

As a company that has a statutory requirement to work with other emergency services during times of severe emergency, we will continue to play our part in emergency flood planning. We undertake joint exercises to demonstrate that our plans work, and we will continue to do this into the future.

We will also develop plans that look to make our own assets more resilient to severe flooding. As part of the DWMP strategic top-down approach we have considered what type of event this planning should include.

We cannot stop severe storms impacting our services without altering the location of our WwTW's and other wastewater infrastructure. While our assets are in, or near to, rivers and the coast we will continue to develop asset resilience plans that reduce the time in which our assets are unable to provide a service.

We will also work with our environmental regulators to support community flood defences where land owned by us forms part of a wider defence network.

7.2.1.4 The Review of Consent Plan

Our NEP has been developed along with our environmental regulators. Our contribution to ensuring that the environment continues to improve as we reduce our impact from our operation is contained and driven by NRW/EA. The current programme that is being put forward in PR24 is a step up in investment from previous cycles. We will work with our regulators to provide more proactive investigations to predicted risk when affordability is not an issue. We will also play our part to investigate ways to continue to inform government about pace of new legislative and aspirational change, with a view to building informative evidence on direction and pace and cost to society.

7.2.2 Rainscape and Engagement Programmes

We have also created two programmes of opportunities as the basis to start our Level 2 engagement with other stakeholders. They are a programme to look at schools and confirm where there are opportunities from our programme and a programme of locations to verify if there is an opportunity at government owned land such as car parks and council buildings.

The first stage of building our project boards is to have an opportunity to work through. We are proposing these as a place to start. There are 993 school locations and 807 public spaces that are candidates for discussion of our initial opportunities. The cost of engagement from all who participate every five years would be in the region of £400,000 across Wales. The cost of the solutions would be in addition. It is important not to underestimate the cost of pooled staff resources on the 13 project boards as this too can be a barrier to success.

To develop joint plans of any kind will take time and the expertise of the organisations involved. We also must consider the constraints from delivery as we cannot undertake work too fast too early without developing a supply of opportunities and a supply chain of organisations to undertake the work. This is where we need to learn from each other and build virtual cross-organisational teams to work for Team Wales.

The development of the engagement programmes will also improve our communication with customers. The joint messaging from water and waste areas of the business on demand reduction has long term benefits but that that demand whole year round has a benefit to those being flooded is less known. Again, it's the hidden cost of engagement that provides the benefits. So, by piggybacking engagement already being caried out we can improve the reach of our messaging regarding blockages, wet wipes, fats, oils, and greases. The cost of starting a new programme was examined but turned out to be costly. Where delivering joint messaging at locations already being delivered would only cost a smaller amount, for example for pamphlets and leaflets.

7.2.3 Bottom-Up Appraisal Methodology

We were not expecting to achieve a bottom-up appraisal for all catchments during Cycle 1. However, we have developed a methodology which has provided an initial potential work programme for the highest priority catchments, of which the first batch was included within our PR24 business plan. The approach will also allow for the further development of solutions during Cycle 2.

The bottom-up approach focuses on both the worst customer experience and the worst environmental harm in a locality in line with the priority matrix shown in Figure 10. Through this approach we have developed 219 schemes aimed at addressing internal flood risk and spills to rivers with a protected status. While this does not reflect a programme for our entire operating area, it does allow us to test the reliability of solution development, using the bottom-up approach, and how this should feed into the price review process.

We now know from those trials and the consultation from customers that the scale of work required, and pace driven from affordability now indicates that smaller incremental stepped options need to be produced to feed into the programme appraisal stage. By doing this change it will allow us to make more reasonable decisions in the short term while still understanding the impact of those decisions on the long-term direction and aspiration from our customers.

7.2.4 Programme Appraisal Approach

There are many ways to carry out plan optimisation. In the water industry this has previously been carried out using a simple cost versus benefit approach, as well as using more complicated and intricate decision support tools that incorporate cost, benefit, single objective to be achieved over time and multiple objectives to be achieved over time.

During the first cycle, a review was undertaken to decide what approach to use during this important development phase. A few of the approaches are discussed below to explain why we chose our approach for this cycle.

The current company's approach, Service Measure framework (SMF), used for the valuation of benefits, is already well established. However, in terms of current and future risk, it was not considered to be an appropriate method to make a preferred or best value choice alongside the least cost option. The business was already preparing to change the SMF tool, ready for the next price review, but the timing of our replacement Multiple Capital Accounting (MCA) tool meant that its use in the DWMP preparation was not possible.

The WRMP (EA Tables) in the past used Average Incremental Costs (AIC) and Average Incremental Social and Environmental Costs (AISC). The table that was developed for the WRMP over a decade ago by a joint EA/Ofwat/water industry project seemed a possible choice for use within the first DWMP. It calculates what would be the whole life cost for the scheme and concludes what that cost would be per volume benefit (AIC), whilst calculating the cost per volume benefit including additional cost benefit derived from carbon and environmental and social benefits (AISC). The tool seemed useful and possible to translate for use within the DWMP.

The optimisation created for the WRMP, though a logical consideration as an approach, is a bespoke tool that would have to be converted to incorporate the specific data required to make decisions relating to drainage and wastewater assets. It was agreed that this bespoke approach would take too long to develop and could not be achieved in the limited time frame of the first cycle. Purchase of more intricate solution optimisation tools was considered, with both Optimatics and Mode Frontier being reviewed.

Both these off the shelf purchasable systems were reviewed using the presentations found on Youtube and reflection from industry discussions. It was concluded that in the future these options would be considered again but due to the limited time available to develop our ability to understand what the outputs from the tool it was concluded that we would wait until other companies had undertaken their reviews. These could then be incorporated into possible approaches for their DWMP and recommendations could be made for their use going forward before we considered these again.

What we needed for the first cycle was an easy-to-use tool, already in existence and requiring very little alteration, one which would allow us to discuss the difference between a least cost scheme and a scheme with added benefit. So, in conclusion the jointly created AIC and AISC comparison approach from the WRMP EA tables was the obvious choice.

The AIC is calculated by adding up the NPV of the volumetric Benefit, the NPV of Capex and the NPV of Opex. Similarly, the AISC is calculated using the AIC but also adding in the NPV of Carbon and NPV of the CIRIA B£ST environmental valuation tool. All costs and benefits have been developed with a discount rate approach of between 40 and 80 years, ready for use in the NPV calculator.

The option appraisal stage of the plan assessed whether the least cost based on the AIC was the preferred option or whether using best value as an alternative solution was preferred. A simple manual assessment by ranking all the options in a list to find the least cost options is Step 1. Another simple ranking however this time using the AISC is Step 2. A comparison of both numbers to conclude if the AISC added value, bringing additional benefit at a lower or similar costs then made Step 3. If the AISC compares two similar options, the highest AISC was taken as the preferred scheme instead of AIC. The preferred solutions are then put forward for Strategic Environmental Assessment (SEA) and Habitats Regulation Assessment (HRA), where applicable. The approach is considered in Chapter 8 – 'Environmental Assessments of the Plan'. The results of the SEA and HRA assess whether the solutions have an overall positive effect on the environment or a negative. The answer aids the decision to either withdraw a scheme from the plan for further consideration, whether an alternative preferred solution is available, or whether to continue with the preferred solution.

The best value set of solutions is a manual decision bringing together the rank of AIC, comparing this with the Rank of AISC, then considering whether the solution has a positive or negative score in the SEA and HRA. When all these are considered along with the 2nd stage solution if there is one regarding the most appropriate time to carry out the delivery. The best value solutions is chosen concluded.

The process we have followed for the bottom-up plan, once the AIC and AISC has been calculated, is a simple rank of projects and then a selection of either the least cost or the best value within a zone at Level 3 to be put forward as the first preferred solution for that area. This removes the alternative options that could have been chosen from the preferred programme.

To create the preferred programme for Level 2 each preferred solution for that area is ranked together to explain the pathway of actions to be undertaken that is also best value for the company at Level 2.

To create the preferred company-level programme, all schemes derived and included within the Level 2 plan were ranked equally against each other and the lowest AIC and AISC combination was derived as the pathway. The full programme appraisal (for the strategic plan – top-down plan) is again another ranking of the preferred solutions. In this iteration the plan will be based on the AIC value, like the options appraisal approach, but instead of comparing solutions and dropping solutions from the choice at this level all solutions are required.

The reason for the appraisal stage is to programme all the solutions over time in a cost-effective way and in the order required by the time horizon. The programme is rolled up from Level 3 and combined with other TPU and again prioritised into a long-term programme of actions. This again can then be rolled up to provide a Level 2 SPU order of prioritisation and once again the process can combine the whole list of prioritised solutions into a company level priority. The PR24 best value programme, the list of optimised solution, and HRA/SEA assessed schemes were put forward to the business plan for further cost and programme optimisation.

This is our approach during Cycle 1 however there is a variety of company approaches being trialled and we will take stock of their learning, reviewing our approach for Cycle 2 based on our own and industry best practice.

7.2.5 Programme Delivery Impacts

7.2.5.1 Deliverability

Consideration has also been given to deliverability. To start to develop a realistic delivery programme some decisions regarding the order in which to undertake suites of solutions need to be clearly thought through. There are 2 options to consider in terms of deliverability, and these are:

- Suites of schemes can be delivered in a zonal approach, so all risks in that area are solved together in a concentrated timeframe; or
- Single solutions are delivered across Wales limiting the impact on customers spreading the benefit but not leaping forward in terms of achievement but taking a slower incremental approach.

Both approaches to deliverability have been incorporated into the plan to develop a methodology for each.

Decisions have also been made in our bottom-up schemes, to limit the disruption to customers in a single location. Therefore, a programme will not have more than one solution delivered in a 5-year period.

We have also considered whether to constrain the programme by setting an equal capital expenditure over the 25 years to undertake the full programme and then produce a list of solutions for each 5-year period. This option is outlined in section 7.2.6, below. Customers asked us to consider the number of times that we return to the same location and during the development of the delivery programme we will consider short and long-term planning to reduce the times we visit a location to make improvements but please note that repairs can be less predictable.

The distribution of work across our operating area is also important. We need to ensure that work is carried out in a way that communities are not impacted too disproportionately. Planning the locations of work to be improved so that our service is maintained is just as important as the limitations on affordability.

7.2.5.2 Affordability

Consideration of affordability was one of the 'willingness to support' objectives from the outset and the ability for bills to remain stable has influenced the development approaches in this Plan.

Willingness To Pay (WTP) has not been included in our methodology, even though it is part of the WRMP approach. As the investment required to 'solve' the programmes of work is in the billions of pounds realm. It seemed more important at this stage to ensure that customers aspirations were captured, leaving the WTP for business plan cost optimisation.

For this cycle, we are excluding the monetary value of willingness to pay as timings suggest that this is a business plan activity rather than a DWMP activity for the first cycle. We have however carried out a willingness to support a programme of work excluding the monetary cost of the whole plan and delved into willingness to support a programme based on aspiration and society level costs. The many billions of funds required to achieve the varying policies being discussed to meet environmental harm, max spills to 40, 30, 20, 10, 3 or 0.

We found that our customers had no tolerance for an extended end destination when it came to the service to customers such as internal sewer flooding to people's homes but were more tolerant of a longer-term time frame for CSO flooding reductions programmes. Now that we know this important pace-setting information, we can include this within our programmes and build it into our optimisation tool.

What we have learnt from the production of this first plan is that the aspirations aims and objectives of government, regulators and stakeholders is much greater than our customers can afford. During the customer research the 30 individuals that were immersed in the detail of the plan understood that there needed to be a balance between what we want to change and how fast we make change happen.

They recognised that bills would need to go up, but the message from customers was to increase gently and not carry out a sudden large increase as this would be difficult for families to budget for. The rate of rise will only go partially to the end destination of both customers and the environment. The range of uncertainty linked to the Welsh government study on storm overflows though could suggest that the rate of rise could need to be higher as Government too set the pace of change. We will review this again while we develop the next plan.

7.2.5.3 Finance ability

Another part of planning for society is the ability for water companies to raise other funds on top of funds from bills. The current route to additional funding is limited to the same borrowing and saving mechanisms that customers use through banks. But there is also a fundamental consideration that needs to be explored. Our ability to raise funds and bills is linked to our legal licence to operate as a water company. There are activities that we are funded to undertake and there are assets that we are funded to maintain. In the arena of drainage and flooding the ownership and responsibility for assets and systems is mixed which causes conflicting decisions between organisations and customers involved with ownership liabilities.

To truly deliver a change to the management of drainage, the ability to access funding routes that are currently not open to a water company is required to do the right thing from a Team Wales approach. Whether access to those funds is through cocreation or alternation of the operating licence, we recognise that change is needed and that we as a society need to work together in the meantime to be as efficient with the funds we have together, to gain greater benefits for the people we service. In the drainage plan there are opportunities that are not in a water company's direct ownership but would still be beneficial to support and as we develop these plans, we need to work with government to make legislation easier to navigate to gain greater efficiency from the money us as differing organisations, working towards one goal, can make alone.

7.2.5.4 Disproportionate Benefit

A constraint that does stop some improvements being made relates to the real issue of disproportionate benefit. This happens when the cost versus the benefit derived means that to stop the occurrence happening either the cost is too high or the benefit too low, or versions of these indicating that the solution shouldn't progress as there are other more beneficial solutions that have a greater overall benefit that can be delivered before it.

When most solutions to solve a problem have been delivered, leaving only those that were previously considered as disproportionate, these problems then have to be stacked against others that solve different problems and again analysed to indicate whether that solution is still disproportionate to the benefit delivered. What is really being said is that unless the value of the problem to be solved changes, the list of remaining disproportionate solutions will still be needed but ranked below others that deliver greater benefits. The DWMP will still prepare the solution and analyse both the cost and the benefit against the risk. These will be presented in each cycle of the plan until such a time as the benefit derived drives the solution or a change can be made to the solution to alter the outcome.

7.2.6 Programme Delivery Scenarios

The programme appraisal approach has been developed at a company level to support decisions that will be made by the company. As the price review planning role is outside of the DWMP itself, several delivery approaches have been developed to inform business planning decisions.

The approach to programming is designed to optimise the delivery of interventions across multiple investment prioritisation periods. This has initially been set in line with the DWMP time horizons, within the cycle that spans from AMP8-AMP12 (2025 to 2049). The functionality of the tool has been developed so that the tool can also be used for different time periods.

In this cycle of the DWMP, the programme appraisal has been carried out on the preferred options for each risk cluster, at a company level, by collating individual preferred options for wastewater catchments, where tactical interventions have been developed through the DWMP. The interventions developed in this cycle of the DWMP are designed to address existing worst served customer flooding and reduce CSO spills within special areas of conservation in line with the approach set out in Chapter 1.16 (Level of Service). The solutions are set out to resolve the existing issue (address CSO discharges at sensitive sites to zero spills) and provide future rainfall protection to 2050. Although the tool focuses on individual options for these locations, the reference option tool which is based on the same data provides the strategic planning tool to support investment cases for costs associated with all combined storm overflows.

Three delivery approaches have been developed and are calculated in the programme appraisal tool. These approaches provide the flexibility and variability to support the investment planning and scenario testing to optimise the delivery of outcomes.

The Programme Appraisal delivery methods are as follows:

- Delivery Approach 1 – Fixed Budget (Constrained delivery plan approach)
- Delivery Approach 2 – Variable Budget (per AMP)
- Delivery Approach 3 - AMP8 Full delivery, AMP9+ Flat Variables

The number of solutions created for the DWMP localised plan and show in the draft was 107 suites of solutions this has risen to 219 due to the added negative impacted SEA/HRA solutions plus the additional of a further five catchments making the total number of catchments to 44. The original 107 solutions from the draft are shown below in Table 66:

Table 66 Overview of the DWMP ODA solutions

Total Overview		
	Total Number schemes	Total Cost
2025-2030	24	£72,916,196
2030-2050	23	£42,190,579
2025-2050	60	£271,257,046
Total	107	£386,363,820

The distribution of schemes as set out in table 66 the post PR24 programme based on the derivation of a solution to solve a risk at a specific time horizon in this case either in 2030 or 2050. The outcome once it was understood that the programme had to be cost constrained due to its large investment requirement drove the need for a cost appraisal optimisation tool. The Schemes in Table 66 were included within these delivery approaches to cost optimisation to identify the best distribution of the overall programme into 5 yearly programmes. The detail behind the approach is included within sections 7.3.2 to 7.3.4 below, along with the potential investment plan for each method.

Table 67 presents an example of an L1 delivery approach comparison. It shows individual scheme costs and benefits, together with any dependency on other solutions being delivered, to facilitate each scheme. Schemes are subsequently ranked to allocate an investment priority, based upon budget parameters set by the company for the three delivery approaches.

Table 67 - Company Level (L1) Delivery Approach comparison example

					Delivery Approach 1 - Fixed Budget	Delivery Approach 2 - Variable Budget	Delivery Approach 3 - Inv Priority 1 Full delivery, Inv Priority 2+ Flat Variables
Scheme Description					Delivery Details	Delivery Details	Delivery Details
AIC	AISC	Fixed Capex	Combination	Year	Investment Priority	Investment Priority	Investment Priority
£199.40	£199.40	£408,811.89	No	2025	Inv Priority 1	Inv Priority 1	Inv Priority 1
£244.21	£225.27	£25,397,207.78	No	2025	Inv Priority 1	Inv Priority 1	Inv Priority 1
£384.01	-£28.22	£2,258,716.71	No	2025	Inv Priority 1	Inv Priority 1	Inv Priority 1
£397.45	£205.47	£1,445,614.39	No	2025	Inv Priority 1	Inv Priority 1	Inv Priority 1
£455.44	£398.65	£1,773,390.29	No	2025	Inv Priority 1	Inv Priority 2	Inv Priority 1

Each of the three delivery approaches takes the output from the NPV Optimisation process at an individual catchment level and collates them at the company level (Level 1). The following are collated into the programme appraisal and therefore prioritisation can be carried out across all schemes for each of these categories:

- AIC – Least cost
- AISC – Greatest Environmental and Social Benefit
- Fixed Capex – Construction cost

All preferred options, once collated, are prioritised into investment planning periods based on the AIC value. It was decided to rank via the AIC rather than the AISC as this follows the Least Cost Ranked approach. The schemes are then ranked for investment priority through the fixed CAPEX cost for the available DWMP delivery budget within each investment planning period. The programme was based on an approach of Fixed CAPEX to align with the business approach towards delivery planning. Where schemes fall outside of the plan time horizons and budget, the schemes are marked to be delivered in AMP13 (and beyond) and all schemes that are not delivered will be re-evaluated through future DWMPs.

Where a scheme has been progressed through the NPV optimisation as a preferred option but is a Parent and Child scheme (the scheme is to be constructed in two phases) the scheme is split into the two phases prior to input into the Programme Appraisal tool. The delivery approaches all have a rule basis, so that the child schemes cannot be delivered before 2030, or before the parent scheme and therefore may be programmed into a later investment period.

Although the options have been prioritised based on AIC, the programme appraisal tool has the functionality to prioritise into investment planning periods based on AISC to support selection of the most beneficial output.

The tool has not been developed to allow for inflation, and this has not been applied to the option costing. This has not been applied intentionally to ensure that the comparison is not skewed by another unknown variable.

Table 68 details the projected investment spend per AMP. This defined budget, limits the schemes that can be allocated to each investment priority level.

To allow us to develop indicative spend profiles and consider their impact on outcomes and cost we have developed a set of realistic CAPEX allocations for AMP8 to AMP12 as thresholds, within which we can consider what can be achieved. The outcome of this investment scenario testing provides the foundation for a PR24 investment case but, equally, a platform for discussions with government and regulators over the most appropriate delivery pace for customers and the environment.

The first investment budget allocation of £60m had been agreed upon internally but during the price review process the 2025 to 2030 budget allocation from the DWMP was reduced to £50m will be supplemented in AMP8 by additional wastewater investment, as part of our business-as-usual investment planning approaches plus investment for NEP. However, future AMPs are projected as indicative values only and will be reviewed as part of Cycle 2, as the integration of the DWMP with our price review planning process is strengthened. The choice of the budget is depending on other factors such as the size of the NEP programme and the base funding from the Ofwat econometric model.

Table 68 - Indicative Investment Budget constraint Per AMP

Delivery AMP	Budget (£ Millions)	Equivalent Priority
AMP8	50	Investment Priority 1
AMP9	120	Investment Priority 2
AMP10	240	Investment Priority 3
AMP11	480	Investment Priority 4
AMP12	960	Investment Priority 5

The appraisal assessment is carried out at L1 based on the input data from the NPV Optimisation at a catchment level. The programme appraisal tool provides filters to identify prioritisation at L2 and L3 for specific catchments at this level, as per the Table 69 and Table 70 examples below.

Table 69 - L2 SPA Appraisal example

L2 SPA Catchment Selector	Tawe to Cadoxton				Delivery Approach 1 - Fixed Budget	Delivery Approach 2 - Variable Budget	Delivery Approach 3 - Inv Priority 1 Full delivery, Inv Priority 2+ Flat Variables
Scheme Name		Location Details	Scheme Description		Delivery Details	Delivery Details	Delivery Details
	Scheme Name	L2 Ref	AIC	AISC	Investment Priority	Investment Priority	Investment Priority
003-DFL.002873_4a-2025-20!	002873_Sustainable_2025-2050	Tawe to Cadoxton	£244.21	£225.27	Inv Priority 1	Inv Priority 1	Inv Priority 1
001-AlfredStreet_4a-2025-205	AlfredStreet_Mixed_2030-2050	Tawe to Cadoxton	£397.45	£205.47	Inv Priority 1	Inv Priority 1	Inv Priority 1
005-DFL.Meadow Street_2a-2(	Meadow Street_Traditional_2050	Tawe to Cadoxton	£455.44	£398.65	Inv Priority 1	Inv Priority 2	Inv Priority 1
RZ006-DFL.003812_2a-2025-	003812_Traditional_2050	Tawe to Cadoxton	£478.96	£469.36	Inv Priority 1	Inv Priority 2	Inv Priority 1
008-DFL.000393_4a-2025-20!	000393_Mixed_2030-2050	Tawe to Cadoxton	£564.49	£549.66	Inv Priority 1	Inv Priority 2	Inv Priority 1
RZ008-DFL.002463_4a-2025-	002463_Mixed_2050	Tawe to Cadoxton	£666.70	£567.48	Inv Priority 1	Inv Priority 2	Inv Priority 1
008-DFL.002828_4a-2025-20!	002828_Traditional_2030-2050	Tawe to Cadoxton	£712.16	£703.96	Inv Priority 1	Inv Priority 2	Inv Priority 1
002-DFL.003287_2a-2025-20!	003287_Traditional_2030-2050	Tawe to Cadoxton	£770.24	£712.24	Inv Priority 1	Inv Priority 2	Inv Priority 1
009-DFL.002506_4a-2025-20!	002506_Mixed_2030-2050	Tawe to Cadoxton	£779.44	£192.08	Inv Priority 1	Inv Priority 3	Inv Priority 1
RZ001-DFL.002030_4a-2025-	002030_Mixed_2050	Tawe to Cadoxton	£862.60	£601.63	Inv Priority 1	Inv Priority 3	Inv Priority 1
001-DFL.004171_4a-2025-20!	004171_Mixed_2050	Tawe to Cadoxton	£920.92	£655.22	Inv Priority 1	Inv Priority 3	Inv Priority 1
RZ003-DFL.002019_4a-2025-	002019_Mixed_2050	Tawe to Cadoxton	£950.54	£658.12	Inv Priority 1	Inv Priority 3	Inv Priority 1
RZ006-DFL.Dunraven Street_4	Dunraven Street_Mixed_2050	Tawe to Cadoxton	£956.45	£529.65	Inv Priority 1	Inv Priority 3	Inv Priority 1

Table 70 - L3 TPU Appraisal example

C	D	E	F	G	H
			Delivery Approach 1 - Fixed Budget	Delivery Approach 2 - Variable Budget	Delivery Approach 3 - Inv Priority 1 Full delivery, Inv Priority 2+ Flat Variables
Location Details	Scheme Description		Delivery Details	Delivery Details	Delivery Details
L3 Ref	AIC	AISC	Investment Priority	Investment Priority	Investment Priority
Ogmore - confluence	£397.45	£205.47	Inv Priority 1	Inv Priority 1	Inv Priority 1
Ogmore - confluence	£564.49	£549.66	Inv Priority 1	Inv Priority 2	Inv Priority 1
Ogmore - confluence	£712.16	£703.96	Inv Priority 1	Inv Priority 2	Inv Priority 1
Ogmore - confluence	£770.24	£712.24	Inv Priority 1	Inv Priority 2	Inv Priority 1
Ogmore - confluence	£779.44	£192.08	Inv Priority 1	Inv Priority 3	Inv Priority 1

This approach allows the budget limits for scheme delivery to be set for each AMP, so that if there are amendments to the available budget, because of changing pressures on the organisation, or because of a different price review settlement, then the programme appraisal can be optimised to the revised budget. The budgets assigned per AMP are set as variables within the tool to allow for scenario testing.

7.2.7 How the programme feeds into the price review process

The DWMP is carried out every five years and within a similar timeframe, but slightly offset, so is the price review. It was our intention to develop the DWMP with both the DWMP framework requirements and Ofwat price requirements in mind. However, the Ofwat Price Review Methodology was published in July 2022. We have utilised our experience of undertaking the Price Review to build a process that works during this non-statutory phase of the DWMP. We have been developing a process that will slowly integrate the two approaches into one approach for the specific price control of the plan, Wastewater Network Plus. We have made great strides and have recommendation for improvement ready for Cycle 2.

However, the DWMP is a strategic long-term planning tool and we have seen an opportunity in Cycle 1 for the plan to inform discussions on national policy and direction in terms of the pace, scale, and affordability of the various delivery options. The outcomes from this first cycle demonstrate that this is not just a discussion about the pace at which we can protect customers and the environment but also about the need for integrated working arrangements with local authorities, the ability of the supply chain to deliver the scale of capital investment and the appetite of the customer for disruption in their communities to deliver the scale of improvement required.

The strategic level is where we show different policy decisions for discussion with government regulators stakeholders and customers. In this plan we have demonstrated the cost to customers to move from today's policy to move to differing alternatives based on a policy of CSO spill variation and also a policy to remove internal sewer flooding.

At a company level, the cost to change the policy and reduce all CSO spills to zero at every location of the 2000+ locations would be £8.4bn by 2050 and including variable rainfall forecast at 2050. This has been noted to be too high an impact on customer bills and the Better River Task force headed up by government has introduced an additional milestone to remove environmental harm as the first priority costing £5bn by 2040.

Our customers have indicated a slower pace would be acceptable due to the cost-of-living pressure at the moment. A management plan should provide a more balanced assessment of the future and by adding in the customer expectation that no customer should experience internal sewer flooding from hydraulic overload we can estimate that the cost would be higher with all customers should £5.5 bn by 2050.

The tactical Level is where we show at each priority location the suite of solutions required at that location not only to meet today's risks but also to incrementally plan to solve for future years risks as well.

During this non-statutory phase, we also considered the most appropriate approach to developing tactical solutions. It was when the plan considered a level of service across a geographical area, rather than a specific performance objective, that suites of solutions were then coordinated to improve service to customers and the environment.

There are three test locations that have undergone the end-to-end process with a view to 'solving' the catchment and these will be used to test the PR24 process and learn how to develop schemes to address catchment level strategy rather than planning objectives.

Our preferred plan for the year 2025 to 2030 will be presented in the price review process and our DWMP will be reworked to take account of the decision to address current issues and their impact on long term delivery. Our plan has influenced the price review and the strategic programmes that the DWMP indicates are being put forward for funding in PR24. We will continue to take on board best practice from the industry while continually improving our approach to planning.

7.3 Choosing the programme approach

The solutions based on the date when the risk could materialise, those allocated to 2025-30 and those allocated to 2030-50, is shown in

Table 71, The table also shows solutions that were constructed by taking the full benefit up until 2050 and delivering the solution earlier, so within the first 5 years. These solutions marked as 2025-2050 would produce a best value plan when the benefit and cost is analysed. The number of solutions created for the DWMP localised plans is 219.

Table 71 Overview of the DWMP ODA solutions

	Total Overview		
	Total Number schemes	**Total Cost**	
2025-2030	21		£49,324,071
2030-2050	44		£68,852,047
2025-2050	154		£1,436,206,936
Total	219		£1,554,383,055

The distribution of schemes as set out in

Table 71 the post PR24 programme based on the derivation of a solution to solve a risk at a specific time horizon in this case either in 2030 or 2050. The outcome once it was understood that the programme had to be cost constrained due to its large investment requirement drove the need for a cost appraisal optimisation tool. The Schemes in

Table 71 were included within these delivery approaches to cost optimisation to identify the best distribution of the overall programme into 5 yearly programmes. The detail behind the approach is included within sections 7.3.2 to 7.3.4 below, along with the potential investment plan for each method

7.3.1 Investment Constraint Analysis

We analysed the preferred list, all of which needs to be delivered at some point. We compared different ways of making decisions so that we can find the programme to meet a no regrets first stage and then to find the ones that would provide greatest benefit if delivered earlier; these may not be required just now but could be cheaper and bring more benefit for the next stage of investment and then to programme those that are left.

We looked at options in terms of investment constraints. All options are constrained to different levels by the amount of investment that can be realistically obtained to deliver them.

This stage is focused on understanding the consequences of different options and decisions on our plans. It tells us whether we can delay spending now until the future, and what the future programme would then need to look like so we can continue improving our service.

Our appraisal takes into account how affordability of today could alter the number of solutions delivered in the first five years and then the consequence to the remaining 20 years of this DWMP period. We have created 219 separate suites of projects overall costing £1.55bn prior to the assessment of the SEA and HRA. The full breakdown of schemes into a programme of work is shown below.

The unconstrained programme to meet both final destinations is based on risk i.e., when it is likely to occur and beneficial outcomes when its more cost effective to deliver them early. This programme is demonstrated as Delivery approach 3 in Section 7.3.4. If money were not a constraint the programme would deliver 80% of the solutions at £1.4 bn within the first 5 years, customers when asked, did not agree that this approach was reasonable. It demonstrated clearly that the amount of work to be carried out and when it is required to be achieved is not possible for customers to fund. The programme is based on meeting the final destinations and achieving standards of rainfall return periods stated within the framework. What is needed for

DWMP29 is the addition of further interim stages between todays zonal performance and the expected zonal performance at each 5 year timestep.

It is important to understand that this is our first plan produced in this way. We have learnt a lot during its preparation and there are some recommendations we need to consider when we produce the next plan. Some of these recommendations have been included in the proposal below as we have learnt that during the phase to manage affordability and produce a delivery programme the way the solution is created has a large impact on the design of the final programme. The development of zonal milestones is also a realisation that needs to be considered when appraising the schemes and we will be looking into that further for Cycle 2.

We have also received the results of the SEA and HRA and learned that some of the solutions had a perceived negative impact with the majority being of minor perceived negativities. Again, as this is our first iteration of a plan in this way, we are going to be cautious when promoting any solutions that may be perceived as negative, whether major or minor. The impact on the programme and reduction in cost is brought out in the following statements.

Any solutions post SEA HRA that indicate a negative impact is still included in the investment programme and if chosen for delivery will undergo further down the line assessments on their impact to the environment. Those that are not taken forward will be reviewed again in DWMP29.

The following sections present an overview of the programme delivery scenarios, which have been prepared using the 219 schemes developed from the bottom-up approach. The scenarios set out below show the range of approaches that can be taken towards profiling expenditure on the 219 schemes, which are targeted at the worst customer and environmental impacts.

The three delivery approaches, discussed in section 7.2, above have been presented below to record how customers made their choice which was the preferred Delivery Approach 2 - a variable increasing profile. We have presented the 3 approaches in this section so that the conclusion can be referenced as we move into DWMP29.

7.3.2 Delivery Approach 1 – Fixed Budget (Constrained delivery plan approach)

This approach uses a fixed budget available for delivery in a 5 year period (AMP8-12) and that budget is consistent across each AMP. In the outputs below the original value within the drafty was a fixed budget set at £60m per AMP. The budget has been applied as a parameter for cost scenario testing. Within the final plan the indicated outcome of the PR24 process has constrained the first 5 years to £50m and this approach has then returned the remaining 20 years back to £60m. This approach allows the assessment of how many schemes could be delivered in one planning period and highlights the number of planning periods required to deliver all schemes.

If a scheme CAPEX is greater than the remaining budget in an AMP period, the scheme will be programmed for delivery in a later period and the next available scheme in the ranking that can be delivered within the remaining budget will be programmed in the delivery period.

Where a scheme CAPEX is greater than the total in period budget then the scheme will be programmed into the future planning period, beyond those within the DWMP cycle of AMP8-AMP12. This sometimes results in schemes with a greater AIC or AISC value being placed in priorities lower than those with a smaller AIC or AISC value, but it is designed like this to get the most efficient programme from a budget.

Table 72 below details the intervention programme for Priority 1 to 6 schemes across DCWW and the investment priority profile is defined in, Figure 92 below. In these examples, Investment Priority 1 schemes are expected to be delivered in the first investment period (referring to AMP8), Priority 2 schemes in AMP9, and so on.

Table 72 - Intervention Programme Fixed Budget Assessment

Delivery Approach 1 - Fixed Budget			
Priority	**Total Number schemes**	**Total Cost**	**Proportion of total schemes**
Inv Priority 1	21	£49,324,071	3%
Inv Priority 2	29	£60,047,180	7%
Inv Priority 3	22	£59,997,165	11%
Inv Priority 4	9	£60,049,969	15%
Inv Priority 5	15	£59,982,453	19%
Inv Priority 6	123	£1,264,982,215	100%

Table 72 demonstrates that, at a spend profile of £60m per AMP, in 5 AMP periods 19% of schemes would have been delivered leaving many projects for delivering in subsequent AMPs, requiring further investment of £1.2bn.

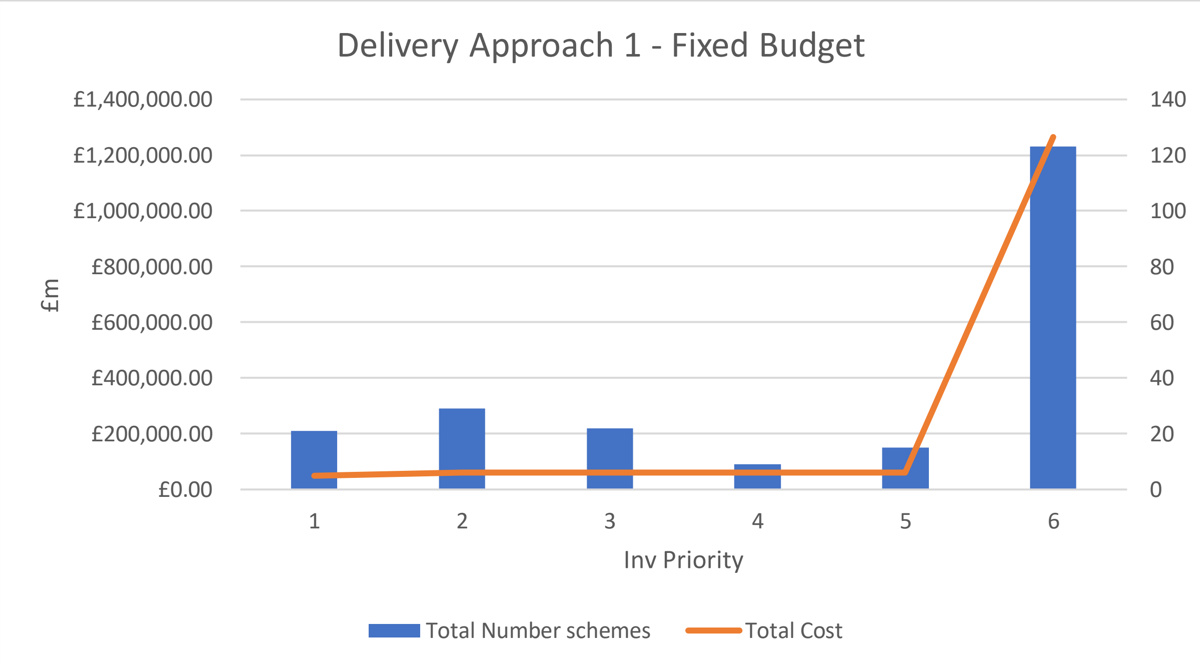


Figure 92 - Fixed Budget Investment Priority Profile

7.3.3 Delivery Approach 2 – Variable Budget (per AMP)

This approach considers a variable budget over each AMP period. The methodology can apply any budget constraint to an AMP period and allows the spend profile of schemes within each AMP to be adjusted accordingly. In the scenario below, the value of the fixed budget has been set at £50m in AMP8 and then increasing to £120m and then doubling subsequent AMP periods, in line with Table 68, above.

Table 73 below details the intervention programme for Priority 1 to 6 schemes across DCWW and the investment priority profile is defined in Figure 93.

Table 73 - Intervention Programme Variable Budget Assessment

Delivery Approach 2 - Variable Budget			
Priority	**Total Number schemes**	**Total Cost**	**Proportion of total schemes**
Inv Priority 1	21	£49,324,071	3%
Inv Priority 2	51	£120,482,532	11%
Inv Priority 3	42	£240,477,573	26%
Inv Priority 4	39	£480,474,880	57%
Inv Priority 5	60	£657,833,830	99%
Inv Priority 6	6	£5,790,165	100%

The table above demonstrates how, at the proposed increasing variable budget distribution, all 219 schemes will have been completed over 5 AMP periods.

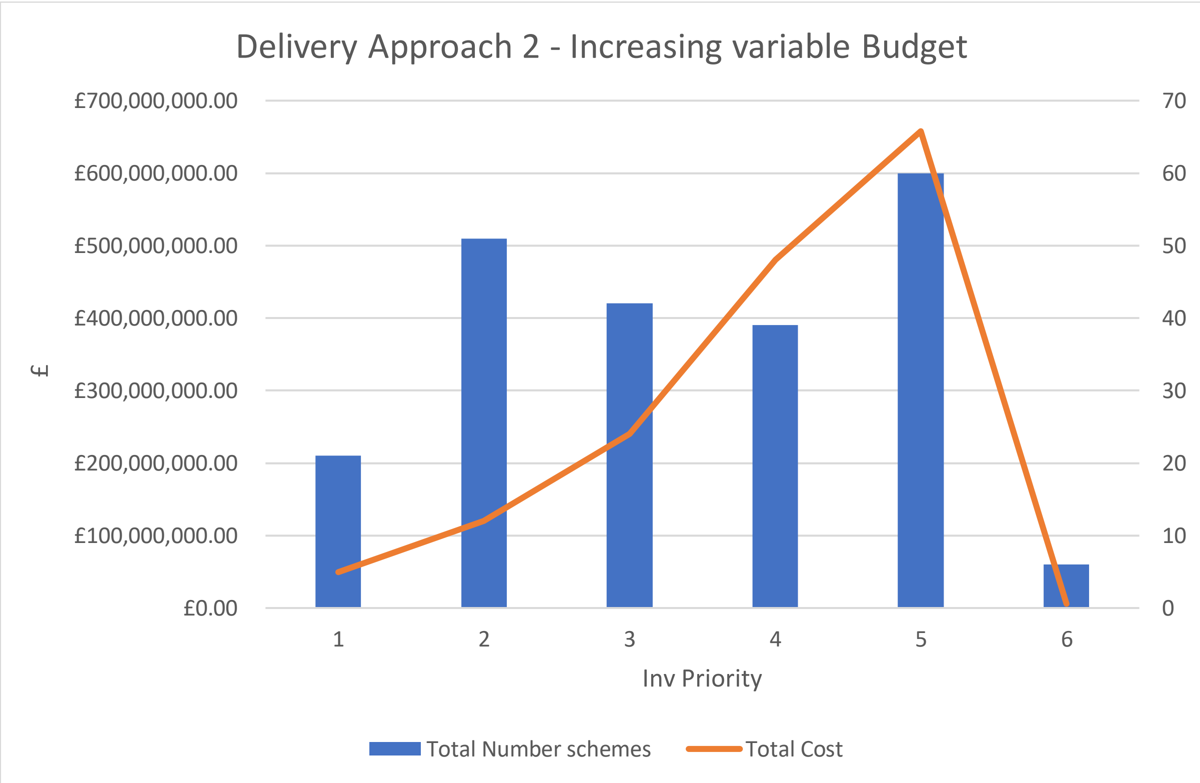


Figure 93 - Variable Budget Investment Priority Profile

7.3.4 Delivery Approach 3 – Investment Priority best value based on Date of delivery.

This approach demonstrated the scale of investment required to deliver the risk and aspiration benefits based on the likelihood of the risk materialising at a date. The profile provides an indication of the total cost required to deliver the best value options for each suite of schemes to resolve all current worst-served customers and stop SAC spills. The profile has indicated that if cost were not an issue the best value programme would have been to deliver within the first planning period (AMP8).

There would still need additional delivery of further enhancement schemes to provide the additional protection up to 2050 of no flooding or spills at these locations. The remaining solutions are then split across the remaining 20 years, 4AMPs of the DWMP Plan. The programme is distributed across the 20 years via the total CAPEX averaged in each AMP.

Table 74 below details the intervention programme for Priority 1 to 6 schemes across the DWMP enhanced and complex areas only and the investment priority profile is defined in Figure 94. Customers through the research programme indicated that the cost was too high, this highlighted that customers were not willing to continue at this pace and aspiration due to affordability.

Table 74 - Intervention Programme Investment Priority 1 Full delivery, Investment Priority 2 + Flat Variables Assessment

Delivery Approach 3 - Inv Priority 1 Full delivery, Inv Priority 2+ Flat Variables			
Priority	**Total Number schemes**	**Total Cost**	**Proportion of total schemes**
Inv Priority 1	175	£1,485,831,008	80%
Inv Priority 2	27	£25,923,840	92%
Inv Priority 3	10	£23,634,300	97%
Inv Priority 4	4	£17,682,266	99%
Inv Priority 5	3	£1,611,639	100%
Inv Priority 6	0	£0	100%

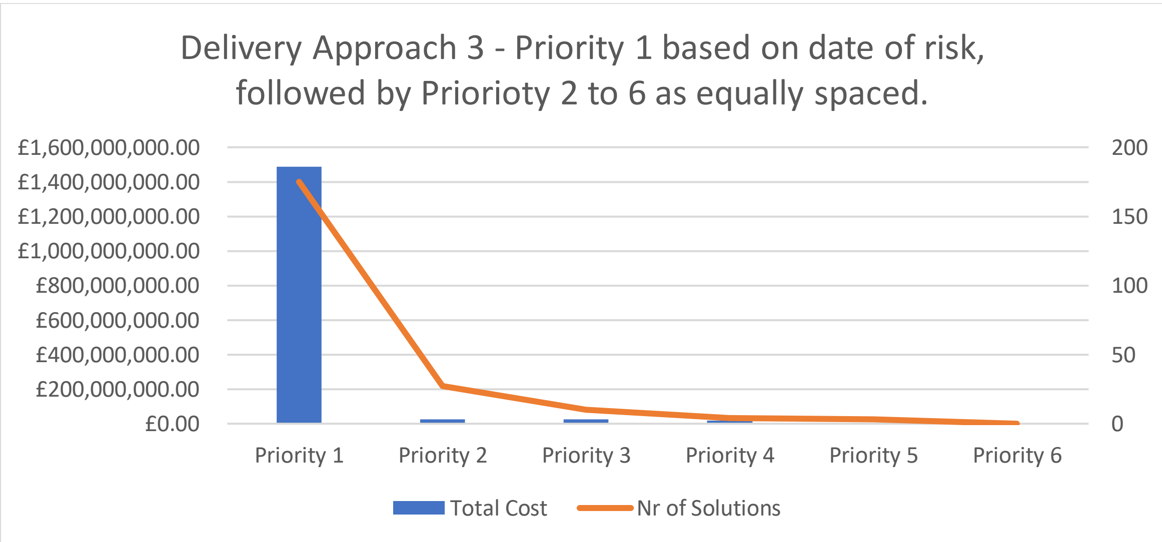


Figure 94 – Time of Risk prioritised without cost constraint.

The above investment scenarios demonstrate that solving all the worst served customer flooding issues and addressing pollution to protected water bodies would not be practical or affordable in a single AMP period, as set out in Delivery Approach 3. It also shows that both the fixed and variable budget approaches would be viable.

The outputs of these approaches have now be assessed as part of our PR24 investment planning work to determine whether the draft indicative budget of £60m could be funded in AMP8. The PR24 assessment indicated that AMP8 would need to be reduced by £10m to align with other drivers in PR24. The combined PR24 and DWMP programme is outlined in Table 68 above. The DWMP profile is indicating a continued rise in investment so that the performance aspiration from customers is considered. The impact from the PR24 process is indicating that the DWMP programme will again each AMP need to be further constrained in future AMPs. These suites of solutions need to be considered alongside other workstreams and programmes such as the NEP. The AMP8 values have been constrained to reflect decisions with regards to the wider drivers. This has provided added insight to the company in addition to the long term delivery strategy indicating that bills will need to be higher in the future to meet the new aspirations of customers and Government.

7.4 The DWMP bottom up programme

We recommend based on customer and stakeholder appetite relating to affordability that a variable budget (Approach 2) be set as there is a need to increase bills to deliver the expectation. The DWMP provided 24 of the detailed solutions all with a requirement for delivery by 2030 for inclusion within PR24 with all solutions containing targets into the future being deferred for additional assessment. All the solutions created are still needed and will be put forward again at PR29.

This programme has produced an investment to improve the environment and to reduce occurrences of flooding to homes and businesses and is in the realm of £49 million by 2030 and £120 million in the years 2030-2035, £240m between 2035 and 2040, £480m between 2040 and 2045 and £660m up to 2050. This investment has been calculated to address only the Catchments consider to be in with Extended and complex risk bands of the DWMP and those to meet 2 planning Objectives, Storm Overflows and Internal flooding. In terms of a bottom up plan there is still additional planning objective to be added to these totals.

We know that this investment will again need to be re-examined for affordability and pace towards the end destination. While this DWMP has provided opportunities to develop new methodologies and approaches to planning we have learnt that the programme is constrained by customers ability to pay their bills, the ambition of government with regards to the latest emphasis e.g. storm overflows. It is our next step to consider how to demonstrate the need for investment by a given date and an agreed milestone at a zonal level and then demonstrating how that investment needs to be altered to meet affordability. This time our plans were developed to reach an end destination of zero for both internal escapes into property and storm overflows to zero in SAC areas in the extended and complex risk zones identified within the DWMP process. There are differing ways to reach the end goal and we will be working with our regulators on this for DWMP29.

The DWMP programme isn't the whole story for the company business plan. What has been produced using the Framework is the beginnings of an integrated process to planning that incorporates differing approach to risk and options development. We are not responsible for the NEP and FLCM methodologies to name a few of the issues that were found. The Framework needs to expand to allow for these methodologies and recognise the are fundamentally the same but different.

7.5 Regional Investment Strategies

For each of the 13 L2 River Basin Catchments a summary overview report has been generated. As well as providing the pathway for that region through the DWMP process, they present a review of the best value plan for the region within these documents which included the testing of types and combination of schemes through to the 2050-time horizon.

The regional summary provides an overview of the area and the assets included within it, the RBCS and BRAVA results, The WFD distribution of Water body ID status, the analysis of Supply and demand risk for both dry weather and for a design storm and the consequence on capacity for the network and the WWTW's, the journey plan activities to resolve flooding and pollution, indicative costs to inform storm overflow policy in the local area, indicative costs to resolve customer flooding in the local area, the number of identified detailed suites of solutions developed and incorporated into a programme.

These regional strategies have identified the likely costs required to mitigate future predicted pollution through storm overflow performance and catchment flooding, two critical network planning objectives. These likely costs across the region are presented as a series of scenarios towards achieving performance improvements based on current catchment conditions as well as the Future Scenarios where the additional impact of growth, creep and climate change influence the investment needs. These summaries include detailed model driven options development as well as non-modelled approaches to determine strategic costs. These have been presented here for transparency to customers and stakeholders. We agree with our customers that the end destination is the aspiration, and we will be delivering the Better River Task force's recommendation to remove environmental harm as our initial milestone first. The DWMP will then continue to plan to reduce all escapes from our network whether to customers or to the environment at the pace our customers can afford for as long as our customers aspiration remains.

7.6 Least Cost Or Benefits

We take the combined best value list from the option development part of the plan and then rank the options on each of the following:

Least cost: What are the lowest cost options?

Benefits: Which options bring the most environmental and social benefits?

We have chosen to rank our programme based on the greatest environmental benefit which was supported by our customers and stakeholders during the consultation process. Our initial thoughts were to produce a least cost plan as the ODA step had already included the greatest beneficial options in our preferred list, however our challenge groups asked us to reconsider. We are driving as many environmentally cost beneficial schemes as possible.

We have chosen to produce a benefit programme of work for the plan, with affordability being the next stage to consider.

7.7 Affordability for customers

Every water and sewerage company in England and Wales is regulated by Ofwat. What this means is that they assess our plans and provide a determination, meaning that we state whether they agree or disagree with our plans for the next asset management plan in this case 2025-2030.

Our proposals must not only consider wastewater which is the topic of this plan but also considers how our water, and retail service is maintained and enhanced overall. Each section requires a proportion of customers' bills to do this. We can also borrow money the same as any business to deliver more benefits when is economically feasible to do so. We are in a unique position as a water company of being not for profit which means any profits we make are reinvested straight back into the business to make further improvements.

What this really means to our investment plans and many demands for action is that what we can deliver is limited by the amount of money we have available to us. Currently, the environmental improvements through the national environmental programme led by our environmental regulator NRW and the EA are in higher proportion to other demands leaving less to go around to make balanced improvements. The recent media coverage regarding how the industry operates specifically regarding the legacy asset of storm overflows has added another demand on the amount of money provided by our customers.

We discussed how customers would like us to prepare our investment plans as part of the customer research with the in-depth selection of 30 customers, they were very vocal on the subject bringing all of the arguments for keeping bills low and discussions regarding those that cannot pay and the need to support these individuals. We as a company have provided support to those customers through additional campaigns. However, they also recognised that if we want to continue to have a higher standard of service for customers and the environment then there will be a need to increase bills at some point.

One individual was adamant and called to us not to carry out a sudden rise on our bills in a similar fashion to the current energy bill increases. The group all agreed that they would prefer an incremental rise over a sudden step rise. We discussed with the group a small increase of £36 each and in principle they felt this an ok starting position. But we must recognise that customers do not separate each area such as water, retail and waste services when they consider bill increases. So, we must be realistic and consider this as a company bill increase, which wastewater is only approximately one third of £36. Customers also discussed their ambition as to when they would like to reach the end destination. This was variable, with some saying within 25 years and some saying over 75 years. The majority rested on 50 years as something they could imagine.

Now we have a starting value that customers could consider for planning purposes we can now indicate the effect of this choice on the end destination. Please note that this is to inform planning as the DWMP does not carry out a business plan and set the value of customers' bills. Setting bills is not a simple process as there are many factors to consider starting with a simple segmentation of domestic versus business customers and so on. So, for management planning purposes to help inform customers of the impact to bills on investment and the consequential time scale when we can achieve both the customer and environmental destination, we have prepared 3 scenarios. In each scenario every customer is assumed to pay the same amount for every year investment is required. It is also assumed that we are only showing the additional increase to bills not the total bill that a customer could pay.

We are continuing to learn how to bring all the requirements to maintain a wastewater and drainage system into one single management plan and recognise the inequality of service being received which has been driven due to a multitude of objectives and stakeholders all with differing objectives, some not being linked to how their objective links with affordability.

In conclusion bringing together our customers requirement to keep bills affordable and recognising that with only a small increase in bills in the near future we can only produce plans that provide an improved level of service to few customers and small areas of the environment or reduce our expectations in the short term to allow all customers and all environment as to gain an equal improvement.

We have already asked our customers via DWMP research and as part of the public consultation the preferences on the future approach. It was agreed by the majority that gaining equal improvements would be preferred while recognising that there would still be a need in some areas to have more improvements than others.

To address this in our assessments that will form the fundamental of our DWMP29 plan, we will develop solutions to achieve both end destinations by 2080 for every area that has a need during that time scale. We will then separate each improvement into the most beneficial order to undertake the improvement. Included in our management plan will be how we have considered the impact on customer bills and its impact on progress regarding the number of improvements to make each 5-year period. As we have shown in the example scenarios above and in Section 7.3 (Programme Appraisal – Choosing the programme approach) of this plan, we will also demonstrate how the programme will alter based solely on affordability and time to destination. In addition there will be alternative scenarios relating to pace and cost.

7.8 What does Base buy?

For this plan, the DWMP AMP8 investment in internal sewer flooding is considered as base investment and the investment to improve the level of service to an area is considered as enhancement. The investment in storm overflows is to drive a change to level of service which is enhancing our service. Base maintenance is assumed to be stable going forward and associated with the number of assets in our ownership therefore a management plan builds investment in addition to base maintenance.

In financial terms our regulator Ofwat wants to understand how much change to our network can be managed within our normal operating expenditure. Controversially, in the sewerage and drainage area of the industry you will hear often from many companies' employees stating that there isn't enough money to deliver the maintenance required. This does highlight a fundamental issue. Base funds in a regulated business are provided from a model that is managed by Ofwat. Several statistics are collected, and a new model is created each asset management planning period.

The results of this model provide funds for staff, the buildings and general business activities. This fund also provides money to replace assets that are failing or about to fail. In an asset management plan, the number of replacements that can be made to manage failure and the number of staff members that base will buy is a constraint and indicates how risk adverse any company can be. If money is tight then any company will hold off replacing assets that are due to be replaced, if there is an abundance of funds, then any company will reinvest in their assets more proactively. This means the company has greater resilience and more time to react if something goes wrong. This is business planning.

So, what does base buy? Put simply, money will be spent on the assets that have broken and money will be spent on statutory maintenance. If there are enough people additional time will be spent to ensure that the assets are optimised to gain as much life from them as possible. However, there is a trade-off here, because time is money.

While base is still finding reactive and short-term planning, assets that are expected to break in the next 12-months, base will not be able to fund proactive or long-term planning. In this plan we have already found out that there were opportunities to early invest in predicted risks that are likely to occur because they were cost effective and beneficial to the environment to deliver them early, however these solutions could not be put forward as the mechanism to fund these above base would mean an increase to customer bills higher than acceptable limits. More work is required in this area to explore how to deliver systematic proactive benefits while still keeping bills affordable.

7.9 Environmental Harm

We have carried out an innovative approach to assessing future water quality using the SAGIS software as mentioned in Section 5.3.2. We have considered several situations that could change into the future to assess environmental risk with climate change.

- The future could be either drier on average or more wet on average.
- The future wastewater discharge to the river could be higher than today or lower than today.
- Future land use could be more agricultural or less agricultural.

When combining all the predictions an envelope of possible risk containing 28 ensembles is concluded. These scenarios were then used to predict a value for ammonia, nitrate, biological oxygen demand and phosphate. This evidence reinforced that the dry scenario noted the areas with the greatest concern in the future. This is also borne out when the principles of aqueous chemistry are considered in a column of water's ability to dilute and a flow of water's ability to disperse. When these three concepts are brought together an assumption of when environmental harm may occur can be concluded.

The time when environmental harm could occur requires the understanding of the volume of water in a river and also relates to the speed of that river as it flows, plus its chemical makeup. What is needed is a mixing effect like a washing machine. The speed of the flow and the friction effect and eddies created as river flow mixes the discharge and disperses it; In dry weather, river levels drop, and therefore mixing ability drops due to the viscosity of different waters two separate plumes can sometimes be seen. This is a naturally occurring phenomenon and is a principle of river dynamics. We are going to use this in our future dry scenario to indicate where a future possible higher risk of environmental harm could occur.

The other principle to help us predict the future environmental harm is dilution. Again, using our SAGIS model which indicates we can assume also that change in the sources of upstream contributions to chemicals in relation to land use could either make dilution easier or harder in the future. Using this dry scenario, we have identified locations across our area that could be of greater water quality risk if that scenario were to materialise in 25 years' time.

When both these pieces of work are combined, we can prepare an investigation programme to delve deeper into those identified and to target options in these areas earlier. These conclusions draw us to managing the seasonal effect of our operation on the environment first and once that is understood move on to average conditions then to more extreme events and this is incorporated into our proposal for Cycle 2. The programme of investigations incorporates a priority based on locations where all 4 determinants indicate a risk in the future. The process for future forecasting water quality risk will need further discussion with NRW and the EA before it begins onsite delivery.

In Britain we have a large proportion of days with either no rainfall or light showers. In hydrology a typical river is known to have periods of low flow and as a generalisation we will say these are clustered in a few months with a couple of weeks being in this low flow range. For ease of discussion let's use April, June and September. This is simplified for discussion. If we consider these to be average conditions but there are also other generalisations that we need to think about which are years that are very dry and years that are very wet. We can then use the historical rainfall data sets to band dry wet and average rainfall through a year and use as a time to forecast the time when an environmental risk could occur.

On addition to these hydrological principles the ecology of the species within the environment is also required. Some species are more susceptible to dry weather and low oxygen demand and when this is added a forecast of where the risk could occur can be mapped alongside the dynamics of the river.

In terms of environmental harm, we can leap to a conclusion for use in forecasting that a river's ability to disperse is reduced in dry weather and we can also leap to a conclusion that in wet weather, that river's ability to dilute is also reduced in dry weather. Our proposal incorporates these two factors, we need to ensure that sewage is contained when the river is at its lowest. The approach will reduce environmental harm to those species susceptible and where the river is most prone to low flows.

In terms of nutrient content however the first flush of rain after a dry spell is also a higher risk for some aquatic life not only from the water industry but also from other catchment users and this risk was included within the SAGIS future assessment.

7.10 Amenity Use

When is amenity at its highest with the greatest number of users? On a warm sunny summer day or evening. The river and coast see lots of families and individuals looking to be closer to nature. This increase of activity during these drier weather periods again reinforces the proposal being put forward from an environmental harm point of view, from an amenity point of view the same conditions should also be used, we should assess for dry and warm conditions. Our improvements need to start when the rivers and coast is at its greatest demand. Again, this is incorporated into our proposal as a place to start to create our plans and will be considered in DWMP29.

7.11 What Happens Next to Our Options

Once the DWMP has carried out its assessment and compared the results. The final list is passed on for the business to incorporate the preferred solutions into the price review process to support their funding request to our financial regulator. The process is managed by Ofwat our financial regulator. It is only when the process concludes through Ofwat's assessment, will we know which solutions will be supported for delivery and the consequence of the final Determination phase at submission. We will then need to re-analyse the position. Using the annual review process of DWMP, which is still in a conception stage, we can then review the impact of the funding determination on our future plans. These continued annual reviews of the published plan become the beginning position of the next plan which will be published as a draft in 2028 and the cycles go on.

We have also created two programmes of opportunities as the basis to start our Level 2 engagement with other stakeholders. They are a programme to look at schools across our operating area and confirm where there are real opportunities to then develop the solutions ready for the next cycle and a similar programme to verify if there are opportunities at government owned land such as carparks and council buildings. We are now looking for the next focused programme and we will add that into plan development during Cycle 2.

The first stage of building our programme boards is to have an opportunity to work through. We are proposing these as a place to start. There are 993 school locations and 807 public spaces that are candidates for discussion and our initial opportunities. The cost of engagement from all who participate every 5 years would be in the realm of £400k across Wales. The cost of the solutions would be on top. It is important not to underestimate the cost to a pooled staff resources on the 13 programme boards as this too can be a barrier to success.

To develop joint plans of any kind will take time and the ability of the organisations involved. We also have to consider the constraints from delivery as we cannot undertake work too fast too early without developing a supply chain of organisations to undertake the work. This is where we need to learn from each other and build virtual cross organisational teams to work for Team Wales.

We will continue to evolve our plan through the cyclical nature of management planning by:

- Re-evaluating the cost to achieve both final destinations.
- Adding addition scope to each of the final destinations.
- Developing interim milestones to achieve to meet the destination.
- Increasing the number of areas included in our detailed options appraisal.

In each cycle more detailed solutions will be added to fill in the overall programme. The ultimate cost is likely to be in the region of £13.9bn to reach our end destination for both customers and the environment. However, the solutions presented in our programme is constrained by affordability.

We have developed £1.5bn of detailed solutions this cycle of which the first 21 schemes are being put forward to OFWAT as part of the PR24 process for delivery up until 2030 with the remaining solutions being spread up until 2050. In our next plan due to complete by 2029, we will clarify the first five years that will be put forward into the price review and develop more locations to greater detail and clarity of solution. Again, those prepared will be constrained by affordability and spread over the 25 years. We will continue to gain greater clarity to the solutions required at each cycle.

8 Environmental Assessments of the Plan

We have embedded the principles of the SEA (Strategic Environmental Assessment) and HRA (Habitat Regulation Assessment) early in the plan development process. We are legally required to complete these assessments which ensure that there is no harm caused by our work, or the choices that we are making as part of the plan to the environment.

The SEA and HRA has been applied once the need for solutions have been identified and when that need is considered of highest priority. For this plan the process has been applied to Locations that have Worst Served customers and that discharge to a SAC and are considered Extended and complex at the problem characterisation stage.

If we find that an option will harm the environment, or natural habitats, we then go back in the process, investigate why there was a perceived risk to the environment, address in in the options or rule that option out and choose an alternative. In some cases, there may not be an alternative option.

This process has been designed so that where a solution is the only solution, and it does cause environmental harm that everyone can comment on it and where there is overriding public interest government can agree to the solution. These are rare but it's important that as a country we have a process to ensure the decision is taken at the highest level when some environmental harm (all be it to produce a benefit elsewhere) may be the consequence.

8.1 Strategic Environmental Assessment

The SEA has five key stages:

- Stage A: Scoping.
- Stage B: Develop and Refine Alternatives and Assess Effects.
- Stage C: Prepare Environmental Report.
- Stage D: Consult on the Draft Plan and Environmental Report and Prepare the Post Adoption (SEA) Statement.
- Stage E: Monitor Environmental Effects.

The first stage of the SEA was a review to identify the major economic, social, and environmental concerns that will be considered in the DWMP. The key issues identified have informed the framework that will be used to analyse the consequences of the proposed DWMP.

To be compliant with the SEA, a plan or program must consider the cumulative effects of its provisions. This includes the overall impact of the proposed DWMP in conjunction with other plans and programmes, as well as the individual impacts of specific measures within it. The proposed approach is considered in accordance with Schedule 2 (6) of the SEA regulations.

The impact of the measures proposed in the DWMP were evaluated based on its type, when it occurs, the geographic scope, sensitivity of human or environmental receptors that may be affected, and the duration of any impact. For each of the SEA goals, a set of criteria was established to determine what constitutes a significant, minor or no impact.

The proposed assessment objectives are assessed against the core sustainable and traditional options considered within the DWMP and assessed against their positive or negative impacts during construction and operation.

The specific detail for all options reviewed prior to the draft plan across the entire DCWW region can be found in the full DWMP SEA Environmental Report. The post adoption statement has been produced and is published along with this plan.

A Strategic Environmental Assessment (SEA) is a formal, systematic process that identifies and examines the potentially significant and cumulative effects a plan or program may have on the environment. The SEA is mandated by the Environmental Assessment of Plans and Programmes Regulations 2004, or SEA Regulations, which transpose into UK law via the European Directive 2001/42/EC.

In Wales, this was transposed into legislation on 12 July 2004 as Statutory Instrument 2004 No.1656 - The Environmental Assessment of Plans and Programmes (Wales) Regulations 2004. These apply to plans and programmes whose effects are wholly within Wales; however, if plans or programmes could affect more than one country in the UK, then The Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004 No.1633) would apply.

The SEA regulations apply to statutory planning obligations of large-scale activities according to various screening criteria. As the DWMP process is not yet a legal requirement, a draft DWMP is not within the scope of the SEA regulations and completion of an SEA is regarded as a demonstration of best practice. In future cycles the DWMP will become part of the normal planning duties, thus making the SEA a requirement. DCWW have therefore decided to undertake both SEA and Habitat Regulations Assessment (HRA) to inform the first draft iteration of the DWMP, which will ensure continuity of the process going forward. We have intentionally brought the SEA into the planning approach as early as possible in the development of options, as the SEA was intended to run alongside the development. The HRA on the other hand is a retrospective assessment and is discussed in chapter 8.2 (Habitats Regulation Assessment) and will form part of the programme appraisal stage.

The purpose of the SEA of the DWMP will be to:

- Identify the potentially significant environmental effects of the draft plans in terms of the drainage and wastewater management proposals being considered;
- Help identify appropriate measures to avoid, reduce or manage adverse effects and to enhance beneficial effects associated with the implementation of the draft plan wherever possible;
- Give the statutory SEA bodies, stakeholders and the wider public the ability to see and comment upon the effects that the draft plan may have on them and encourage them to make responses and suggest improvements to the draft plans; and
- Inform the selection of drainage and wastewater management proposals to be taken forward into the final version of the plan.

The assessment of the DWMP involved a quantitative risk assessment and qualitative appraisal of the likely impacts that will be mitigated through implementing different options. The SEA looked to identify mitigation and preventative measures including specific proposals to minimize, eliminate, reduce, or offset significant adverse effects on environmental considerations, identified through stages within the DWMP process.

The proposed assessment objectives that will be used are shown in Table 75. The impact of the measures proposed in the DWMP were evaluated based on its type, when it occurs, the geographic scope, sensitivity of human or environmental receptors that may be affected, and the duration of any impact. Each measure's assessment will be recorded in a uniform manner using assessment matrices.

Table 75 - Proposed Assessment Objectives for the DWMP

Topic	Proposed Objective
Biodiversity, Flora and Fauna	1. To protect, restore and enhance biodiversity, including designated sites of nature conservation interest and protected habitats and species, enhanced ecosystem resilience, habitat connectivity and creation and contribute to the sustainable management of natural habitats and ecosystems.
Soils, Land Use and Geology	2. To protect and enhance soil quantity, quality and functionality and geodiversity and ensure the appropriate and efficient use of land.
Water – Quantity and Quality	3. To protect and enhance the quality and quantity of surface and groundwater resources.
Water – Flood Risk	4. To reduce or manage flood risk.
Air	5. To minimise emissions of pollutant gases and particulates and enhance air quality.
Climatic Factors	6. To reduce greenhouse gas emissions. 7. To adapt and improve resilience to the threats of climate change.
Population	8. To promote a sustainable economy and maintain and enhance the economic and social well-being of local communities.
Human Health	9. To protect and enhance human health and well-being.
Material Assets - Water Resources	10. To promote and enhance the sustainable and efficient use of resilient water resources.
Material Assets – Waste and Resource Use	11. To minimise waste, promote resource efficiency and move towards a circular economy.
Cultural Heritage	12. To conserve and enhance the historic environment including the significance of heritage assets and their settings and archaeological important sites.
Landscape	13. To conserve, protect and enhance landscape and townscape character and visual amenity.

For each of the SEA goals, a set of criteria has been established to determine what constitutes a significant impact, a minor impact, or no impact. These ‘definitions of significance’ will assist the reader in evaluating the assessor's judgments and help ensure that there is a uniform approach to determining the magnitude of effects. To be compliant with the SEA, a plan or program must consider the cumulative effects of its provisions. This includes the overall impact of the proposed DWMP in conjunction with other plans and programmes, as well as the individual impacts of specific measures within it. The proposed approach is considered in accordance with Schedule 2 (6) of the SEA regulations.

The findings of the evaluation will assist in determining DCWW's choice of drainage and wastewater management solutions for future DWMP consideration.

The SEA scoping report was published for consultation to the Welsh SEA bodies (Natural Resources Wales, CADW, and the Welsh Government) and the English SEA bodies (the Environment Agency, Historic England, and Natural England) as part of the preparation for the draft DWMP between 22nd October and 26th November 2021.

The SEA completed Stage B: Develop and Refine Alternatives and Assess Effects. The assessment has been carried out on the original 39 catchments. The results of these assessments have been included within Environmental Reports, which was issued for consultation alongside the draft DWMP. Consultation on our draft DWMP showed support for our SEA approach. The additional catchment will not be included within this SEA formal assessment process as they all form future investment after 2030 and can be more effectively included within DWMP29.

The Environmental Report(s) has the following purposes:

- To ensure that the likely significant environmental effects associated with the draft plan are identified, characterised, and assessed;
- To propose measures to mitigate the adverse effects identified and, where appropriate, to enhance potential positive effects;
- To provide a framework for monitoring the potential effects arising from the implementation of the draft plan; and
- To provide sufficient information to those potentially affected to enable them to contribute effectively to the public consultation.

8.1.1 SEA Options Screening

An initial generic assessment of option type (sustainable green and traditional) against the SEA assessment objectives was completed to provide magnitude and significance of impact of both construction and operational stages of an option. As the assessment is against broad option types, the specific locational context of the impact of an option there are uncertainties in that magnitude and scale. No likely significant positive or negative effects have been identified in Table 76 below.

Table 76 - Generic Assessment of the Effects of the Broad Option Types

Option	Stage	1. Biodiversity	2. Soils, Geodiversity and Land Use	3. Water Quality	4. Flood Risk	5. Air Quality	6. Greenhouse Gas Emissions	7. Climate Change Resilience	8. Economic and Social Well-being	9. Human Health	10. Water Resources	11. Waste and Materials	12. Historic Environment	13. Landscape
Sustainable	Construction (negative)	-/?	-/?	0	-/?	-/?	-/?	-/?	0	-/?	0	-/?	-/?	-/?
	Construction (positive)	+/?	+/?	0	0	0	0	0	+/?	0	0	+/?	0	0
	Operation (negative)	0	0	0	0	0	0	0	0	0	0	0	-/?	-/?
	Operation (positive)	+/?	0	+/?	+/?	0	0	+/?	+/?	+/?	+/?	0	0	+/?
Traditional	Construction (negative)	-/?	-/?	0	-/?	-/?	-/?	-/?	0	-/?	0	-/?	-/?	-/?

Option	Stage	1. Biodiversity	2. Soils, Geodiversity and Land Use	3. Water Quality	4. Flood Risk	5. Air Quality	6. Greenhouse Gas Emissions	7. Climate Change Resilience	8. Economic and Social Well-being	9. Human Health	10. Water Resources	11. Waste and Materials	12. Historic Environment	13. Landscape
	Construction (positive)	0	+/?	0	0	0	0	0	+/?	0	0	+/?	0	0
	Operation (negative)	0	0	0	0	0	-/?	0	0	0	0	0	-/?	-/?
	Operation (positive)	+/?	0	+/?	+/?	0	0	+/?	+/?	+/?	+/?	0	0	0

Options generated within DWMP Cycle 1 have been screened in a two-stage process to identify where there is the potential for the option to have a likely significant effect based on sensitivity of the location (reflecting the number, nature, and extent of environmental designations) and the proposed scheme to determine factors that could affect the deliverability of the option. Some options were identified that had no likely significant effect, and locational and scheme factors were taken into account, which meant that 68 options were taken forward for the SEA Options Assessment.

8.1.2 SEA Options Assessment

From the overview of the options screening, 68 options were screened for further assessment. The options proposed within each of the Level 2 River Basin Catchments were reviewed in detail against the SEA assessment objectives. Table 77 below illustrates the specific SEA review of options within Gowerton which is part of the Carmarthen Bay and the Gower L2 Catchment.

Table 77 - Example Assessment of options effects (Gowerton)

Option	Stage	1. Biodiversity	2. Soils, Geodiversity and Land Use	3. Water Quality	4. Flood Risk	5. Air Quality	6. Greenhouse Gas Emissions	7. Climate Change Resilience	8. Economic and Social Well-being	9. Human Health	10. Water Resources	11. Waste and Materials	12. Historic Environment	13. Landscape
50628-A-RZ004-DFL.001688_4a-2025-2050-M	Construction (negative)	-	-	0	0	-	-	0	0	-	0	-	--	-
	Construction (positive)	+	+	0	0	0	0	0	+	0	0	+/?	0	0
	Operation (negative)	0	0	0	0	0	0	0	0	0	0	0	-	?
	Operation (positive)	0	0	+	+	0	0	+	+	+	+	0	0	?
50628-A-RZ005-DFL.003065_4a-2025-2050-M	Construction (negative)	-	-	0	0	--	--	0	0	--	0	--	-	--
	Construction (positive)	+	+	0	0	0	0	0	++	0	0	+/?	0	0
	Operation (negative)	0	0	0	0	0	0	0	0	0	0	-	0	-
	Operation (positive)	0	0	+	++	0	++	++	++	++	++	0	0	0

The assessment for all proposals can be found in the full DWMP SEA Environmental Report. The full summary of options screened in, likely effects identified and specific comments from the assessment is illustrated in Table 78 below. This identifies schemes where there are potentially significant negative effects against SEA objectives.

Table 78 - Summary of Options Screened for assessment and findings

L2 River basin catchment	L4 drainage area	Number of options screened in	Likely significant effects identified	Comments
Carmarthen Bay and the Gower	Gowerton Llanelli Coastal	2 1	☒ ☒	A range of minor and moderate positive and negative effects for construction and operation have been identified and assessed, reflecting the small scale of the proposed schemes
Clwyd	Kinmel Bay	2	☑	Two proposed schemes with likely significant negative effects against one SEA objective during construction.
Conway	Ganol STW	6	☑	One proposed scheme with likely significant negative effects against one SEA objective during construction.
Dee	Five Fords (Wrexham) Llanasa (Nr Prestatyn)	2 5	☑ ☑	Two proposed schemes with likely significant negative effects against one SEA objective during construction. In operation, likely significant positive effects against one SEA objective. Two proposed schemes with likely significant negative effects against one SEA objectives during construction.
Llyn and Eryri	Bangor Treborth Porthmadog	9 4	☑ ☒	One proposed scheme with likely significant negative effects against two SEA objectives and one likely significant positive effect during construction. In operation, likely significant positive effects against four SEA objectives.
Meirionydd	Tywyn	3	☑	One proposed scheme with likely significant negative effects against one SEA objective during operation.

South East Valleys	Cardiff Bay Cilfynydd Newport Nash	2 1 27	☒ ☒ ☑	15 proposed schemes with likely significant negative effects against up to five SEA objectives and one likely significant positive effect during construction. In operation, likely significant positive effects against up to five SEA objectives.
Tawe to Cadoxton	Pen-Y-Bont Swansea Bay	2 2	☒ ☑	One proposed scheme with likely significant negative effects against three SEA objectives and one likely significant positive effect during construction. In operation, likely significant positive effects against five SEA objectives.
Total		68*		

8.1.3 SEA Cumulative Impact Assessment

The cumulative effects of the DWMP Plan in combination have also been considered as per the SEA regulations. To have cumulative effects, several variables are reviewed including the nature, location and timing of option implementation, the number of options that are ultimately implemented either within a catchment, and the interaction of these options with other plans or programmes. The effects are also dependent on the sensitivity of receptors, their extent, and the receiving environment to the effects of the proposed options whether operating alone, or cumulatively.

Construction activity, unless, of significant scale and concentrated in specific localities and occurring concurrently is unlikely to lead to cumulative significant effects on receptors, as it is anticipated that the effects of the options can be managed through the application of the mitigation hierarchy and a range of construction mitigation practices. However, for schemes that represent significant engineering works and capital investment, there will be individual and cumulatively significant positive and negative effects in terms of SEA Objectives 6 'Greenhouse Gas Emissions', 8 'Economic and Social Wellbeing' and 11 'Waste and resources' which need to be considered where appropriate.

From an operational perspective, options should at minimum do no harm to the water environment or communities in which they are located, and preferably make a (significant) contribution to enhancing the quality of each locality, by reducing the adverse effects arising from flooding and poor water quality. There may be specific instances where at present, due to uncertainty of scheme design or location, the operational effects may be considered uncertain, and potentially negative; however, as proposed schemes are still evolving, there is further opportunity to complete investigation and refine scheme design as well as consider further assessment.

Table 79 below highlights the potential cumulative effects from cumulative DWMP schemes as well as integration with wider plans for each of the 13 SEA objectives.

Table 79 - Commentary on the Potential for Cumulative Effects

Objective	Potential for Cumulative Effects of the DWMP Programme?	Potential for Cumulative with Other Plans and Programmes?
1. To protect, restore and enhance biodiversity, including designated sites of nature conservation interest and protected habitats and species, enhanced ecosystem resilience, habitat connectivity and creation and contribute to the sustainable management of natural habitats and ecosystems.	Cumulative effects are most likely where options are located within same L4 drainage area of L2 catchment, with the more schemes that are implemented within an area, the greater the potential for disturbance of biodiversity. Even where located in separate catchments, there is the potential for cumulative effects on receptors such as coastal designated sites into which rivers from several catchments may flow (for example, Severn and the Dee Estuaries, both designated as Ramsar, SAC and SPAs). For three L4 areas (Five Fords, Llanasa and Newport Nash), proposed schemes (whether traditional or SUDs) potentially could, through direct construction effects on functional habitat and/or the creation of wetlands, have effects on the features recognised within designated sites (Johnstown Newt Sites SAC, the Dee Estuary Ramsar and SPA and the River Usk SAC). However, it is very likely that the effects could be avoided or mitigated using established measures although additional information may be required to determine the likely location of proposed infrastructure relative to the designated sites. Many of the schemes have been undertaken to reduce flooding (albeit focused on WSC) by introducing temporary storage. This will reduce peak volumes and flows, and the resultant mobilisation of pollutants and entrainment of debris with relatively beneficial effects on downstream water quality (and associated receptors). In addition, several options within this draft DWMP are being undertaken to specifically reduce CSO spills to SAC, with the objective of achieving zero spills by 2050. In consequence, the cumulative effects of operating the proposed schemes will be positive on the designated features. Those sustainable options may also lead to cumulative positive effects through the	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.

Objective	Potential for Cumulative Effects of the DWMP Programme?	Potential for Cumulative with Other Plans and Programmes?
	creation of wetland habitats, suitable for protected species, for example amphibians and wetland birds.	
2. To protect and enhance soil quantity, quality and functionality and geodiversity and ensure the appropriate and efficient use of land.	Many of the traditional schemes will require works within urban settings, with activities on existing developed areas and previously developed land for example, relaying/resizing of pipes/sewers) and relative to many other plans for new infrastructure will be more compatible with the SEA objective (both individually and cumulatively) for the preferential use of previously developed land. Where greenfield sites are affected, these are likely to be urban fringe sites, typically with poor soil quality, which the creation of new habitats associated with SUDs schemes, may help, over time to improve.	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
3. To protect and enhance the quality and quantity of surface and groundwater resources.	Cumulative effects are most likely where measures are located within same WwTW drainage area or L3 catchment. Many of the schemes have been undertaken to reduce flooding (albeit focused on WSC) by introducing temporary storage. This will reduce peak volumes and flows, and the resultant mobilisation of pollutants and entrainment of debris with relatively beneficial effects on downstream water quality (and associated receptors). In addition, several options within this draft DWMP are being undertaken to specifically reduce CSO spills to SAC, with the objective of achieving zero spills. In consequence, in many instances, from the operation of the schemes, consistent with the contribution to the planning objectives, the cumulative effects of operating the schemed will be positive on water quality and quantity (by increasing infiltration and residence time of water within the catchment).	Potential for cumulative effects depending on the nature, location, and timing of the draft DWMP measure and other plans and programmes.
4. To reduce or manage flood risk.	Many of the schemes have been undertaken to reduce flooding (albeit focused on WSC) by introducing increased network capacity, flow diversions. temporary storage, and a range of SUDs schemes. Cumulative significant positive effects will occur	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.

Objective	Potential for Cumulative Effects of the DWMP Programme?	Potential for Cumulative with Other Plans and Programmes?
	within each L4 drainage area and aggregate up to the L2 catchment and which are reflected in the DWMP ‘flood benefits’ identified. The use of SUDS schemes provides an opportunity to address the effects of urban creep (and the growth in impermeable surfaces within developed areas), which then exacerbate the risks of flooding.	
5. To minimise emissions of pollutant gases and particulates and enhance air quality.	Cumulative effects will occur within each L4 drainage area with the more schemes that are implemented within an area, the greater the potential for emissions, associated with construction of the proposed schemes. Cumulative effects on air quality will need to take into account the coincidence of proposed activities with locations designated as AQMAs (associated with either NOX or PM10), noting that for some locations the scale of additional vehicle movements may be incompatible with the requirements of the AQMA.	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
6. To reduce greenhouse gas emissions.	Effects are additive; the more schemes implemented within an area, the greater the amounts of materials and energy used (and the embodied and operational carbon emitted) and the greater the effects against this SEA objective. Cumulatively, and associated with the scale of future investment, it is estimated that embodied carbon associated with the 160 selected schemes is likely to exceed 100,000 tonnes, reflecting the substantial quantities of concrete and steel used. However, for many of the proposed schemes, once in use, it is anticipated that the energy use (and the associated operational carbon emissions) is likely to be relatively modest (within the context of Welsh Water’s current energy use).	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
7. To adapt and improve resilience to the threats of climate change.	The DWMP used datasets that included those from the NRW Flood Risk Assessment Wales (FRAW) project, which included consideration of the effects of climate change. Climate change is likely to increase the frequency and intensity of future rainfall events and are likely to be associated with greater	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.

Objective	Potential for Cumulative Effects of the DWMP Programme?	Potential for Cumulative with Other Plans and Programmes?
	overland flows and less time to infiltrate into the ground. This would then be exacerbated by the effects of urban creep. The DWMP takes an approach to each risk area that seeks to preferentially provide a sustainable approach, which aligns with the overall catchment strategy. Where the sustainable approach has not been sufficient to resolve the issues, a mixed approach has been developed which comprises elements of sustainable engineering and hard engineering. The use of SUDS schemes provides an opportunity to address the effects of climate change by increasing infiltration and residence time of water within drainage and catchment areas. Many of the schemes have been undertaken to reduce flooding (albeit focused on WSC) by introducing increased network capacity, flow diversions. temporary storage. Cumulatively this has been assessed to contribute significant positive effects.	
8. To promote a sustainable economy and maintain and enhance the economic and social well-being of local communities.	The DWMP covers the period 2025 to 2050, and if all 160 schemes are implemented has a cumulative capex value of greater than £1bn, and so would average a spend of some £40m per annum, or an average of some £7m per scheme. Many of the identified schemes are phased to begin work in the period 2025 – 2030, with further elements then developed. Cumulatively, it represents a significant investment in essential infrastructure which would, given its longevity create long term economic benefits and employment opportunities in the water and construction sectors of Wales. Direct, indirect, and induced employment opportunities, given the focused areas of investment could also be beneficial to the communities in each L4 area.	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
9. To protect and enhance human health and well-being.	Many of the schemes have been undertaken to reduce flooding on WSC by introducing increased network capacity, flow diversions. temporary storage, and a range of SUDs schemes, and will have a direct effect on any	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and

Objective	Potential for Cumulative Effects of the DWMP Programme?	Potential for Cumulative with Other Plans and Programmes?
	affected customers health and well-being. The DWMP, by reducing flooding and ensuring surface water and bathing water quality is maintained within statutory limits will also contribute cumulative to communities' health in catchment areas. Additional greenspace areas created as the result of the implementation of SuDS infrastructure such as swales and wetlands, as part of the sustainable option type, may also lead to additional positive effects on community health and social wellbeing.	other plans and programmes.
10. To promote and enhance the sustainable and efficient use of resilient water resources.	The DWMP includes a range of measures aimed at reducing water entering the wastewater network. These include policy and demand management measures that seek to maximise the efficient use of water resources. By including schemes that seek to maximise infiltration and increase the resident time of water within a catchment, there are also opportunities for water to contribute to surface and ground water flows, increasing resilience of the water resources available.	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
11. To minimise waste, promote resource efficiency and move towards a circular economy.	Effects are additive; the more measures implemented within an area, the greater the amounts of materials and energy used and the greater the effects against this SEA objective.	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
12. To conserve and enhance the historic environment including the significance of heritage assets and their settings and archaeological important sites.	Potential for cumulative effects on heritage assets where measures are near each other.	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.
13. To conserve, protect and enhance landscape and townscape character and visual amenity.	Potential for cumulative effects where measures are near each other. Effects will be greater for measures requiring new infrastructure in sensitive landscapes (AONB, National Parks).	Potential for cumulative effects depending on the nature, location, and timing of the DWMP measure and other plans and programmes.

From an additional plan perspective, the DWMP has the potential to have cumulative impacts when considered alongside:

- DCWW Water Resources Management Plan 2019 (and its update in 2024)
- National Policy Statements (NPS); and
- Nationally Significant Infrastructure Projects (NSIP)

The cumulative effects of the DWMP in-combination with other plans and programmes are difficult to accurately assess given the inherent uncertainties concerning:

- Future changes to baseline environmental conditions;
- Changing water resource plans; future population and economic growth; and
- The deliverability of some NSIPs (and the potential for new NSIPs to be brought forward).

As such, it is necessary to keep these factors under review as the DWMP is implemented to ensure that the latest and most up to date information is taken into account during delivery and within future cycles, but currently:

- The DWMP is not expected to have any adverse cumulative effects in-combination with the NPS' listed above. This is because the NPS' are either not site specific or because specific NSIP proposals are unlikely to affect, or be affected by, the measures that comprise the DWMP.
- Defra is currently preparing a NPS for water resources. This will set out the need for NSIPs related to water resources, and the Government's policies to deliver them. Whilst this NPS' will not be site specific, implementation of the DWMP is likely to be compatible with those objectives of the NPS for improving water supply resilience.

8.1.4 Mitigation and Enhancement

The potential effects of the draft DWMP are described in the sections above. In some cases, there is an opportunity to reduce some of the potential negative effects identified. The detail of this mitigation needs to be considered during the planning phases of each of the individual measures if / when they are taken forward for implementation.

Specific mitigation and preventative measures could include:

- The adoption of best practice construction techniques (such as the use of sediment traps) to minimise or avoid the effects of construction on designated sites.
- River flow and water quality monitoring during the implementation of supply-side measures.
- The rental or re-use of onsite equipment to minimise resource use.

8.1.5 Feedback from the Consultation process

There were nine comments made from three responders which were Historic England, Welsh Government and Afonydd Cymru.

In general, the consultation on our draft DWMP showed overall support for our SEA approach. There was concern that we had held up some schemes that had shown a possible negative impact on the environment however as this was the first implementation of a SEA for wastewater and drainage schemes, we were being prudent to understand the consequences of the negative outcomes prior to putting the solutions forward. We now confirm that some of the negatives are due to the level of information available at the time of the assessment and these can be considered down the line i.e. Those solution can go forward without any changes and be assessed at the next stage of planning, the delivery stage. There are still a small number though that need further review and we will work to understand the cause of these more extreme negatives to update our process as we may need to alter our approach in options creations to assess the negative impact earlier.

8.1.6 Next Steps

Once the DWMP has been adopted, the selected schemes for managing drainage and wastewater contained in it will need to be implemented through specific projects. As part of this process, each project may be subject to further assessment to understand and manage its potential environmental and social impacts.

These assessments, which may additionally include HRA and EIA, will take account of the issues discussed in this report but will also be informed by the greater detail available as the work progresses about construction techniques, building materials, and agreed locations and routes.

If the DWMP is implemented and specific options deployed, its effects on the environment and people will need to be taken into account. In this regard, it is a requirement of the SEA regulations to establish how the significant effects of the DWMP will be monitored. Monitoring can help to answer questions such as:

- Were the SEA predictions of effects accurate?
- Are mitigation measures performing as well as expected?
- Are there any adverse effects? Are these within acceptable limits, or is remedial action desirable?

It is not necessary to monitor everything or monitor an effect indefinitely. Instead monitoring should be focussed on:

- significant effects that may give rise to irreversible damage, with a view to identifying trends before such damage is caused; and
- significant effects where there was uncertainty in the SEA and where monitoring would enable preventative or mitigation measures to be undertaken.

We have now carried out the production of the post adoption statement and it is published alongside this plan. The 22 solutions have been taken forward from this plan as part of business planning those that are delivered will move into stage 5 the monitoring stage all others will be assessed again as part of DWMP29.

8.2 Habitats Regulations Assessment (HRA)

Habitats Regulations Assessment (HRA) – examines the potential effects of a plan or project on nature conservation sites that are designated to be of European importance. The HRA is mandated by the Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations'), which transposes into UK law the European Directive 92/43/EEC (The Habitats Directive).

DWMPs are not currently a statutory requirement although it is arguable that they would in any case remain subject to the provisions of Regulation 63 of the Regulations. DCWW has therefore decided to assess the DWMP against the provisions of Regulations 63.

Regulation 63 states that if a plan or project is:

> *"(a) is likely to have a significant effect [Likely Significant Effect, LSE] on a European site or a European offshore marine site [a designated site] (either alone or in combination with other plans or projects); and (b) is not directly connected with or necessary to the management of the site"*

Then before the giving of consent or authorisation the competent authority must:

> *"…make an appropriate assessment of the implications for the site in view of that site's conservation objectives".*

The plan or project can only be given effect if it can be concluded (following an 'appropriate assessment') that it *"…will not adversely affect the integrity"* of a site unless the provisions of Regulation 64 are met.

The HRA process begins when the development of the DWMP has reached sufficient progress to include specific details about potential projects, such as location and scale. There are no formal guidance or precedent cases to directly inform the application of a HRA to the DWMP. Therefore, there is a degree of flexibility for the HRA process. This allows the process to be ran in a manner that provides maximum benefit for plan development and decision-making. there are four stages to an HRA.

8.2.1 Stage 1 – Screening or 'Test of significance'

This stage looks for the potential consequences of a project or plan on a designated site, either alone, or in combination with other projects or plans, and assesses whether these outcomes are likely to be significant. The screening test, often known as the 'significance test,' is a minimal threshold intended as a trigger to further investigation.

8.2.2 Stage 2 – Appropriate Assessment (including the 'Integrity test')

This Stage is a more thorough analysis of the plan or project, in which the consequences on relevant locations have been identified as significant or uncertain. The scope of an appropriate assessment is not defined in the regulations and is left to be determined by those performing the HRA. The assessment is required to assess the likely significant effects of a proposal on the integrity of the site and its conservation objectives.

The HRA test must show beyond all reasonable scientific doubt if an adverse effect on the site's integrity can be ruled out or not, this is called the 'Integrity Test'.

Adverse effects to a site's integrity include:

- Destruction, damage or significant change to all or part of the designated habitat.
- Significantly disturb the population of a designated species.
- Harm the site's ecological connectivity with the wider landscape.
- Harm the site's ecological function, or its ability to survive damage, and reduce its ability to support a designated species.
- Change the site's physical environment.
- Restrict access to resources outside the site that are important to a designated species.
- Prevent or disrupt restoration work, or the potential for future restoration.
- Consider ways to avoid or reduce any potential for an 'adverse effect on the integrity of the site'.

Mitigation measures, which have been included in the plan or have been developed during the HRA process to address the potential adverse effects, must be assessed to determine likely effectiveness. This assessment must demonstrate:

- How the measures would be implemented and monitored, and over what duration.
- How enforcement of the measures should be achieved.
- The level of uncertainty of the mitigation measures efficacy.
- How long it will take for the measures to take effect.

- The acceptable level of performance for the mitigation measure and corrective action that would be undertaken if performance were not achieved.

8.2.3 Stage 3 – Assessment of Alternative Solutions

Where adverse effects remain after the inclusion of preventative or mitigation measures, Stage 3 examines alternative ways of achieving the objectives of the plan that avoid the adverse impacts. A plan that has adverse effects on the integrity of a designated site cannot be permitted if alternative solutions are available, except for reasons of overriding public interest. In certain circumstances a proposal that has failed the integrity test can go ahead under a derogation where the proposal qualifies on three legal tests:

- There are no feasible alternative solutions that would be less damaging or avoid damage to the site.
- The proposal needs to be carried out for imperative reasons of overriding public interest.
- The necessary compensatory measures can be secured.

8.2.4 Stage 4 – Assessment Where No Alternative Solutions Exist and Where Adverse Impacts Remain

This stage assesses compensatory measures where it is deemed that there are no alternatives that have no or lesser adverse effects on designated sites, and the project or plan should proceed for imperative reasons of overriding public interest (IROPI).

There is currently no specific guidance or case-practice for the assessment of DWMPs against the Habitats Regulations. The HRA process will therefore be used iteratively to inform the optioneering stage by providing a mechanism for proposal assessment that ensures proposals are not ultimately prohibited under the habitat regulations. A pragmatic approach has therefore been proposed to apply the HRA process to the following steps in the DWMP process as follows:

Step 1 - Prioritised catchment option assessment: the identification, description, and evaluation of the effects of the selected best value combination of options (and any reasonable alternatives) for each prioritised catchment, identified following consideration of the key risks and operational requirements.

Step 2 - Preferred programme assessment: the cumulative effects assessment of the preferred programme of options for the prioritised catchments, to ensure that the effects of the Plan have been identified, described, and evaluated.

As the DWMP process matures and potential project options emerge in designated sites, the accuracy of the HRA assessment process will be improved to further demonstrate compliance with the regulations.

The HRA process will therefore be used iteratively to inform the optioneering stage by providing a mechanism for proposal assessment that ensures proposals are not ultimately prohibited under the Habitat regulations.

8.2.5 HRA Scope and approach

A key issue for the HRA is the level at which assessment can be reasonably and meaningfully undertaken. For a DWMP L3 level, which is relatively wide-ranging; an HRA undertaken would necessarily be quite high-level also and would likely defer much of the assessment to a lower planning tier due to the absence of detail on the location of interventions. With risk clusters considered at greater resolution within individual WwTW catchments to resolve issues, the scope of the HRA is based on a review of the scale and characteristics of the specific options proposed. Due to the relatively small-scale construction of typical options which do not involve substantive permanent land take, the HRA has considered:

- All European sites that are within 1.5km of the relevant risk cluster or new option infrastructure (if identified)
- All European sites that are downstream of the relevant risk cluster and / or the WwTW catchment (no distance threshold)
- All European sites upstream of the relevant risk cluster or new option infrastructure (if identified) that support fish (for example, they could be potentially exposed on migration)
- Any other sites within 5km where evidence suggests a mobile feature might be exposed to significant effects due to the construction or operation of the option that cannot be avoided through the normal project design and planning process. Although we can note that these sites are not systematically documented in the screening.

A series of national geospatial datasets covering critical European sites were collated to enable this baseline assessment. Where possible the site data is used to identify other features that may be relevant to site integrity including typical species, supporting habitats and functional habitats.

Following the geospatial screening, where options cannot be excluded from having an impact, an '**appropriate assessment**' was undertaken in accordance with HRA practice. Within this appropriate assessment best practice avoidance and mitigation measures were considered to ensure that options were not screened out during the baseline assessment.

In addition to individual options, a series of '**in combination effects**' were considered across both wider plans across Wales including Flood Risk Management Plans and the DCWW WRMP, but also within separate / hybrid options at specific sites.

HRAs of plans and strategies typically must deal with a degree of **uncertainty**, where it is not possible to generate a detailed assessment of proposal effects. Where the available information is insufficient to complete a meaningful assessment, the assessment may be deferred '**down the line**' to a lower planning tier.

8.2.6 HRA Assessment

Table 80 below details the screening summary for WwTW Catchments where the HRA has been undertaken. This identifies those catchments where likely significant effects were identified, requiring a more detailed 'appropriate assessment'.

Table 80 – WwTW HRA Screening Summary

WwTW Catchment Area	Likely Significant Effects	Rationale
Aberporth	No	This L4 area has 3 options relating to the same location; whilst this is within 1.5km of two European sites the works are minor (sewer relining to reduce CSO spills) and will clearly be achievable at the scheme level without significant effects (irrespective of mitigation).
Afan	No	Kenfig/ Cynffig SAC is downstream of some parts of the L4 area, although this is not hydrologically linked to any of the option locations; there are therefore no pathways for effects on any European sites.
Amlwch WwTW	No	No options for this L4 area are within 1.5km of any European sites. Options are proposed for one L7 area to

WwTW Catchment Area	Likely Significant Effects	Rationale
		manage flooding; depending on the planning horizon these comprise provision of small amounts of additional storage / attenuation (SuDS) or impermeable area removal. The Anglesey Terns / Morwenoliaid Ynys Môn SPA and North Anglesey Marine / Gogledd Môn Forol SAC are downstream receptors from the L4 area (and hence the three options proposed), although these sites will not be significantly affected by construction effects due to the small scale of the works and location (irrespective of any mitigation measures); operation of the scheme will not negatively affect these sites.
Bangor Treborth	Uncertain	This L4 area covers much of Bangor and Menai Bridge either side of the Menai Strait. There are 5 L7 areas with 12 options between them; these L7 areas are all close to, or overlapping with, Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC. The options are all intended to reduce predicted CSO spills to the SAC, and so there will be no operational effects. Whilst some of the options are relatively minor interventions (for example, sewer upsizing, additional storage) options associated with one L7 area (coinciding with Bangor) involve substantial and extensive works to remove impermeable areas and provide attenuation (swales, SuDS etc.). These interventions would arguably be a series of 'minor' works but options are likely to rely on project-level mitigation to ensure no adverse effects.
Cardiff Bay	No	This L4 area covers a large area around Cardiff and Caerphilly. There are 19 options within the L4 area, all of which are relatively small-scale works (sewer upsizing, provision of SuDS, additional storage tanks, and so on) located within urban areas. The scale / location of the options is such that significant effects would not be expected at the project level, irrespective of any mitigation measures; the options will resolve flooding issues and will not negatively affect the downstream receptors (the sites associated with the Severn Estuary).
Cilfynydd	No	The options associated with this L4 area address flooding; the L4 area is a substantial distance upstream from the Severn Estuary sites and there will be no effects on these sites because of the options.
Cwmgwrach	No	The closest site (Coedydd Nedd a Mellte SAC) is upstream of the L4 area; the options involve minor works (sewer upsizing, reductions in impermeable areas and so the site and features are not exposed to any effects associated with the options.
Five Fords (Wrexham)	Uncertain	The Five Fords L4 area covers much of Wrexham and the surrounding area. Most of the L7 areas are over 1.5km from the nearest European site although one L7 area (DFL.001426, two options) overlaps with the Johnstown Newt Sites SAC; the works required in this area will be in close proximity to the SAC and there is a

WwTW Catchment Area	Likely Significant Effects	Rationale
		likelihood that they will affect functional land associated with the site/features even if they do not directly affect the site itself (although the nature of some options (SuDS provision) suggests that nearby greenspace may be utilised, which may coincide with the SAC or functional land). The options are designed to reduce flooding and will have no negative operational effects on the downstream receptors (River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC, hence the Dee Estuary/ Aber Dyfrdwy SAC, The Dee Estuary SPA or The Dee Estuary Ramsar). Options are likely to rely on project-level mitigation to ensure no adverse effects.
Ganol STW	Uncertain	The Ganol STW L4 area covers much of Llandudno, Conwy and Colwyn Bay, and so discharges are ultimately made to the Liverpool Bay / Bae Lerpwl SPA and Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC. One of the L7 areas overlaps with the Great Orme`s Head/ Pen y Gogarth SAC, although this is a minor digitisation artefact and the options for this catchment will not directly affect this site (which is largely up-catchment in any case). Options are likely to rely on project-level mitigation to ensure no adverse effects.
Gowerton	No	The L4 area covers a zone around the Burry Inlet. The L7 area associated with one option (DFL.003065_4a) overlaps marginally with the Gower Commons/ Tiroedd Comin Gwyr SAC, although this is where the L7 area coincides with a road adjacent to the European site, and the overlap is likely to be a digitisation artefact; in any case, the SAC is several hundred metres up-catchment from the areas likely to be affected by the works associated with this option (removal of impermeable area and installation of a small amount of additional storage volume) and there will be no LSE on this site (irrespective of mitigation). Four of the remaining L7 areas are in the surface water catchment of the Burry Inlet SPA/Ramsar and the Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd SAC, within 1.5km of these sites, although the works required for the options associated with these L7 areas are small-scale (additional storage and removal of impermeable areas) that will not affect these sites. Construction of the options will not affect any sites; operation will reduce CSO spills to the Burry Inlet SPA/Ramsar and the Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd SAC.
Kinmel Bay	No	The Kinmel Bay L4 area covers much of Rhyl and Prestatyn and so discharges are ultimately made to the Liverpool Bay / Bae Lerpwl SPA. The L7 are all over 300m from this site, and the options involve relatively minor works (SuDS provision, impermeable area removal, localised provision of additional storage) intended to reduce flooding. Construction effects on other

WwTW Catchment Area	Likely Significant Effects	Rationale
		sites locally (particularly the Liverpool Bay / Bae Lerpwl SPA) are considered unlikely due to the scale and location of the options, irrespective of mitigation (hence no LSE). The options are designed to reduce flooding and CSO spills and so there will be no negative operational effects on any sites.
Llanasa (Nr Prestatyn)	Uncertain	The Llanasa L4 area covers parts of Prestatyn and the coastal areas to the east of this town, and so discharges are ultimately made to the Liverpool Bay / Bae Lerpwl SPA, The Dee Estuary SPA / Ramsar and the Dee Estuary/ Aber Dyfrdwy SAC. Of the seven L7 areas, two are immediately adjacent to terrestrial units of the Dee Estuary SPA / Ramsar; whilst the options require small scale minor works, the options in these L7 areas include small-scale works (provision of additional storage including SuDS provision) that may impinge on these designated sites. Construction effects on other sites locally (particularly the Liverpool Bay / Bae Lerpwl SPA and Dee Estuary/ Aber Dyfrdwy SAC) are considered unlikely due to the scale and location of the options, irrespective of mitigation (hence no LSE). The options are designed to reduce flooding and CSO spills and so there will be no negative operational effects on any sites. Options are likely to rely on project-level mitigation to ensure no adverse effects.
Llanelli Coastal	No	The L4 area covers a zone around the Burry Inlet. The L7 areas associated with the options is in the surface water catchment of the Burry Inlet SPA/Ramsar and the Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd SAC, within 1.5km of these sites, although the works required for the options associated with this L7 areas are small-scale (additional storage and removal of impermeable areas) that will not affect these sites. Construction of the options will not affect any sites; operation will reduce flooding and will have no effect on the Burry Inlet SPA/Ramsar and the Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd SAC.
Llanfaglan	No	The options associated with this L4 area are minor schemes (impermeable area removal, small-volume storage, minor WwTW upgrades to treatment capacity) that are intended to reduce CSO spills to the Afon Gwyrfai a Llyn Cwellyn SAC. Works associated with the WwTW will be close to the SAC but for all options adverse effects from construction are clearly avoidable with normal measures given the scale of the works. There will be no negative operational effects.
Newport Nash – Cae Brinton	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Newport Nash – Malpas	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.

WwTW Catchment Area	Likely Significant Effects	Rationale
Newport Nash – Newport East	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Newport Nash – Newport West	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Newport Nash – Caerleon	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Newport Nash – Magor Pill	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Newport Nash – Caldicott	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Newport Nash – Chepstow	Uncertain	Options are likely to rely on project-level mitigation to ensure no adverse effects.
Pen-Y-Bont (Merthyr Mawr)	No	There are no European sites near the L7 areas for the options associated with this L4 area, except for two options; both are within 1.5km of Kenfig/ Cynffig SAC but outside the surface water catchment for this site, and there are no pathways for effects; no other options will affect any European sites through construction or operation.
Porthmadog	Uncertain	The L4 area covers a zone around Porthmadog. The L7 areas associated with the options are located in the surface water catchment of the Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC and overlap with this site and the Coedydd Derw a Safleoedd Ystlumod Meirion/ Meirionnydd Oakwoods and Bat Sites SAC (although in both instances this is a digitisation artefact and no works will be required within the SACs to deliver the options). Coedydd Derw a Safleoedd Ystlumod Meirion/ Meirionnydd Oakwoods SAC is up-catchment from the L7 area in any case and would not be affected (mobile species included). The options will reduce CSO discharges to the Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC, and so no negative operational effects would be anticipated. However, options are likely to rely on project-level mitigation to ensure no adverse effects.
Swansea Bay	No	There are no hydrologically connected (downstream) sites that could be affected by the options in this L4 area. The majority of the options are relatively minor schemes in the Swansea urban area; one L7 area (with two options involving removal of impermeable areas) is located within 1.5km of Crymlyn Bog Ramsar and Crymlyn Bog/ Cors Crymlyn SAC, although in a separate surface water catchment, and there are no pathways by which this option could affect these sites.
Tywyn	Uncertain	The works required in this L4 area will reduce flooding through provision of small amounts of additional storage and introduction of a small new storm network to prevent surface water entering the FC system; the proformas suggest that this new network would require an outfall to sea (it is not clear if this is existing) and whilst the storm

WwTW Catchment Area	Likely Significant Effects	Rationale
		network would be expected to receive 'clean' run-off only this aspect may need to be explored as the outfall brings the area of impact substantially closer to the Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC (which may then be vulnerable to operational effects depending on the nature of the storm discharge).

In most instances the environmental changes associated with the options will almost certainly be manageable or avoidable at the scheme level, although this relies on mitigation assumptions and so some options and WwTW Catchments are ‘screened in’ for appropriate assessment.

The following table summarises the specific sensitive sites potentially impacted across the WwTW catchments where appropriate assessments were undertaken in Table 81 below.

Table 81 – WwTW Catchments where appropriate assessments were undertaken and site triggers

WwTW Catchment	Sites
Bangor Treborth	Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC Traeth Lafan/ Lavan Sands, Conway Bay SPA
Five Fords	Johnstown Newt Sites SAC River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC
Ganol STW	Liverpool Bay / Bae Lerpwl SPA Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC
Llanasa	The Dee Estuary Ramsar The Dee Estuary SPA
Llanfaglan	Afon Gwyrfai a Llyn Cwellyn SAC Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC
Newport Nash	River Usk/ Afon Wysg SAC River Wye/ Afon Gwy SAC
Portmadog	Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC
Tywyn	Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC

Specific details of the 'appropriate assessments' for the WwTW Catchments, including potential effect pathways and mitigation and effect assessment can be found in the full DWMP HRA document. In summary:

- Whilst options are identified the proposals are not intended to be definitive plans for schemes that cannot be deviated from; in practice, none of the options are of a scale or type where adverse effects (through construction or operation) are likely to be an unavoidable consequence of their delivery.
- For all options, the environmental changes associated with construction will be manageable or avoidable at the scheme level using standard project-level avoidance, preventative and mitigation measures that known to be available, achievable, and effective.
- Regarding operation, the options within the current iteration of the DWMP are fundamentally addressing relatively small-scale local flow-management issues to reduce spills or flooding at a particular location and ensure that these volumes can be passed to the relevant WwTW for treatment in accordance with the WwTW's permits. Their operational effect on receiving waters is therefore likely to be positive (or at least neutral) compared to the status quo.

The effects of options operating 'in combination' have been explored through the screening and appropriate assessment phases. These assessments have concluded that adverse effects 'alone' are not likely to occur for any European sites or features as any such effects can clearly be avoided or mitigated at the project level; this also applies to 'in combination' effects between options as:

- The environmental changes and zones of influence of options in different L4 areas will be negligible and will not overlap spatially or temporally; nor will the result in complex synergistic or temporally dispersed effects.
- Mitigation can be relied on to reduce the effects due to any individual option such that there will effectively be 'no effects' due to construction or operation.

The options will not therefore have adverse effects 'in combination' that are likely to be unavoidable at the project level.

Regional and local plans have been reviewed at a high level to determine whether there are any likely significant 'in combination' effects with proposed options. This review has not indicated any potential or likely 'in combination' effects that could occur because of cumulative development pressure, and the timescales involved in the implementation of the DWMP options and the absence of detail on allocation proposals makes any 'in combination' assessment difficult and potentially meaningless. However, the DWMP options account for anticipated local and regional growth and so are inherently unlikely to operate 'in combination'.

8.2.7 HRA feedback from the consultation

In general, the responders of the consultation agreed with our approach. There were three responders, Natural England, Welsh Government and Afonydd Cymru. Similarly to the SEA comments, the concern regarding the negative impacting solutions and our decision to defer taking these forward in the short term was noted. How we address the negative impact at the planning stage or whether we defer the assessment to nearer the delivery phase is not determined in this first iteration but will be reflected on and our process updated for DWMP29. With additional application and consideration of the areas continually being assessed as negative, we can address some concern in our DWMP methodology while also deciding if for others there are no alternative solutions and put forward ORPI. As ORPI has not been tested on a DWMP programme before we expect this risk to be small however we will continue to be prudent and ensure that any negatively assessed solutions are only put forward where mitigation on that solution is found.

8.2.8 Next steps

The consultation comments have been considered and incorporated into the DWMP itself and the Final HRA. The HRA is published alongside the final DWMP and formally completes the process.

8.3 SEA and HRA Consultation

The DWMP consultation included separate formal consultations for the draft SEA and HRA. The responses received during these consultations have been collated, reviewed, and addressed through a published statement of response (SoR). The Final SEA and post adoption statement and Final HRA has been published alongside this plan taking account of the comments within the SOR.

During the consultation process, Natural England, Welsh Government, and Afonydd Cymru provided responses, showing overall support for our approach. However, there were concerns regarding our decision not to propose solutions that could have an adverse impact on the environment. After reconsideration, we have determined that some solutions can still proceed with the provision for a future assessment when more information becomes available. However, a small number of solutions require re-evaluation and implementation of additional mitigation measures. These solutions will be revisited during the options development stage of DWMP29, ensuring a comprehensive assessment cycle. We acknowledge the need to learn from this process and intend to incorporate it earlier into the planning stages, allowing for more thorough review of environmental impacts.

Feedback on preventative and mitigation measure in the SEA and HRA has also been taken into account. The SEA identifies potential preventative and mitigation measures, including those related to cultural heritage, and we will explore further opportunities to enhance heritage assets during the DWMP development. If a scheme progresses, the planning process will address any adverse impacts on cultural heritage or the landscape.

Respondents expressed appreciation for the inclusion of the SEA and HRA in the DWMP, and their support influenced the selection of preferred solutions. It has been recognized that the implementation of the DWMP should consider these assessments. As a result, ongoing collaboration with Welsh Government will continue, with a focus on further developing the methodology.

The Final SEA and HRA, along with post-adoption documents, have been produced and published alongside the Plan, ensuring transparency and accessibility of the assessment process.

8.4 Environmental conclusion

We have produced our best value options taking account of their impact on the environment and for each location we have looked at using the approaches discussed to inform the next plan. These zonal plans have been combined so they can be summarised in the zonal summaries and to be brought together as one programme to be taken into the next stage which is to create a prioritised company programme of work.

Two separate reports on the options developed have been written showing the detail of the environmental risk. The detail from these have been brought to reports is available alongside this main report.

8.5 Carbon Impact

During this learning phase of the DWMP we have produced a preferred best value plan that delivered a direction of travel to a more sustainable future. In doing so we found that there is still a necessity to build traditional schemes in the short term to ensure there is enough capacity for the sewage plan, like the blue band mentioned earlier. Inevitably, in terms of a carbon impact, it is recognised that the solutions driven from this plan when added up will have a carbon increase. We would like to bring this element out in this plan so that we can learn from this outcome and work out how to limit these increases in future iterations of DWMPs. Now that we recognise that there will always be solutions that are needed to increase the carbon impact, we will develop the process further in the DWMP that can reduce our carbon impact overall. Either by locally removing carbon in the same location to the solution being delivered or by offsetting carbon elsewhere.

There are also other ways to reduce our net carbon. One of these is at our WWTW where through the process gases are emitted such as nitrous oxide and methane. We are going to work on reducing the emission of these gases as part of our carbon reduction plans. There are always going to be solutions that increase our carbon footprint. However, by using other carbon reduction schemes to offset the increase we intend to keep our carbon footprint stable while providing the additional service to more customers for instance and then make a positive reduction to ensure we continue to drive our carbon impact down.

9 The Review of Consent Plan & The National Environment Programme

In this section we have introduced the National Environment Programme for both England and Wales, noted as NEP in this document. And discussed how the future scenarios relating to new permits and new policies will be incorporated into the next DWMP29.

Section 9.1 introduces the drivers behind the NEP and section 9.2 shows how these drivers and other future scenarios will be incorporated into future planning cycles.

In the future, this plan will consider more than the NEP. We have to consider that the NEP process is linked to certainty via investigations and improvements, more longer-term impacts are difficult to predict. This plan is highlighting that we need to continue to allow investment to reduce our impact on the environment and make an allowance for this continued work in management planning. The Review of Consents plan will develop the possible impact to our current permits and place them alongside the NEP. Over time, the aim is to develop a continuous programme of work so that investment in this important area can be more stable and still drive the environmental improvements that are expected.

9.1 Introduction – The NEP

The public has become increasingly concerned about the health of our waterways and we are committed to reducing our impact. The Environment Agency/Natural Resources Wales provide information on the 'reasons for not achieving good ecological status' (RNAGS), which we use to understand the factors impacting the health of our rivers. Figure 95 below shows that most rivers failing to achieve an ecological status of good are not primarily impacted by water company action. 22% of RNAGS are attributed to water company and our national environmental programme work is targeted to reduce.

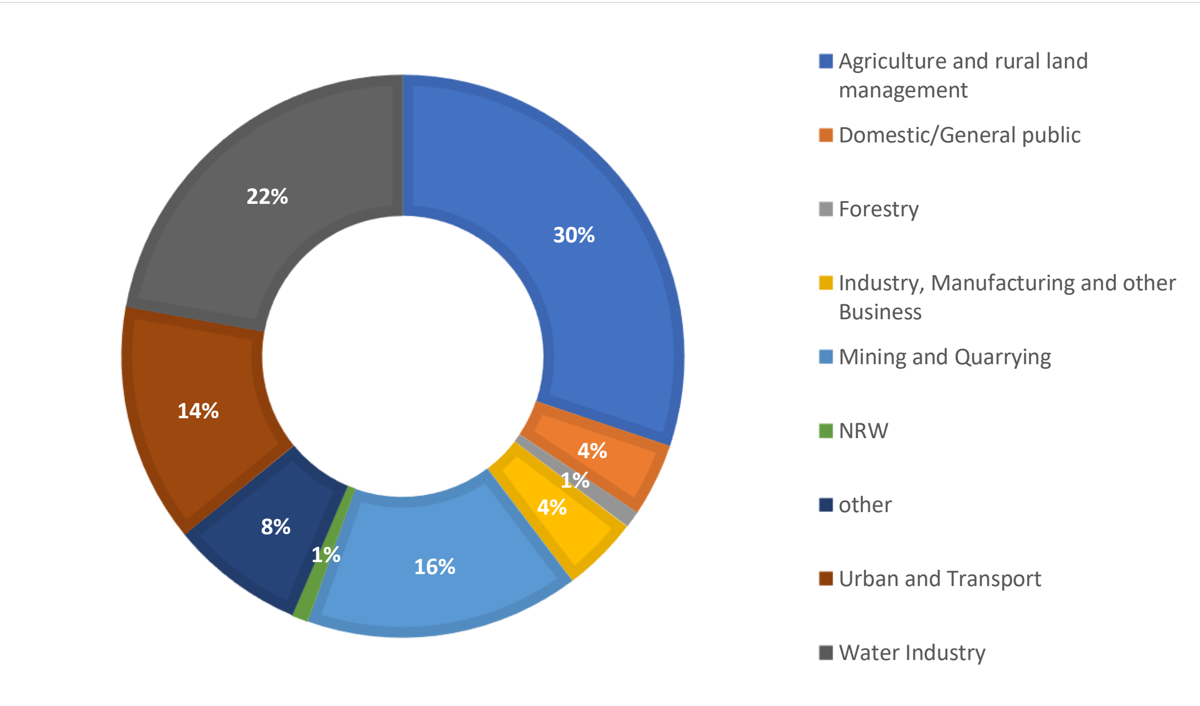


Figure 95 – Reason for not achieving good ecological status.

The following sections introduce the areas of work that contribute to the overall achievement of status.

The NEP and WINEP (covering the areas of England we serve) has been combined into categories and the drivers have been compiled beneath each category. Each driver is a programme of work where our environmental regulators would like us to improve our operation to achieve a betterment to the natural environment.

9.2 River Water quality – Continuous and Intermittent

Work here covers improvements to river water at locations where nutrient and pollutant levels within the river can be improved. This includes nutrients such as phosphorus and compounds that have an acute impact on water quality such as ammonia. These improvements are above levels indicated on our current permits and will lead to a new permit in the future.

9.2.1 Storm Overflows

During wet weather, more water enters our sewers than we can fully treat. To prevent this water from directly impacting customers through flooding of homes and businesses, sewerage systems have release points which discharge excess flows into nearby watercourses. Understandably, this raises concerns for customers about the impact of the operation of these discharge points on the receiving watercourses. To manage this impact and to work towards eliminating the ecological impact harm caused by this interaction, we have installed monitors on all our storm overflows, which measure when wastewater is being discharged and for how long.

This data allows us to identify overflows which are discharging frequently, and currently we are investigating all overflows which discharge over 40 times per year. These investigations allow us to identify and implement schemes to reduce/eliminate the impact of these overflows on the receiving watercourse. We will expand our investigations to include all storm overflows in between 2025 and 2030, AMP8.

9.2.2 Storm Discharges

The recent ambition set out by the Wales Better River Quality Taskforce recognises that the scale and complexity of delivering sustainable solutions for eliminating the impact of storm discharges with require investment over several AMP investment periods.

The current approach for storm discharges is a prioritisation based on ‘harm’ to fish and the ecology of our rivers and includes waterbody sensitivity as directed by the Better River Quality Taskforce. For investment in AMP8 (2025-2030), the outcome of our impact investigation programme will be used to prioritise investment based on ecological harm and sensitivity of the receiving water body.

The method for assessing the impact of a storm overflow on the ecology of a water body and the water quality needed to support its environmental objectives are based on a nationally agreed Storm Overflow Assessment Framework (SOAF) process and in line with the objectives of the Better River Quality Task Force, the strategic steer from Welsh Government and our regulators’ requirements.

DCWW has developed its PR24 investment plan for storm discharges from a sample set of over 250 completed SOAF investigations to date. Once the impact of all storm overflows has been assessed in AMP8, the AMP9 and 10 investment programmes will be modified to ensure no storm overflows have an ecological impact after 2040.

DCWW also has also identified a number of unpermitted storm overflows. These have had the same overflow monitoring installed and they are being assessed at the same time as other sites. They will be included in the improvement programme with a similar priority for investment.

As DCWW operates “wholly or mainly in Wales” water quality targets for the areas of England we serve are determined by Welsh Government, the EA establishes drivers in their WINEP.

9.2.3 Barriers to Fish

Migratory fish such as salmon and sea trout have obstructions in the rivers that they need to navigate past to spawn. There are currently 366 DCWW owned barriers identified across our operating area that we need to confirm is a barrier rank, how that barrier is affecting fish migration and our resulting programme for removal or improvement of the barrier.

9.2.4 Flow

NEP drivers under to increase full flow to treatment (FFT) at WWTWs and increase storm storage at treatment works were part of an adaptive plan set out originally in AMP7. DCWW have carried out a rationalisation of all FFT, storm storage and monitoring requirements to refine the programme for AMP8 and it represents a substantial component of the NEP programme.

There is also investment in flow pass forward monitoring at the last storm overflows before WWTWs which will allow DCWW to report against new monitoring requirements in AMP8.

9.2.5 Emergency overflow monitoring

In addition to storm overflows DCWW also has emergency overflows at many of its pumping stations. These ensure that homes and businesses are not flooded in the event of a mechanical or other failure (such a power failure in the area) but do not normally operate in wet weather.

In AMP8 DCWW will be extending its spill monitoring network to over 750 of these sites so that their operation can be monitored and reported to regulators. NRW’s requirements differ from the EA requiring overflow monitoring only and not flow monitoring at the pumping station too.

9.2.6 SAC Rivers

Since NRW published revised SAC data in January 2021 DCWW has led on the development of Source Apportionment GIS (SAGIS) models for the 7 designated freshwater SAC rivers wholly in Wales and worked jointly with the EA on the modelling for the Wye and Dee which cross the Welsh border. SAGIS modelling is a standard approach adopted by Regulators and the industry across the UK for assessing the sources of nutrients such as phosphorus in rivers and it allows companies and regulators to agree the improvements required at WWTWs.

In January 2023 NRW completed an external audit of the models and planning tools developed which concluded they are suitable for investment planning and setting measures for DCWW.

A collaborative NRW and DCWW working group senior leaders was established and DCWW committed to adding an additional £60m, enabled by its not-for-profit model, to its AMP7 investment programme at the Welsh First Minister’s summit in July 2022. This investment allowed it to bring forward investment on 12 large WWTW to be completed early in AMP8 and enable planning approvals and housing development to restart in those areas. AMP8 programme then targets a further 26 WWTW. The combination of the AMP7 and 8 programme will see over 90% of the DCWW’s fair share phosphorus reduction contribution delivered by the end of AMP8. The remaining WWTWs will be improved in AMP9.

In addition, DCWW have supported NRW’s recent policy position to apply backstop phosphorus limits to prevent deterioration all other WWTWs above 20 m3/d within the SAC ‘catchment’.

9.2.7 Appropriate treatment

Following NRW sharing the W_U_IMP7 driver paper, DCWW undertook a regulatory review of the driver entry criteria, to understand the legislative, policy grounding and potential overlap with other drivers. As a result of this review, we remain concerned over the legislative basis behind the requirements. Therefore, DCWW proposed AMP8 investment is only allocated to high confidence sites (where we have data and where we have certainty of the legislative need) and high priority sites (based on river needs, designation and environmental benefit that can be delivered). This approach results in 5 sites being proposed for AMP8 W_U_IMP7 drivers. All 5 sites are to improve septic tanks in DCWW's ownership discharging to surface waters.

Where additional sites qualified but are of lower priority (low priority due to low population served and lack of river need, for example high status of the water course they discharge to), DCWW proposed those sites are profiled for investment in future AMPs. That will allow for multi-AMP planning based on river and environmental needs.

9.2.8 WFD water Quality

For rivers not designated as SAC catchments other water quality improvements have been included in the NEP to comply with Water Framework Regulations (WFD). To support this a complex assessment of water quality data (recorded on the Reasons for Not Achieving Good or RNAG database), causes of water bodies not meeting the required WFD standard and consideration of locations that met cost benefit criteria was undertaken with regulators.

The AMP8 programme will look to improve all WWTWs present on the RNAG database with a positive cost benefit. This programme will see approximately 200km of river improved. NRW also set the ambition for a full assessment of river needs on all non SAC water bodies which DCWW has been included in the AMP8 investment plan.

There are 30 WWTW listed within the NEP with 60 obligations (revised permit limits).

Where improvements we considered to be disproportionately costly, it was agreed that DCWW accept a programme level obligation to develop a framework and guidance for such cases. In collaboration with NRW, DCWW will undertake a wider benefits and natural capital assessment during AMP8, with an aim to build an AMP9 approach in PR29.

9.2.9 Nitrogen TAL

The technically achievable limit, or TAL, for total nitrogen is considered to be 10mg/l at present. This limit is to be reviewed by a review of what can be achieved by existing treatment processes designed to limit the total nitrogen emitted by WWTWs as part of a national study. DCWW will contribute to this study by studying how its existing WWTWs with total nitrogen limits can be optimised.

9.2.10 UWWTD & Sensitive areas

WG have recently added Milford Haven to the list of Welsh water bodies designated at sensitive under the Urban Wastewater Treatment Regulations. This has led to the inclusion of phosphorus limits at Merlins Bridge WwTW (serving Haverford West).

9.2.11 Chemicals

AMP7 saw a large investigation programme managed through the national Chemical Investigation Programme 3 (CIP3), the majority of which was profiled to conclude 31 March 2022 to support PR24. Under the issued NRW guidance, there are no obligations for 'implementation' of any outputs of CIP3 in AMP8. NRW have agreed an approach to advance our understanding with further investigations. There is no specific environmental destination for Wales at present, and full agreement that the resources in research and trial offered through the industry Task and Finish groups (TAF) is expected.

9.3 Bathing and Shellfish

We work with our environmental regulators to ensure that designated shellfish and bathing waters are protected. We are also working with our regulators to increase the number of locations that wild swimming and other water users can use.

9.3.1 Bathing Waters

In 2022 more than 95% of Welsh bathing waters were classed as either Excellent or Good with over 99% of bathing waters passing minimum bathing water standards. Bathing waters are essential to the Welsh economy and tourist sectors as well as important for the health and wellbeing of our customers. In recent years there has been an increase in designations of coastal bathing waters in the South East and South West areas and more are expected throughout Wales in the future including riverine bathing water sites.

There is approximately 1700 miles of coastline in Wales, and in 2022 there were 106 designated coastal bathing waters and 1 inland location at Llyn Padarn. Bathing water quality is monitored by NRW during the bathing season (May to September inclusive) and classification is based on concentrations of Intestinal Enterococci and Escherichia Coli measured over four years. The classifications are linked to the likelihood of bathers becoming ill as a result of swimming in that class of water.

Improvements to sewerage systems and WWTWs alone will not guarantee good bathing water quality. The generic risks to each bathing water are recorded on NRW's Bathing Water Quality website (NRW, Bathing Water Quality, 2023) namely:

1. Pollution from sewage – bacteria from sewage can enter our waters because of system failures or overflows or directly from sewage works
2. Water draining from farms and farmland – manure from livestock or poorly stored slurry can wash into rivers and streams resulting in faecal material entering the sea
3. Animals and birds on or near beaches – dog, bird and other animal faeces can affect bathing water as they often contain high levels of bacteria (much higher than treated human waste)
4. Water draining from populated areas – water draining from urban areas following heavy rain can contain pollution from a variety of sources, including animal and bird faeces
5. Domestic sewage – misconnected drains and poorly located and maintained septic tanks can pollute surface water systems

NRW also identify risks specific to individual bathing waters in its profile[7], for example Rhyl East bathing water[8].

[7] NRW, Find a bathing water: https://environment.data.gov.uk/wales/bathing-waters/profiles/
[8] NRW, 2023 Bathing Water Profile for Rhyl East: https://environment.data.gov.uk/wales/bathing-waters/profiles/profile.html?site=ukl1302-40650

We have included investment for bathing waters in AMP8, but our investment is limited to 3 areas:

- Bathing waters where DCWW are reason for deterioration from the 2017 baseline – only the Barry bathing waters fall into this category. This will be a multi AMP investment across the catchment area targeted at reducing surface water in the Barry area. There are other bathing waters at risk, but we are a minor contributor in those cases (a good example is Rhyl which is mainly impacted by diffuse inputs).
- A study to investigate how bathing waters can be improved from sufficient and good to good and excellent.
- Work to allow 5 inland bathing waters be classified at our recreation sites.

We will also investigate the reasons for any newly designated bathing water failing to meet the minimum standard.

Welsh Government have set an ambition to begin a process to designate new inland bathing waters. We are a key partner in the working group and currently supporting a trial to investigate help designated more inland sites. We will work to understand what these requirements are likely to be. We are also undertaking trial work at five visitor centres to help develop the process, and we will support these new designations through the development of detailed bathing water quality models which will provide information on the risk of failure to meet standards.

9.3.2 Shellfish

DCWW delivered substantial investment in AMP6 to protect shellfish water quality, particularly in the Loughor Estuary with post scheme analysis confirming the that is has successful. In AMP7 We are investing to protect shellfish on the Menai straight and AMP8 will include more investment in the Loughor and Menai along with investment in Swansea.

9.4 Marine water quality and protected areas

Investment in AMP8 will be focused on investigations into a number of transitional and coastal (TRAC) water bodies with a focus on Marine Protected Areas (MPA) such as Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Marine Conservation Zones (MCZ). DCWW will develop hydrodynamic coastal models that are able to reflect the transitional environment focusing on WFD DIN failures. TRAC waterbodies will be prioritised in AMP8 based on likelihood that DCWW's assets are the cause of the problem and suitability of base hydrodynamic model. DCWW will develop our models in these areas, include existing data available from NRW and upgrade with revised SAGIS models for the rivers that discharge to the transitional areas. It is likely that further water quality monitoring will be required by NRW to allow these models to be developed further so as to support a robust basis for investment in AMP9.

9.5 Biodiversity

Investment in this area covers work to record and enhance the current biodiversity on our land, improve the conservation status of terrestrial SSSIs on our land or that we are putting at risk or measures to reduce the spread of invasive non-native species (INNS).

The combined impact of our measures should help to ensure DCWW can play its part in meeting the nature emergency and supporting measures to help deliver the Welsh Governments objective of delivering '30 by 30' in line with the COP15 conclusions.

9.5.1 Biodiversity

Biodiversity drivers include investigations to consider necessary changes to licenses and the identification of opportunities to maintain or enhance biodiversity either on our or others' land.

The NEP includes investment to meet these drivers by investigating the biodiversity benefit provided by using constructed wetlands, baseline studies for improving connectivity corridors on between our sites and other habitats, and other biodiversity enhancement opportunities on our designated and undesignated sites.

Improvements cover the requirement to fund the changes to licenses and actions to maintain and enhance biodiversity including measures to improve peatland and heath land areas. The NEP includes investment to improve non-designated areas as well as those with section 7 priority species to bring them into favourable conditions through enhancement and restoration through meadows and connectivity corridors and woodlands. Measures also include creation of a native plant nursey and seed banks to support biodiversity restoration and enhancement projects and creating of native plant wetlands.

9.5.2 INNS

INNS drivers include investigation drivers to identify potential INNS pathways and mitigation measures, to monitor and report on INNS, to prevent deterioration, and actions to reduce the impacts of INNS through direct management or partnership working. The NEP includes investment to assess the interactions between INNS and changing conditions due to climate change and subsequent impacts on water quality, build on our AMP7 investigations using evidence to deliver improvements identified and continuing support Wales Resilient Ecological Network (WaREN) Project to prevent deterioration.

9.5.3 SSSI

SSSI drivers include investigations to consider necessary changes to licenses and the identification of opportunities to maintain or enhance biodiversity either on our or others' land, improvement drivers to cover the requirement to fund the changes to licenses and actions to maintain and enhance biodiversity, measures to monitor the condition of SSSI's and investigation, and improvement measures to prevent deterioration in the status of SSSI's on DCWW land. The NEP includes investment to investigate and improve designated sites for enhancement opportunities (including woodlands).

Our largest individual project will be to replace a sewer that runs from Caldicott to Newport (Nash) WWTW which crosses much of the Gwent Levels SSSI and where a number of key species, such as the Shrill Carder bee, have been found to be in unfavourable conservation status and our current approach to managing the risk of failures on the sewer is insufficient to support restoring good conservation status of these and other species.

9.6 Net zero

DCWW has a Net Zero Strategy with the aim of reaching net zero by 2040 and our plan accounts for "process emissions" where methane and nitrous oxide compounds can be given off at WWTWs as well dealing with the more conventional carbon sources such as vehicle fuel, electricity needs, embedded carbon in construction materials and carbon associated with our supply chain. Our AMP8 plan will build on the investment already delivered and help us on our journey to 2040.

9.7 Biosolids

In terms of investment this aspect is not included in the DWMP currently, but it has been written as an introduction here to explain what is excluded from the DWMP.

The sewage sludge (biosolids) drivers are aimed at delivering improvements in the resilience of the sludge management chain. This can be achieved by improved sludge management practices, increased agronomy support for farmers and the creation of suitably robust contingency measures. Developing and utilising new and additional sludge treatment and management technologies, and better contingency plans to manage impacts of climate change and periods of supply chain disruption, will better serve the continuous production of treated sludge (biosolids) that are beneficially supplied to farmers for spreading onto their agricultural land, helping to maintain the productivity of their soils and reduce costs and carbon associated with imported artificial fertilisers.

Investments through these drivers will also support requirements to assess the impact of our biosolids on soil and water quality, as well as helping the broader net zero carbon commitments to be realised. The obligations include implementation of trial technologies to increase dried product, investigations into chemicals and microplastics, innovation in nutrient removal and resilience in landbank and storage.

9.8 Microplastics

AMP8 will include investigations into microplastics as part of a National working group which will have to develop approaches and methodologies for this project. DCWW is fully committed to this area where the obligation will have to be defined further once confirmed at a national level.

9.9 Profile & Outcomes

Our NEP list of obligations is currently ambitious and will be highly dependent on the availability of key resources within the industry, supply chain and NRW for its delivery. The PR24 plan has seen a continuation to the approach developed in PR19, an adaptive plan with considerable areas of advanced evidence being collated to support the next price review (PR29). Technical resource areas in water quality modelling, chemicals and ecology will be key to the investigation programmes to meet the 2027 timeframes set out.

9.10 The Link to The Review of Consents Plan

It became clear during the draft consultation that our regulators would prefer to see the NEP and scenarios for the future within the DWMP process. We have included the NEP in its entirety showing all the drivers for investment to improve the environment from this cycle of improvements. With the addition of these additional objectives which were not set out in the strategic context phase of DWMP24 or covered as part of the DWMP Framework in any detail the opportunity to combine the NEP cycle with the DWMP cycle was missed.

To reflect on the new possibilities, we have combined scenario planning of drainage, namely The Drainage Plan alongside the NEP. We have included a combined scenario to innovate and consider how to bring together both workstreams in a coordinated way, while still allowing the water company to prepare plans for the remaining areas not in the focus of the NEP. This will form the main principle behind our DWMP, including the NEP for DWMP29.

This section includes any future permit or policy driven change that is not needed as part of today's consent or legislation. The benefit of bringing in this additional section of the plan (the Review of Consents plans) clearly separates the work of the company to enhance its operation for growth creep and climate change rainfall (the Sewage and Drainage plans). We can compare this to work supporting the national drivers, such as new legislation and new government direction which, brings a step change to normal operation.

In this plan drivers relating to storm overflows now sit within the review of consents plan as the outcome and direction from regulators and government is driving a change to the company's current permits. Once the permit is agreed and certain the storm overflow improvement programme can become part of the sewage and drainage plan to maintain its operation efficiently while planning for growth, creep and more rainfall.

The drive to remove environmental harm from the operation of storm overflows is now included within the NEP but our customers' ambition to improve storm overflows further is highlighted here. It is scenarios like this that indicate a future plausible opportunity that would not normally be considered within a business plan.

A similar consideration that could impact the company in the next 25 years would be the introduction of the revised Urban Wastewater Treatment Directive which is still being reviewed at the European Parliament. If Welsh Government decides to include it within its legislation there will be a cost implication to the company and this needs to be considered and information provided to government via a DWMP prior to their decision on its introduction, improving the facts to draw conclusion.

Climate change will also be included in this section going forward as there is still uncertainty around the scenario that ties into the reality of today's climate and how climate change will be represented in future permits.

10 Adaptive Planning and Long Term Delivery Strategy

Adaptive planning is a process to show how our short-term investment plans support a wide range of possible future investment plans, which take account of possible different future challenges or emerging policy changes. It helps us to show that we understand what may trigger us to change strategy and when greater certainty might enable us to make a decision to shift to a different investment pathway.

An example of an emerging policy change is occurring during the first development of the DWMP, namely the change to storm overflow legislation. The policy currently can range from what is currently in place in a consent to a new consented requirement. In a management plan, this is shown as a step change. Adaptive planning is the assessment that states in the end what action would you take in every scenario tested as those actions are always needed.

10.1 Overview of Requirements

The DWMP Framework as set out by UKWIR requires adaptive planning to be considered. The UKWIR guidance was published in 2019, however in April 2022 Ofwat published its requirements for Long-Term Delivery Strategies (LTDS), with the expectation that there would be a '*significant shift towards long-term adaptive planning in the [water] sector'* and that long-term delivery strategies would *'improve decisions about how to deliver long-term outcomes.'* Understanding future uncertainties is a key requirement, with water companies asked to present adaptive pathways that *'set out how decisions will be made under different plausible circumstances*.'

The 2023 DWMP has therefore adopted the guidance and forms a key strategy and evidence base, alongside the Water Resources Management Plans, in informing the Long Term Delivery Strategies.

The Drainage and Wastewater Management Plan (DWMP) Framework promotes an adaptive planning approach and DWMP Guiding Principles stipulate that;

> *'The adaptive pathways approach should be used to indicate how those plans may change with technology advances and other sources of uncertainty.'*

As set out in Figure 96, different pathways might be followed based on changes in asset capacity requirements. While the number of scenarios to be tested is up to water companies, Ofwat has set out common reference scenarios that it suggests all companies should explore as part of their long-term delivery strategies. A summary of the scenario requirements is presented in Table 83. The DWMP Framework and guiding principles don't specify specific scenarios, but LTDS guidance invites us to include a 'Most Likely' pathway where that reaches an outcome which is different to the 'core pathway'. Note that each future parameter (for example climate change, technology and demand) could be tested independently or in combination, and that the High and Low scenarios should be 'plausible extremes' that could feasibly occur.

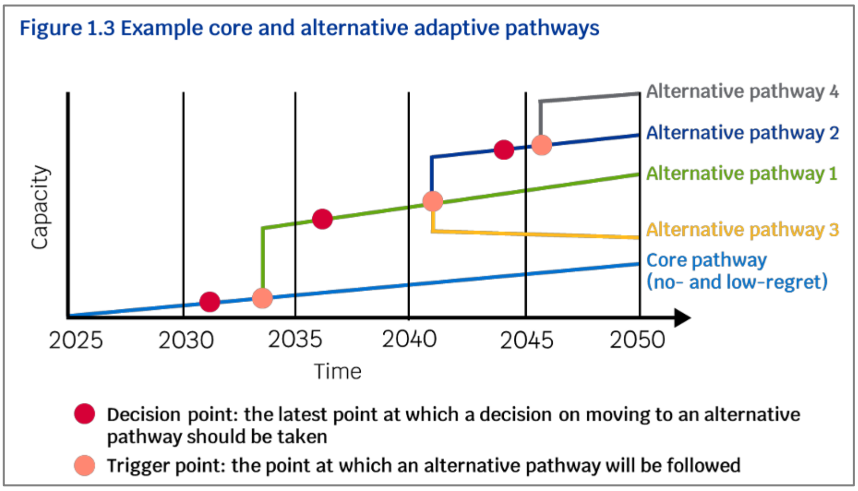


Figure 96 - Illustration of adaptive planning from Ofwat's PR24 requirements for long-term delivery strategies.

Table 82 - Ofwat scenario/pathway requirements

Scenario/Pathway	Ofwat definitions

Core pathway	Must include any activities that meet the following criteria:
	• 'No and/or low regrets' investments, for example investments that are required:
	  ○ In both benign and adverse scenarios;
	  ○ Across a wide range of plausible scenarios; or
	  ○ Need to be undertaken to meet short-term requirements; and
	• 'Investment required to keep future options open (such as enabling work or learning and monitoring), where possible, or is required to minimise the cost of future options.'

Central or 'most likely' pathway	'Companies should integrate their water resource management plans (WRMPs) and drainage and wastewater management plans (DWMPs) into their strategies by presenting their central or 'most likely' pathway as an alternative pathway.' 'This will show where the activities required to meet 'most likely' scenarios diverge from those described by the core pathway.'
Adverse scenarios	• **Climate** – UKCP18 probabilistic (land) or marine (sea level) projections, RCP8.5, 50th percentile probability level. • **Technology** – slower development than expected, for example, 'Progress on open data across the sector is limited throughout the period to 2050, with only a handful of water companies opening up large numbers of their datasets.' • **Demand** – higher growth forecasts, assume no change in building regulations and product standards. Highest of forecasts from local plans and Office for National Statistics projections.

	• **Abstraction reductions** – Environment Agency's 'enhanced' scenario (in England). • **Wider scenarios (optional)** – local or company-specific factors, as appropriate, or parameters between the reference scenarios, for example, a 'medium' scenario.
Benign scenarios	• **Climate** – UKCP18 probabilistic (land) or marine (sea) projections, RCP2.6, 50^{th} percentile probability level. • **Technology** – faster development than expected, for example, 'monitoring and advance forecasting of localised surface water rainfall and related pollution/wastewater stresses, including intelligent sewer technology, enabling rapid response and/or prior action.' • **Demand** – lower growth forecasts and new legislation on building regulations and product standards by 2025. Lowest of forecasts from local plans and Office for National Statistics projections. • **Abstraction reductions** – current legal requirements (in England and Wales). • **Wider scenarios (optional)** – see 'adverse' scenario comments.

10.2 Methodology

The scenarios that were modelled for cycle one of the DWMP are set out in Table 83. Due to time constraints, model runs were undertaken for the three 2050 scenarios in Table 85 and for a 2020 baseline, but for no interim epochs. These scenarios were undertaken for the 44 catchments (61 models) listed in the Appendix Section 13.2.

Table 83 - Scenarios that will be modelled for cycle one DWMP

Year	Scenario name	Demand**	Creep*	Climate Change	
				Rainfall Intensity – Flooding	Time Series – Overflow Spills
2020	Base	-	-	-	-
2050	Low	Based on historic build-out rates	Using UKWIR methodology reduced by 30% (x0.7)	5% uplift	No perturbation – use 2020 typical year
2050	Most Likely	'Central estimate' for growth: based on ONS forecasts, historic growth and LDP.	UKWIR methodology	Existing DWMP method – UKCP09 between low and medium scenario, from UKWIR 2017 paper central estimate. 35% uplift for north, 15% for south.	Using RED-UP version 3, RCP8.5 projections to 2030

2050	High	Based on local authority projections	Using UKWIR methodology increased by 30% (x1.3)	UKCP09 high scenario, from UKWIR 2017 paper. 65% uplift for north, 35% for south.	Using RED-UP version 3, RCP8.5 projections for 2050
*Creep is not mentioned in Ofwat's LTDS guidance but has been included in the DWMP assessment. **Modelling does not include reductions in daily water use by households or businesses. However, impacts of reducing water use were explored as part of DWMP option development.					

The following sections explain why these model scenarios were chosen.

10.2.1 Growth

Growth is made up of a combination of population and property forecasts multiplied by the return to sewer component of per capita consumption. It is the combination of increasing properties, the number of people distributed amongst them, and the amount of water forecast to be consumed that provides the growth forecast and variations of these forecasts that provide the growth scenarios.

The long-term delivery strategy uses a defined set of combinations to address the uncertainty in the components of the growth forecast. The 'low' scenario is made up of the forecast derived from the historic build out rates (the properties expected to be built).

The 'most likely' scenario includes the forecast based on local development plan (the properties planned to be built and allocated by the council) combined with the office of national statistics forecasts.

The 'high' scenario include the forecast based on (the properties allocated by government to drive development at a regional scale).

In each scenario the population and return to sewer rate has been used linked to the WRMP.

10.2.2 Creep

There is limited information on current rates of urban creep, rates of urban creep in rural areas, or rates of urban creep in Wales. Current industry practice and the DWMP Framework recommends UKWIR's 2010 report (UKWIR, Impact of Urban Creep on Sewerage Systems, 2010) and this report has therefore been used to generate the DWMP 'most likely' scenario.

There is even less information on likely creep for the 'low' and 'high' scenarios. The DWMP Framework recommends sensitivity testing at ±30% of the UKWIR-estimated urban creep and these were therefore used, -30% for 'low' scenario and +30% for 'high' scenario. No caps on the amount of urban creep have been considered in the 'high' scenario, for example creep may exceed the available permeable area within a catchment.

10.2.3 Design rainfall

There is limited guidance on applying RCP2.6 or RCP8.5 forecasts from UKCP18 to design rainfall, as required by Ofwat in its LTDS report. UKWIR have published guidance on uplifting design rainfall for the medium and high emissions scenarios in UKCP09 (UKWIR, Rainfall Intensity for Sewer Design - Technical Guide, 2015). Further evidence is published in The Institute of Civil Engineers 'UKCP18 Briefing Report' (ICE, 2022) and suggests that RCP8.5 in UKCP18 is broadly equivalent to the UKCP09 high emissions scenario, in terms of temperature. Using this evidence, the UKCP09 'between low and medium' scenario was used for the 'Most Likely' scenario in Table 84 - Extract from the ICE UKCP18 Briefing Report - Equivalence with UKCP09

Table 84 - Extract from the ICE UKCP18 Briefing Report - Equivalence with UKCP09

UKCP18 RCP	Increase in GMS temperature (deg C) by 2081 - 2100	UKCP09 most similar SRES scenario (in terms of temperature)
RCP2.6	1.6 (0.9 – 2.3)	None
RCP4.5	2.4 (1.7 – 3.2)	Low emissions (SRES B1)
RCP6.0	2.8 (2.0 – 3.7)	Between low and medium (SRES B2)
RCP8.5	4.3 (3.2 – 5.4)	High emissions (SRES A1F1)

No low emissions scenario rainfall uplift values could be found for UKCP09 or UKCP18. The CIWEM Urban Drainage Group Rainfall Modelling Guide (CIWEM U. D., 2016) suggests a lower end estimate for all England of 5% for 2050 based on UKCP09 and this has therefore been adopted for the Low scenario.

An alternative option was to derive new uplift parameters for UKCP18, but this was not considered feasible within the time available for model runs. Guidance is provided in Future Drainage: Guidance for applying rainfall uplifts (Murray Dale, 2021), however, a comparative approach has been provided by JBA below. This suggests that the UKWIR 2017 uplift values for high and central scenarios are generally greater than or similar to likely UKCP18 uplift factors, with the exception of the central estimate for south UK, which is around 5% lower than the likely UKCP18 values in Figure 97 below.

Table 1 – Approximate comparison of uplifts to the UKWIR 2017 values for 2050, 30-year return period.

UKWIR 2017 values			FUTURE-DRAINAGE Range	
			From	To
North West UK	Central estimate	35%	15%	30%
	High estimate	*65%*	*35%*	*45%*
North East UK	Central estimate	20%	10%	30%
	High estimate	*50%*	*25%*	*45%*
South UK	Central estimate	15%	20%	25%
	High estimate	*35%*	*25%*	*35%*

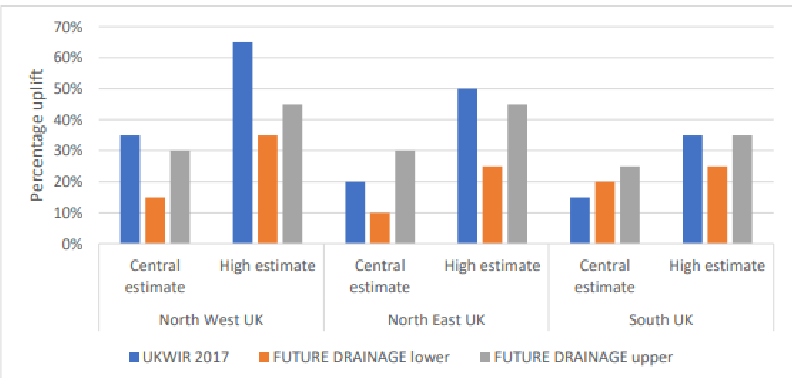


Figure 3 - Approximate comparison of uplifts to the UKWIR 2017 values for 2050, 30-year return period.

Figure 97 - Approximate comparison of uplifts to the UKWIR 2017 values for 2050, 30-year return period

The UKWIR DWMP Framework is more simplistic than the approach proposed here with a standard percentage uplift for all of UK.

From the model runs, predicted flood volumes from sewers (design rainfall) and predicted number of overflow spills (time series rainfall) were generated. These were then converted to number of properties at risk of internal flooding and number of pollution events. See Section 4 (Risk Assessment) for further detail regarding this process.

10.3 Outputs

Our modelling indicates that currently there are 75,512 properties which could be at risk of internal sewer flooding in the 2020 time horizon across 44 catchments. We have used our models to assess how this could be impacted by the scenarios proposed by the Ofwat Adaptive Pathway possible scenarios. It must be note that in terms of comparing modelled prediction and actual experienced a recent UKWIR report "Quantifying, managing and communicating the differences in storm overflow spill data between Event Duration Monitoring (EDM) outputs and hydraulic model predictions" published too late for inclusion in this plan indicates how to improve the prediction versus numbers experienced.

As would be expected, the number of properties predicted to be at risk of internal sewer flooding increases between 2020 and 2050 varies significantly depending on the pathway followed. Based on these findings, and as illustrated in Figure 98, there is an estimated 41% increase in properties at risk of internal sewer flooding for the 'low' pathway, 68% for 'most likely' pathway and 109% for the 'high' pathway when compared to the 2020 time horizon model.

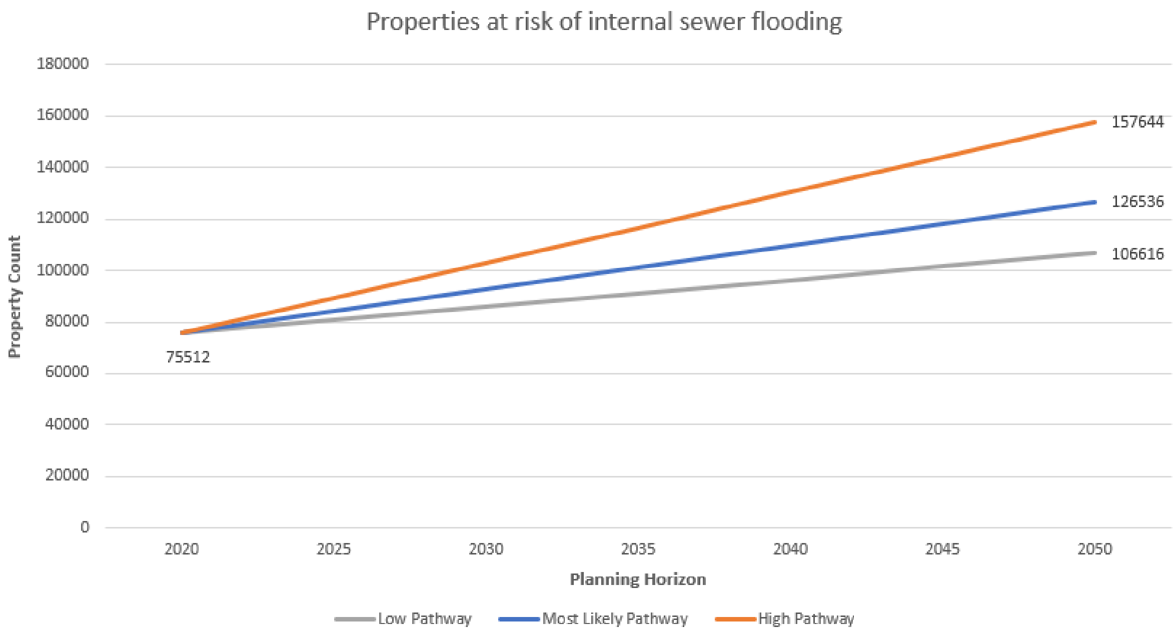


Figure 98 - Variation in properties at risk of internal sewer flooding between adaptive pathways

10.3.1 Costs

To assess the potential impact of the proposed 2050 scenarios on the size and therefore cost of potential solutions, we have looked at both the reference option, as described in the Options chapter, and options developed following The Journey Plan. The reference option is a simplified cost estimate which may realistically resolve the flooding or pollution at a given location. It is not necessarily the most appropriate solution, however it provides a comparable cost across a range of catchments. The potential variation in costs using the reference option for the possible scenarios assessed is shown in Figure 99 and Table 85.

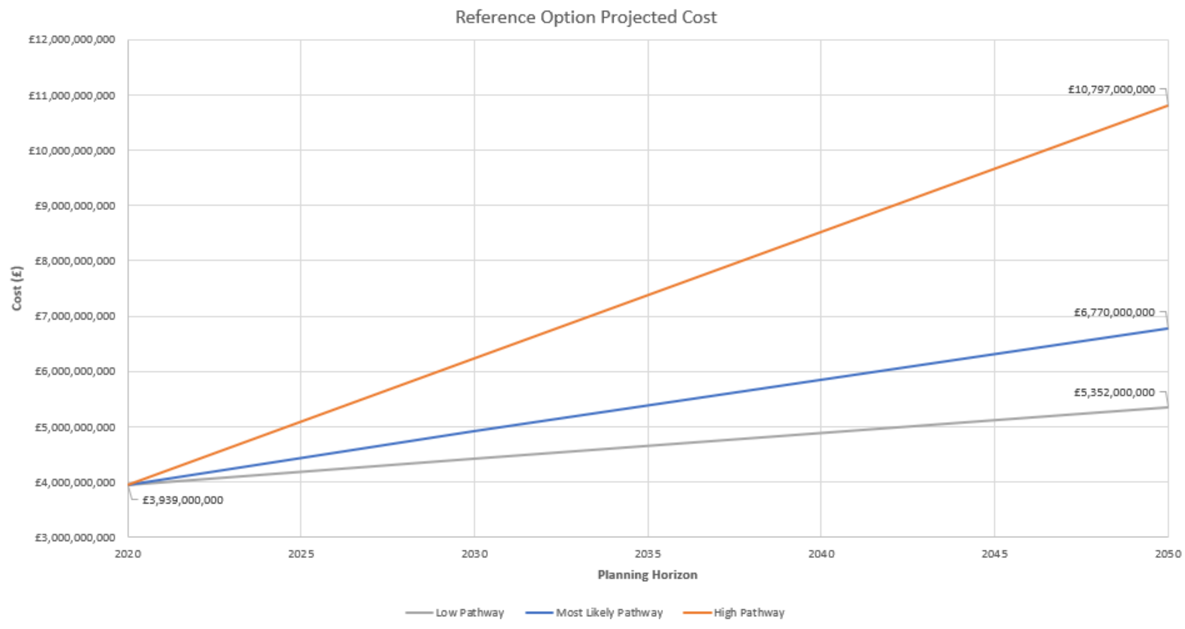


Figure 99 - Reference option cost variation for each of the three potential scenarios that includes both Storm overflows and customer flooding with a target of 40 spills.

	2020	2030	2050
High	£3,939,000,000	£6,224,000,000	£10,797,000,000
Most Likely	£3,939,000,000	£4,907,000,000	£6,770,000,000
Low	£3,939,000,000	£4,410,000,000	£5,352,000,000

Table 85 - Reference option cost variation for each of the three potential scenarios

In line with the Journey Plan detailed in this report we have developed options for the 2030 most likely scenario and then assessed any additional requirements against each of the Ofwat's planning scenarios. The Journey Plan was designed to deliver the best hydraulically beneficial schemes for each catchment. The Journey Plan promotes the removal of rainfall runoff from connected impermeable area which could help mitigate against the impacts of climate change and future uncertainties. The tests undertaken on the 44 catchments are shown in Figure 100 and Table 86, showing the reference option cost variation for each of the three potential scenarios.

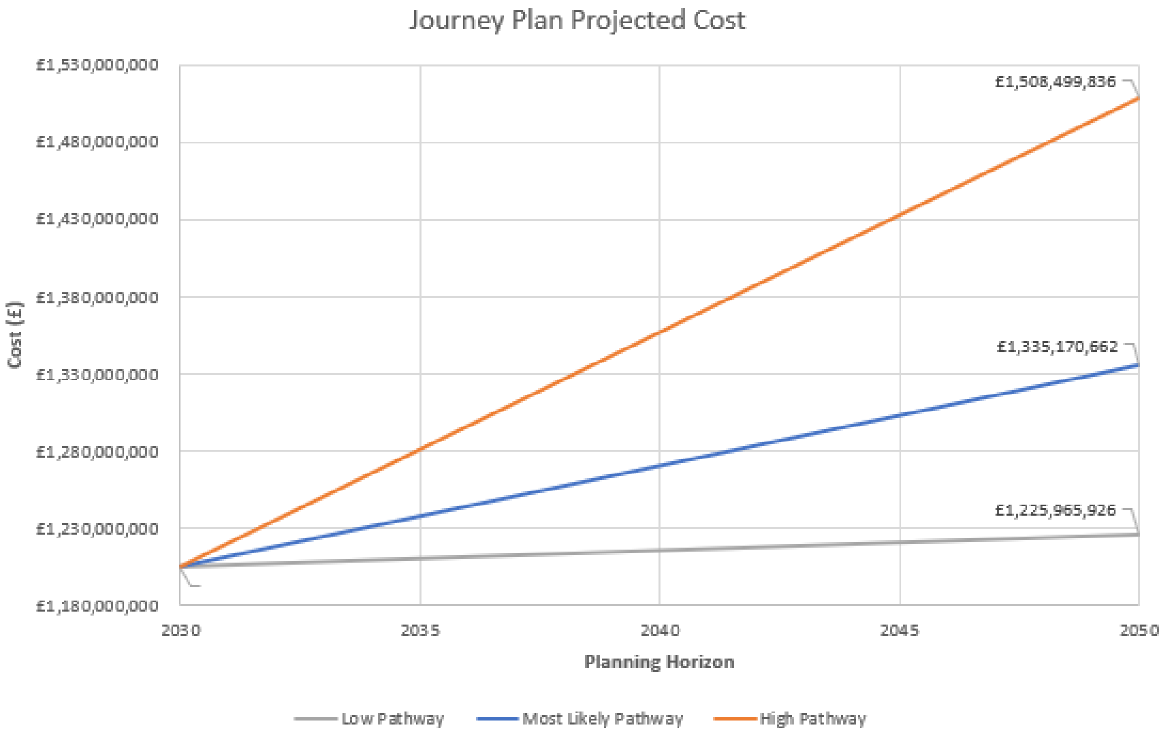


Figure 100 - Journey Plan projected cost for each of the three potential scenarios covering both storm overflow to 40 spills and customer flooding

	2030	2050
High	£1,204,903,838	£1,508,499,836
Most Likely	£1,204,903,838	£1,335,170,662
Low	£1,204,903,838	£1,225,965,926

Table 86 – Journey Plan cost variation for each of the three potential scenario

The results indicate that when options are developed in line with the Journey Plan the impact of future uncertainties are mitigated to a much greater extent when compared to the reference option, which has been derived using traditional hard engineering solutions. The most significant benefit of the Journey Plan option is the removal of runoff from impermeable area draining to the foul or combined sewer network. The removal of the connected area mitigates against the impact of increased runoff because of climate change.

10.3.2 Tipping Points and Decision Points

The key to adaptive planning is knowing which future scenario is most likely to occur and therefore when to switch to the appropriate planned pathway. In the 2023 DWMP we have assessed what the likely impact of three scenarios could be, however when we need to switch between each of the scenario pathways is a much more complicated question. We have reviewed possible tipping point and decision points below:

Population Change - A Tipping Point:

We have undertaken analysis of historical build out rates and considered data available in local development plans in determining whether population change in a region will itself be positive or negative and what the change in population will mean for the performance of our assets. However, this assessment is based on models and is not necessarily what will happen. We will therefore continue to review our population predictions and when developments start to have an adverse impact on the performance of our assets, which could be used as a means of informing us that population is changing in such a way that we need to adjust our management plan.

Climate Change: A Tipping Point:

We will monitor the performance of our assets to determine when we think changing weather patterns are triggering a change in the performance. Through modelling we will work to determine triggers which could be used as a means of informing us that the climate is changing in such a way that we need to adjust our management plans.

Legislation: A set of Decision Points:

We are currently committed to delivering investment in our sewer network, over and above our normal levels of maintenance (termed 'base expenditure') primarily through existing guidance:

- The Water Industry National Environment Programme (WINEP); and
- The Storm Overflow Assessment Framework (SAOF)

We are also developing our plan to ensure zero environment harm from our assets on the water bodies with our operating region. The impact of these existing and future pieces of legislation will impact when we make investment in our sewerage network.

By reviewing our DWMP every five years we will review each of these potential tipping points and decision points on a regular basis and amend the revised plan accordingly.

As we reassess our plans each five years, we will use the core plan and the DWMP most likely plan as backdrops to new decision year and trigger year indicators.

10.3.3 Development of the Adaptive Plan

We will continue to review the impact of the change on our sewer system. We will continue to ensure that the DWMP drives the LTDS to ensure the requirements of Ofwat are met, while ensuring our plan remains resilient to external demands and changes to policy and legislation in the future.

The business has continued to develop the long-term delivery strategy merging in the methodology with the price review for 2024 and the following graph (Figure 101) has been produced based on the information provided from the DWMP and work streams looking at resilience and business as usual approaches.

The Core Pathway and Alternative pathways developed to support the Price Review are show below in Figure 101.

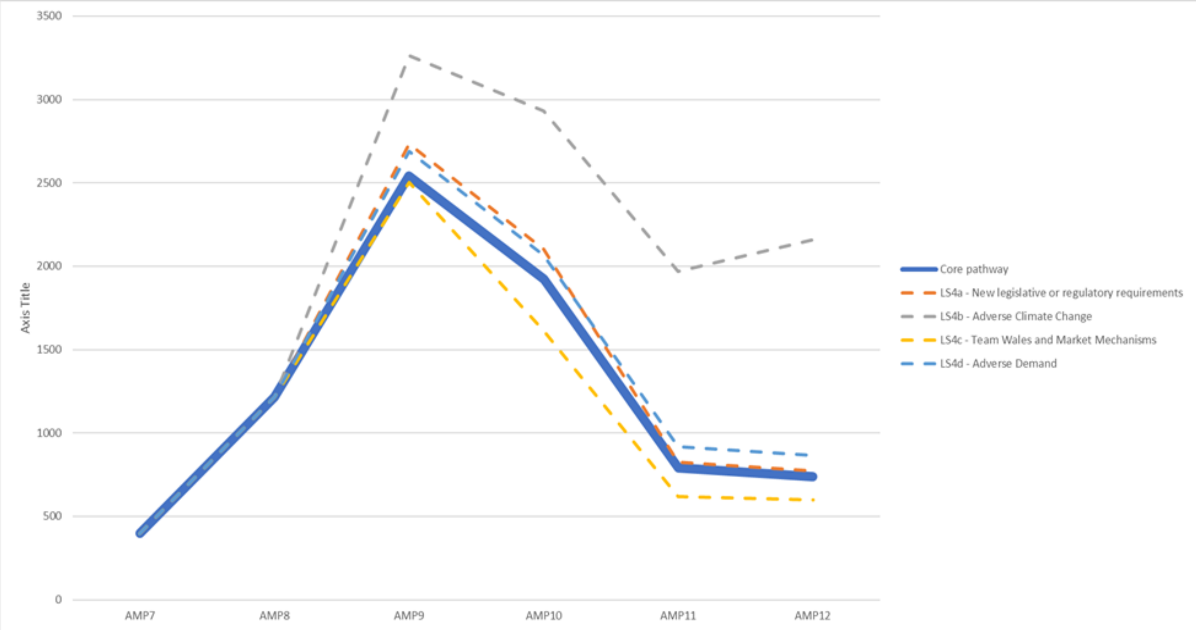


Figure 101 - Core Pathway and Alternative Pathways

The core pathway and its alternatives are based on the assumption that investment in storm overflows will continue throughout the 25 years, but the NEP will end within 15 years. The company's application of this methodology has led to an investment that peaks and then drops back. This profile highlights that the current NEP which would normally have been delivered by 2027 has been spread over a longer time period to make the investment more manageable to customers. What it also highlights is the company NEP is limited to drivers from NRW/EA and those drivers are to meet a deadline linked to the water framework directive cycles which is current to deliver improvements by 2027.

The DWMP shows that beyond the prescriptive NEP, there will always be investment required to continuously improve our impact on the environment. Whether that is to achieve greater phosphorus or nitrate removal or go further than regulators expectations of upper quartile performance. We have already discussed with customers their expectations of final destinations for sewer flooding and storm overflow activation. Therefore, we know that we need to sustain investment into the next 50 years to reach these destinations. It is no longer about what we need to achieve but it is about when we can reach the destination given the limited amount of funds, we can obtain from customer bills and financial investments.

Drawing again from customer research, customers are willing to increase their bills as long as we drive the improvements. The more likely investment which is shown in the DWMP, rather than the LTDS, shows the same early years increases but retains the higher investment in AMP 11 and 12. The DWMP highlights that the following 25 years will also show an increasing profile for wastewater assets and performance improvements.

10.3.4 Adaptive planning at the catchment level

While this plan has demonstrated that both a strategy and a programme of work can be incorporated into a management plan, the application of adaptive planning at a company level is different to adaptive planning at a localised level. The local plan is made of solutions required to maintain and improve service now with different types of solutions in the future but still to manage the same fundamental excess of volume. While the strategy discusses the high-level choices in terms of do we shift strategies. A local solution is discussing do we drive more surface water removal or storm more water. Going forward, the future solution will take this into account and demonstrate whether the solution needs to be a few more metres cubed larger or needs to be something totally different. What this means is that more consideration was required to develop adaptive planning for DWMP programme of work and what the triggers / drivers / benefits were.

11 Our Plan

Our Plan has concluded that risk is variable across our operating area with pockets of great service and pockets of medium to good service to customers and that the environment is also defined by NRW as part of WFD using a range from Poor to Excellent. Our planning approach has been created to ensure that as many areas as practicable see an improvement but still consider the overall cost to customers. We have taken two approaches to planning, a strategic direction plan and a localised journey plan.

Our strategic plan presents what we expect the company will need to invest to deliver two major areas of investment; this includes milestones to reduce storm overflow impacts and milestones to reduce customer flooding. It presents how we will need to manage pace and expectations while ensuring both drivers are being delivered and progress is made.

Our local journey plan has focused on the area where the highest risks were identified in the Problem Characterisation stage of risk assessment from the DWMP Framework. These are also overlaid onto the planning priority matrix as areas that are linked to the worst kind of customer flooding and the highest designation for environmental improvement in SAC's. In these areas we have produced detailed action plans totalling 219 suites of feasible solutions to solve volumes of wastewater and rainfall between 2025 and 2050.

The short-term delivery solutions are solving needs that are from past risks and therefore are not always the same locations. The forward-looking risks have been identified as our highest priority locations through the DWMP process and locations supported by our customers and stakeholders.

We reviewed the preferred solutions for each location for environmental impact and the business plan combined these with other drivers for investment. Where a solution developed by the DWMP has not been taken forward into the draft business plan (for delivery within the AMP8 investment period of 2025 to 2030), these solutions will be reconsidered as part of our next cycle of the DWMP.

We have concluded the following strategies that we will continue to use going forward to drive improvements for both our customers and the environment together limiting competing needs so that there is a balance to improvements overtime.

We took from our company strategic solutions the need for additional investment and discussed this without customers through customer research as to how they would like us to ramp up our expenditure overtime.

Customers asked us to make a small increase in our expenditure levels now but there would need to be incremental increases in expenditure across future investment cycles to enable us to reach the destinations proposed within our DWMP. One approach that was supported during the consultation was to double the increased investment each decade until a new stable level of investment was reached, so that the ambition could be met over 50 years preferred or 75 years as an alternative. At a practical level, what this means is that due to the current economic climate and the 'cost-of-living crisis', the company will take a precautionary approach to increasing investment and continue to develop this ambition with customers going forward.

Our reference level assessment indicated that to:

1. resolve both storm overflow to the destination of zero spills.
2. remove internal sewer flooding from a hydraulic overload impact to the destination of zero escapes.

3. include the new developments planned during that time and the highest Climate Change risk of RCP8.5 expected by 2050.

It would cost in the region of £13bn. We concluded that we needed to put in place a clear strategy for all involved to understand so that whoever created or co created solutions knew what had to be achieved and how.

11.1 The Strategy

Our plan has produced a detailed strategy which will be the main core of DWMP29. The DWMP strategy is below:

Sewage Plan
Maintain our current operating licence and current permits by ensuring the capacity of our assets remain the correct size for the populations and business customers of today and for those of tomorrow. In our network, we will build in capacity to react to blockages and collapses and programmes to manage situations to ensure the customers experience is improved. Continue to build into our systems the capacity to fit the number of houses and population expected to be built into the next 25 years but we will plan this so that customers to today do not have to pay for the customers of the future. It includes the agreement of a proactive allowance to enable future trade connections up to a percentage value of the catchment capacity in any network as a maximum permitted allowance. The approach is yet to be agreed by the board and government We will reassess this commitment during the DWMP29 and discuss with government their preference and subsequent direction. We will work with developers to agree an alteration to the process which works more proactively to support future development while also ensuring customers who are already connected are not detrimentally impacted. Maintain our system by investing in infiltration reduction programmes and working with customers and businesses and other stakeholders who have inadvertently misconnected into our sewer so that the volume misconnected is diverted to the correct and more sustainable drainage route.
The Drainage Plan (Rainfall)
Seek the formation of a National Drainage Programme which can bring all RMA's and stakeholders together for a common purpose. Without the common purpose collaboration will be much harder and less effective. Proactively seek to divert rainfall into rivers, streams, and the sea through natural features, before rain enters the sewer. We will analyse where there are opportunities to retrofit surface water systems separately from sewer systems so that the environment benefits from the added water volume for longer especially in rural areas where natural flood management will have a greater improvement. Where we as a

water company do not have the legislative power to deliver such schemes, we will work with the agencies that do, to still deliver the overall benefit.

We will work to remove environmental harm caused by the operation of storm overflows as soon as possible, while maintaining our current permit.

The Flood Plan

To play our part along with other landowners to maintain flood defences to meet the current national standards for community flood defences and work with government and regulators where there is likely to be a change to those national standards.

Apply a company standard to our assets and lands that are within the flood risk areas and inside the national flood defences so that we bring that asset back to service after an extreme event has occurred. Where assets are not protected by a national flood defence the company will ensure that the assets are similarly defended by a flood defence. All assets will require additional mitigation to manage floods as climate change impacts increase and more interventions will be planned to ensure that assets are brought back to service as soon as practicable after an event sooner, if an event were to occur.

Review of Consents and Permits

Continue to monitor our operational permits to predict when a permit is likely to need amendment based on population change and variation in climate and future policy.

Manage the operation of storm overflows proactively, we will continue to reduce the need for storm overflows into the future to reflect our customers and stakeholders' requirements, especially at locations where wild swimming increases in our rivers, lakes and seas. This means that swimming could occur throughout the year. We will work proactively as more locations become ready to be newly designated bathing waters.

Seek to reduce our reliance on storm tanks at WWTW's overtime due to the increased operational costs of their long-term management to meet climate change impacts by introducing more nature-based alternatives such as natural storage and attenuation solutions at WWTW's.

Seek to continuously improve our service to customers and reduce our operational impact on the environment, through the delivery of the national environment programmes of both Wales and England. In addition to the agreed NEP we will look to forecast the impact of a future NEP on the business, so that we can drive enhanced improvements collaboratively with other landowners and stakeholders along a river system. We will work with our environmental regulators to agree a method to carry out that supporting activity.

Continue to protect customers from flooding which was the function of a storm overflow, and is written within the current permit. We will look to drive change to these permits over time in a proactive way, while taking rainfall out of the sewer and re-routing it to a more natural water course. This is the preferred and more sustainable approach in the long run, or for short term improvements, we will build our assets only-just big enough to contain the rainfall and move the volume to be discharged after treatment at the works. We will proactively follow the surface water separation approach for future flows, to become more sustainable in the long run.

The costs to deliver the strategy is referenced below and starts with indications for large programmes of work where further knowledge would be preferred before delivering a solution. These opportunities or strategic programmes will lead to investigations and engagement with others to refine the need, and confirm the solutions through the tactical methodology which produces the 25-year programme.

11.1.1 Investment targeting the Sewage Plan scenario.

The cost to ensure compliance with DWF into the future (using a simple length of main in Km multiplied by a one-size pipe capacity increase) is £10 million. However, it should be acknowledged that the set-up costs for deliver would be excessive as there are 9km of network distributed across the whole operating area. To provide the additional capacity to incorporate drizzle a further 51km of network would need to be increased at an estimated cost of £61 million.

The development of these forecast capacity risks would be more efficiently delivered when combined with solutions to meet other risks. We will continue investigating through hydraulic modelling and combining the outcomes with other work programmes, to understand the causes of the capacity restriction.

The cost to reduce infiltration and misconnections is difficult to assess, as there is a considerable need for upfront engagement. To support this, we have introduced a team that will discuss with individual customers, who have connected inappropriately or incorrectly to the surface water system to improve localised pollution, and also identify instances of connections from land drains. The initial cost for this work will be an operational subsumed cost. Any opportunities established will be merged and managed alongside other programmes and delivered depending on the risk and opportunity identified.

11.1.2 Investment targeting the Drainage Plan Scenario.

The cost to drive natural drainage solutions targeted at public owned land and schools is anticipated to cost in the region of £502 million. This programme has been assumed to contribute to the National Drainage Programme, if supported by government could help to reduce extreme flooding in the long term.

We consider that as part of a National Drainage Programme, our contribution could be approximately a third of this. However, we do not expect the programme of solutions to produce outcomes until the AMP9 (2030-2035) period as upfront work to confirm the locations and agree the systematic policy that supports the national drainage programme would have to be agreed prior to implementation. In the interim, ad hoc opportunities will continue to progress where they are found, and we will support our contribution. We will be promoting the need for a national drainage programme in Wales and working with councils to prioritise the list of locations for early opportunities.

11.1.3 Investment targeting the Review of consents Plan Scenario

The National Environment Programmes are set by our regulators and is being confirmed at the time of publication of this DWMP. The investment required to deliver the full programme from both England and Wales to meet a deadline of 2027 is too high to be paid for by our customers in a single five-year period. The extent of change has required negotiations to smooth out the investment over 15 years.

The summary of investment in the NEP is listed in Table 89 below. In addition to the NEP a further three areas that form work to meet new requirements or new aspirations from customers covering expenditure over a longer period of time to reach the end destinations covering storm overflows and customer sewer flooding, the provision of screening where permits had not indicated there was a need and screen to meet the new minimum screen size of 6mm. An allowance to meet a possible investment required if the new UWWTD is incorporated in Welsh Legislation is not included currently but noted here due to the expected level of investment it would likely indicate approximately £1bn to £2bn as an early estimate.

Table 87 - Summary of NEP Investment

Driver	Investigation Cost £m	Improvement Cost £m	Total Programme
River Water Quality Continuous discharges	£6.58	£186.85	£193.43
River Water Quality Intermittent discharges	£39.84	£449.09	£488.93
Bathing water and Shellfish waters	£6.72	£28.92	£35.64
Marine water quality and protected areas	£2.51	£6.95	£9.46
Biodiversity	£0.72	£83.99	£84.71
Net Zero	£0	£42.01	£42.01
Permit Application charges	£0	£6.57	£6.57
Total AMP8	£56.36	£804.38	£860.75

The figures include an assumption for climate change at the highest forecast of RCP8.5 however in terms of investment profiles the recognition that the investment can either achieve fewer higher resilient solutions to meet RCP8.5 or more solutions to a lower climate change assumption allows us to discuss with customers the approach to risk regarding climate change while still showing the pace using an affordable investment profile.

We will be developing a supporting model to indicate future risks to the environment that could allow us to prepare earlier for future NEP drivers.

Driver	Programme 2030 £m	Programme 2050 £m
River Water Quality Continuous discharges	£193.43	£325.45
River Water Quality Intermittent discharges	£488.93	£921.88
Bathing water and Shellfish waters	£35.64	£72.75
Marine water quality and protected areas	£9.46	£23.02
Biodiversity	£84.71	£120.84
Net Zero	£42.01	£58.50
Permit Application charges	£6.57	£9.50
Total AMP8	£860.75	£1341.35

We are anticipating an increased number of locations for investigation going forward followed by more improvements following the results of the investigation programme. As the NEP isn't developed in the same way of other investment and is predicated on drivers and new directions, we can only highlight that we expect to need to continue to reduce our impact on the environment. We can sensibly allocate an allowance to these activities, whether the need does become a reality at this stage depends on many assumptions. The first is that as a company, we believe our customers want us to continue to deliver a storm overflow reduction programme, increase the number of designated wild swimming locations and bring about greater ecological improvements as part of the climate and ecological emergency. We have made simple assumptions to show a direction of investment to account for these outcomes.

The investment to reduce storm overflow impact to reduce environmental harm is continued within our NEP. Our customers and stakeholders would like us to continue to invest in storm overflow reduction plans. We have estimated the cost of varying reductions to all our storm overflows and this programme is in the region of £8bn which includes the investment to remove environmental harm and go beyond this. We agree that each storm overflow will go through a transformation into the future, and each will reach its destination at varying times. We have included this scenario in our most likely projection as a 50 and a 75-year trajectory in recognition that the direction of travel is correct, but the pace of change is dependent on customers support and any new risks emerging. We will continue to check the pace of change against our achievement.

We expect that the impact from changes to policy could be considerable with the initial estimate relating to the urban wastewater directive that is being discussed in the European union currently as an example. As this is not within the NEP but only an anticipated cost it is currently stated here as a possible impact that will need to be within a future NEP or at least continue to be discussed until more clarity is confirmed within this section of the DWMP. This estimate is truly uncertain and although being included here as an indicator of future change it is not included in the 25-year company strategy as more analysis of it ultimate impact is required.

11.1.4 Investment targeting the Flood Plan

We have carried out a flood risk assessment and prioritised locations based on their proximity to a watercourse. When this work is linked to the indicative risk from future sea level rise, we can expect to invest in this area overtime starting with maintenance of flood defences that are part of national flood defences that defend a whole community and then to asset locations that are not defended by any national defences, and we alone need to defend these locations.

In addition, we must consider when a defence could be overtopped and for these areas how to reengineer our sites to be more resilient to extreme flooding, for example moving electricity circuits to a higher level in buildings ensuring that we return to service quickly after an event. We also recognise that our outfalls to rivers and seas will not operate during times of higher sea level rise, and some will need to be re-engineered to ensure discharges can still occur either by relocating them or timing them to low tide.

We have considered that approximately £20m should be allocated to the management of extreme flooding each AMP going forward. This is a conservative estimate. We expect more national flood defences will be known by NRW as they progress their work to reevaluate flooding in the future and the example site in Porthmadog has highlighted that we as company need to be ready to work with NRW at the locations they prioritise while also delivering our priorities.

11.2 Maintaining our service

We have estimated that as we reach the end of the 25 year of the plan 56% of every £1bn of our funds will deliver programmes that support the principles laid out in our journey plan. This is proposing a move to proactive forward planning. With the remaining 44% being environmental improvements from the NEP and other new drivers.

This investment will allow us to ensure:

1) we continue to meet the demands of new growth and development.

2) continue to meet evolving performance improvement commitments.

We expect that this level of investment will become balanced over the next 25 years.

11.2.1 Maintaining our current performance with todays and tomorrow customers

We expect that the majority of funds will be required to deliver continuous proactive and reactive maintenance. We have a large asset portfolio with every asset being pushed to ensure we gain as much life from it as possible without impacting on critical service delivery. These assets include:

- Pipes
- Pumps
- Overflows
- Sea outfalls
- Treatment processes
- Sludge disposal
- Telemetry
- mechanical and electrical systems

All of these need a minimal level of funding to keep them in working order. There are also programmes to ensure pumps, pipes and channels are cleaned so that their efficiency isn't compromised. We are also very mindful of the operating costs (such as human resources, offices and vehicles) which are required to enable us to continue to maintain and support our physical asset base. Each Management plan will assume a level of maintenance is being achieved and funded and our plan will provide investment reasons to go beyond this fundamental requirement.

11.2.2 Carbon

One of the ways we can reduce our carbon impact is at our WWTW where through the process, gases are emitted such as nitrous oxide and methane. We are going to work on reducing the emissions of these gases as part of our carbon reduction planning.

We can also create a programme of offsetting carbon for solutions that are required to build concrete structures that are carbon increasing activities. For example, for each concrete project we could remove the same equivalent carbon through a green infrastructure project building a SUDS system nearby. However, to obtain the proactive funding support to deliver such an approach would need to be supported by government and our regulators and may need changes to legislation to deliver effectively.

11.2.3 Decisions support Tools, monitoring and investigations.

The DWMP has informed the company of the need for investment in permanent and temporary monitoring along with continued development of models informed by the monitoring programme. We have learnt from the introduction of the Event Duration Monitoring (EDM) programme, which was a requirement as part of government strategy, that the data and decision tool improvement programme needs to be developed and implemented over time with the pace of implementation informed by affordability.

During our first DWMP the BRAVA stage identified that more decision tools were required before we could conclude the overall risk of an area without reference to anecdotal evidence. We took a pragmatic decision to continue to develop every location to a strategic point for the first cycle which is shown in the journey plan for each area, as without the development of a model or the investigation into risks at sites BRAVA would always conclude that there was more to understand before going any further. The delivery plan specifically relating to the DWMP continuous development become a must do requirement so that plans in the less informed areas could be improved.

The programme of work required to support this improvement over the first five years of this plan is to increase our hydraulic model coverage from 80% population coverage to 95% population coverage with a stretching target to achieve 98% population coverage (based on our annual performance report FT2 performance commitment). It is important to know that in terms of the number of distinct models required to cover the remaining 20% of the population would increase the number of models from 199 to 828. In addition to hydraulic model coverage, other asset level models are required such as those that indicate the correct size of pumps to deliver the future volumes of flow. The size and dimensions of processes within a treatment works to meet and maintain the future flow requirement once CSOs are contained or variations of containment from reducing environmental harm all the way to meeting levels required for bathing waters to the end destination and driving the new requirements required to meet the WFD status of good and then to excellent.

These new models could be combined together to create a new review of consent process that works within the management plan, to inform the environmental destination of sewerage and drainage could aid the regulation of the future impacts to environmental policies.

There are other programmes of work that we have classed as DWMP continuous improvements, and these are related to working with stakeholders and customers.

11.2.4 Investigations and reviews of data programmes

In all planning systems, there is a requirement to understand what is changing over time and the consequence of that change causing an impact to customers. Another aspect of planning is assessing then reassessing the assumptions that had been made during the planning process. As time passes, with proposed solutions ready for delivery in the future a programme of assumptions, investigations can also be driven that continually improves the certainty of the solutions being put forward. There is a need to undertake investigations for many reasons most linked to the solution that is going to be delivered. Therefore, a proportion of maintain service is set aside to answer questions raised from an operational perspective and to improve assumptions made during the planning process. Now with the advent of management planning, the need to answer questions in a consistent and systematic approach brings the added cost of formal investigation programmes. Again, these investigations are driven by affordability.

So, programmes need to be set to cover as many assets and catchments as possible at a rate and detail that enables continuous improvements in a timeframe suitable to inform first the management plan to reflect and evidence strategies to deliver, then to inform the asset plan risk and consequence assessments and then the business plan to inform the short term funding requirements and finally at the delivery plan the assumptions become known factors as the project concludes and which are then fed back into the planning process and information improved.

Investigations culminating in confirmation that the current permit is fit for now and the future or that new permits will be required and when will they be needed. Information required to produce forecasts of 25 years as a minimum and confirm assumptions are:

- Quantity - Pg+I+E
    - P population
    - G per person consumption
    - I infiltration catchment allowance
    - E trade flow allowance maximum agreed
- Infiltration
- Trade Permit agreements
- Population Growth
- Urban creep
- Climate change
- Quality - Formula A
- Flow into the WWTW's
- Pass forward flow in the network
- Chemical impacts
- Nutrient impacts
- Discharge permits
- Predicted Land use change in a catchment
- Environmental – dilution
- Flow in the river during dry and normal and wet conditions
- Ability of the river to mix the permitted discharge
- Ability of the river to dilute the permitted discharge

11.2.5 The customer area of options development

The information required in a proactive way to effect a behavioural change in the population. This includes UK level messaging, Wales level messaging, regional messaging and localised messaging. The means of messaging is different for each level covering such as TV, Radio, social media, newspapers and roadshows at supermarkets and other popular locations such as the Royal Welsh Show.

The topic relevant to these informative sessions are:

- Reduction of water demand during the whole year and not only during a drought to support a reduction in the volume returned to the sewer.
- The impact of continual disposal of wet wipes, fats oils and grease through a sewer system that still continues to escape into our rivers and seas.
- Understanding the consequences of building over sewers on land owned by customers and businesses.
- Understanding ownerships of culverted watercourses and how to maintain them.
- Information to understand plumbing and misconnections and the consequences to the environment of those connections.

The programme of sessions to provide information is currently part of business-as-usual activities such as company level campaigns relating to stop the block. There is also benefit when combining messaging from other areas of the business such as water demand programmes and leakage programmes.

In addition, and again using the business-as-usual model we can also focus our messaging at trouble spots to resolve localised blockages.

The programme of work in this area has been assessed and where the cost of delivery and the method of delivery is calculatable the benefit is not yet available to support a cost versus benefit assessment. As it is the right thing to do, and because our customers support the continued delivery of information, we will continue in the most efficient delivery way while we develop a research programme to obtain the benefit data to drive additional informative programmes.

11.2.6 Surface water removal campaigns

We have developed programmes targeting surface water removal at specific landowners or type of settlement. We have started with schools publicly owned so that we can influence the educational departments programme of school improvements. These locations can be retrospectively fitted with SuDS or other surface water systems that can aid the council's sustainability goals and carbon reducing targets. It would be unlikely that we could support the funding to make the alterations, as the programme identified the opportunities are spread across our operating area and do not form a high enough priority to support investment on their own.

In terms of understanding the achievable volumes of rainwater to redirect back to the environment, we would support a joint programme of investigations across Wales to understand where the opportunities could be and quantify the contribution to a local driver. In a similar way, there are also places where we can help councils and government building managers to retrospectively improve their sustainability and carbon footprint by providing information as to approaches to apply.

Again, we can support others by carrying out investigations to quantify the benefit from a volumetric standpoint. Once we have enough areas mapped from both these programmes, we then can also use the data to inform surface water opportunities either a cofounded or joint programmes with other stakeholders. This wider investigation programme to map locations identified as possibilities is just as important as delivering confirmed solutions. These possible locations and the transition from a dot on a map to a fully-funded project for the community can take between five and 10 years to reach a delivered benefit. When linked with education programmes to stakeholders and customers, benefits can be delivered by others when they are empowered to make the right decisions.

We have costed how much it could cost to make improvements retrospectively to all the locations identified at this stage however the cost of delivery would be high if all delivered over 25 years. Again, the pace of delivery is linked strongly to affordability, deliverability and finance ability. So, the pace will start slowly and gain pace as funds become available. We will create a pipeline of opportunities already for co-funding and joint delivery to meet joint government driven outcomes.

Another investigation programme will also be developed ready for the next plan which is to increase our targets to include industrial and business parks.

When these programmes are combined at a catchment scale and turned into staged improvements to meet our drainage plan, we can then demonstrate the need for investment in our delivery programme and confirm the benefit to gain support through the final determination business plan process.

11.2.7 The Flood Plan

We are aware that we are jointly responsible for national flood defences. It is important that our contribution to manage community flood defence is the responsible thing to do. As a company, we do not manage the process as NRW/EA carry out the assessment. Once there is a proposal at a location, we then work with these organisations. To ensure each upgrade or maintenance request is funded, we must predict when the likelihood of investment will be required. We have predicted that support for flood defences is required, and we have predicted a need for an allowance within our long-term strategy and this plan.

In addition to those defences that are to support defence of the community we also need to consider additional defences where our assets are not protected by national infrastructure. An allowance for this has also been included.

The final area of flood planning is the work to assess and ensure that our operation returns to service as soon as practicable after an event has occurred. This work includes provision of alternative sources of energy supply, ensuring that buildings that need them have property level mitigation such as flood doors, and even within the buildings themselves moving mechanical and electrical equipment sensitive to water flooding up out of the reach of the storm water to a practical level. While this is a retrospective programme of work we can also learn from this developing area and ensure that new sites proactively consider the height of the flood. We cannot stop floods and we must recognise that, due to climate change, there will eventually be a higher flood in the future, but we must make plans to carry out the most practical of the flood mitigation solutions. We must also state that due to the nature of our business we inevitably must have property and operational processes within the flood plain, so we need to be practical and consider the most beneficial actions to undertake to reduce the impact to our services.

The allowance that has been put forward is approximately £20 million each 5-year period.

11.3 Tactical 25-year Programme

Our ambition through DWMP is to produce a 25-year programme of interventions that are required to drive improved standards by complying with the current operating licence and permits, building resilience to extreme flooding, and developing scenario planning to incorporate possible futures that describe the solutions to drive those changes that include the drivers from the National Environment Programme of today and the future.

We have achieved the core strategy for all enhanced and complex sites and applied the DWMP framework to these locations covering three of the common objectives. These are: Treatment works compliance, storm overflows and internal flooding. Our next achievement will be to incorporate the National Environment Programme into the tactical programme.

Figure 102 and Figure 103 show the examples show how at a catchment the individual interventions that make up the suite of preferred schemes to resolve the risk for both 2030 and the 2050-time horizon could be spread over the 25 years to ensure that an improvement occurs.

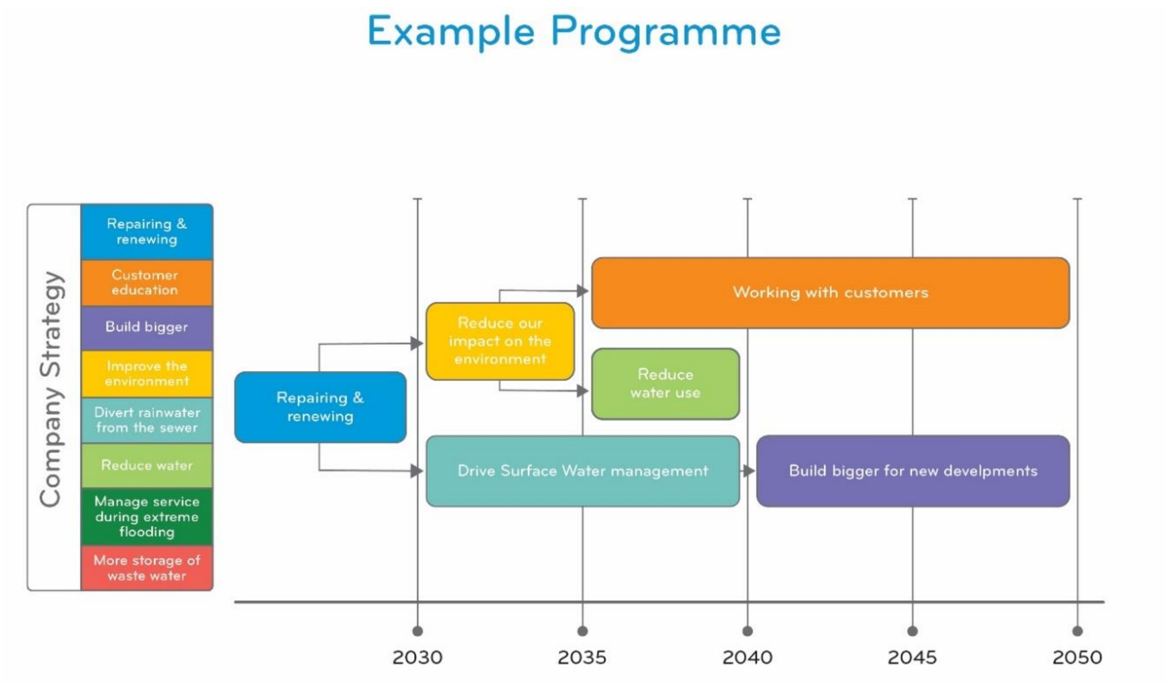


Figure 102 - Delivery Programme for the Example Catchment 1

The example Figure 102 shows how the option strategy can explain the 25-year programme at a location. For this example, the first decision would be to repair or renew a section of pipework. Following that decision, there could be two alternative choices to reach the same end benefit. The choice could be to undertake an environmental solution such as create a wetland to remove phosphorus to allow new connections from a developer, followed by working with customers to provide understanding on their impact on the environment from their choice of detergents, or wet wipes. A drive to reduce customers' consumption, and a drive for the surface water separation scheme in readiness to allow a developer to connect to build a bigger network, to make up for the area that could not be separated in time.

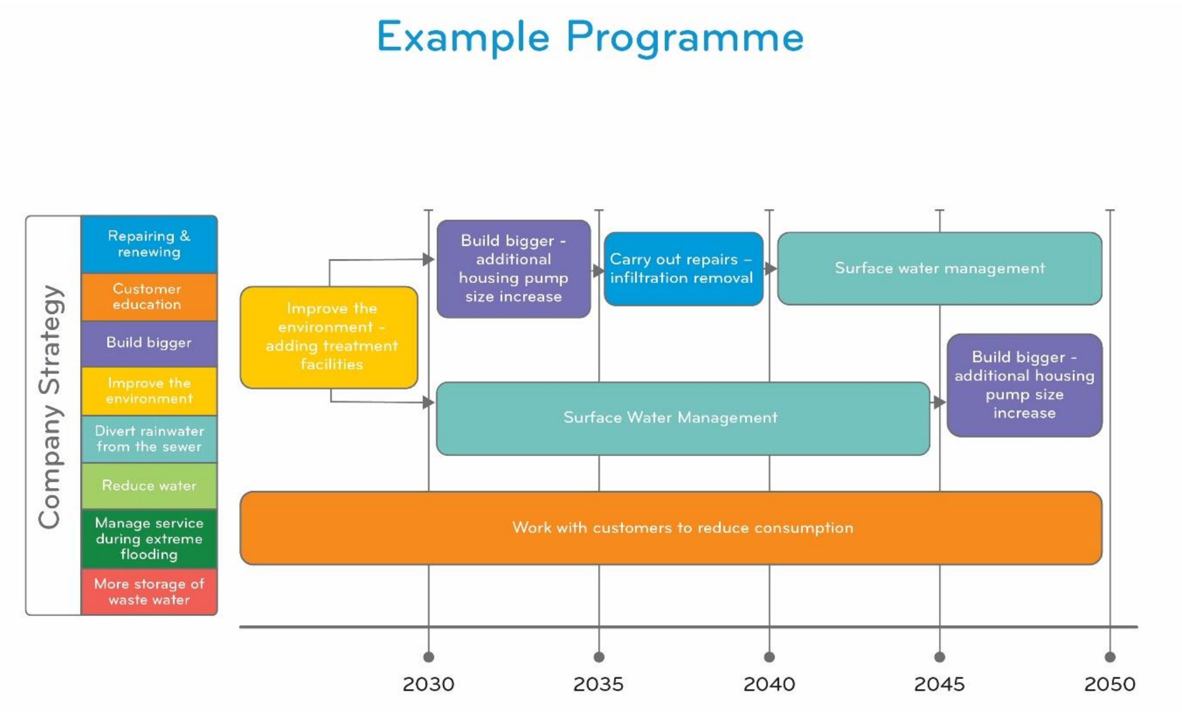


Figure 103 - Delivery Programme for the Example Catchment 2

The example in Figure 103 shows that there could be more than one choice within the short term plan in this case the continued customer support to understand their impact on the environment, rather than a more companywide campaign to reduce consumption in a targeted programme that combines consumption with the impact from wet wipes, fats oils and greases due to a known history. Alongside this continued localised effort would still need a solution to reduce phosphorus in the river likely with a wetland followed by two alternative routes to allow development to connect. Both combining surface water management with building new pipes and one adding the removal of infiltration and repairs to network.

What these examples show is that there is a clear need to decide the initial solution and build in the remaining years as alternatives. When the alternative futures are compared to the benefits to the environment and to customers plus the costs of each alternative will indicate the preferred route and become the best value programme. At each plan, the impact of the next decision and subsequent impact on the alternatives will be reassessed and so on until the improvement our customers want has been achieved.

The 25-year programme currently has focused on the enhanced and complex risk locations and focuses on quantity – resolving flooding to worst served customers and quality through the management of storm overflows. The table below provides a short extract from the full initial review.

Ynys Mon and Teifi Level 2 as examples of the programme		**Location Details**	**Scheme Cost Benefit**	
Scheme Ref	**Scheme Name**	**L2 Ref**	**AIC**	**AISC**
72152-A-RZ01-DFL.004110-2025-2030-T1	Location A Flooding - Traditional Storage	Ynys Mon	£1,351.99	£1,247.77
72152-A-RZ01-DFL.004110-2025-2030-M1	Location A Flooding - Wetland overflow (1/2)	Ynys Mon	£1,860.28	£1,338.06
72152-A-RZ01-DFL.004110-2030-2050-M2	Location A Flooding - Wetland overflow (2/2)	Ynys Mon	£1,125.43	£759.97
52768-A-RZ001-CSO.70727_3a-2025-2030-S	70727_Sustainable_2030	Teifi and North Ceredigion	£141.55	£141.55

Table 88 – 25 year programme initial review figures

**Please note the figures quoted are not the cost of the scheme but the calculated cost benefit resulting from the calculation of net present value and volumetric benefit achieved.

In addition to these delivery schemes, the plan has highlighted programmes of work that would be beneficial to start straight away. These programmes of work will gain momentum and ensure that drainage is managed more environmentally friendly and prepare for green solutions, rather than grey solutions. But it is important to note that third party planning alongside our planning is required to make green solutions successful and programmes such as surface water separation are in this category. We have developed opportunities at schools and publicly owned land to aid that process and help inform the level of resource required to make drainage planning a seamless joint multi-organisational programme.

What is important to draw out here though is that the company and stakeholders already work together, create joint solutions and deliver joint projects. For example, Luston WWTW is currently being highlighted as a new wetland in association with the local council and has been delivered. What we have mapped in the DWMP regarding joint working is a change to how we work with others, making that work into a process that is repeatable in every location that will then drive simplicity, ensure that incremental improvement delivers for the location and then is translated into other areas. This is to ensure that consistent coordinated long term planning as an approach improves every location and the same level of benefit is experienced by everyone.

We also have assessed our assets in general terms, to ensure that capacity of the whole network is maintained into the future. we have created a programme of investment over time that will meet future legislation, as it is important to recognise that reliance on storm overflows will need to reduce and the impact from that will be the need for larger pipes, pumps and treatment works if the pace of change is required quickly impacting short term planning. Taking steps now to plan at a catchment scale will ensure that each river and bay will improve systematically, and an assessment be carried out in a programmed manner for all areas at the next cycle.

Our tactical programme built from the 44 catchments is shown below. A total of 219 suites of solutions have been created made up of two steps for each risk zone within a catchment. Each suite of solutions has been created to meet the end destination along with volumes to be contained or redirected estimated for 2050.

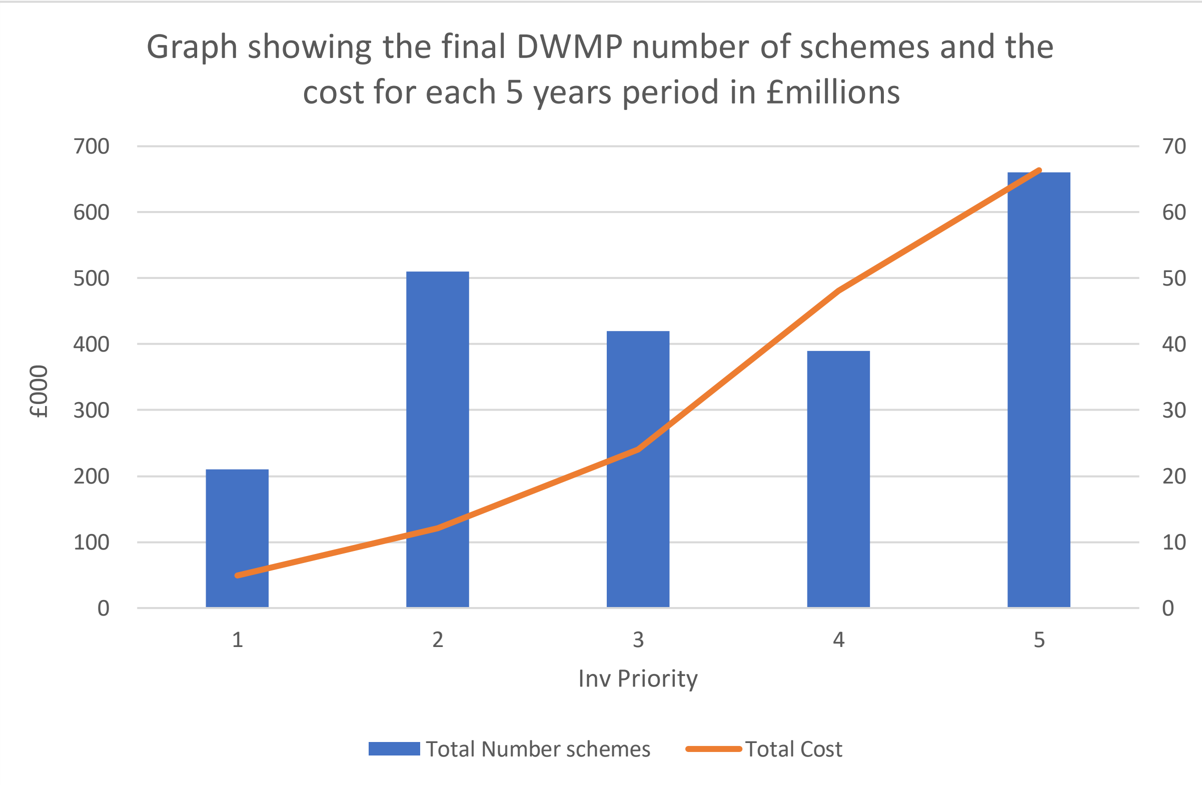


Figure 104 - Graph showing the final DWMP number of schemes and the cost for each 5-year period in £millions

11.3.1 Localised Solution development to meet future aspirations.

We have worked on developing a mechanism that identifies solutions that can be compared so that we can explain the costs versus benefits of delivering a traditional construction scheme versus delivering a more sustainable nature-based scheme at a hydraulically connected area sometimes where there are approximately 50-100 houses. But we must recognise that the permutations of possibilities are of too great a magnitude to carry out this intensively at every catchment of our operating area within the time period of one cycle. We have estimated that there could be as many as 4000 areas in which we need to assess the risk with this level of detail. And similarly, the intensity required to establish the exact possibility to deliver is also costly and time consuming. Over the years the decision to deliver a solution to a problem at a location has taken many years to establish the route cause and determine the exact course of action before sourcing funding and putting the spade into the ground. The investigation phase into the need for a delivery scheme has always meant that the most urgent current needs go through this detailed assessment.

The management plan is a programme that combines both current risk with predicted risk in the future. This is required to draw population at risk of flooding estimates so that we can reassure customers and government that the risk is low, while the distribution of risk is widespread we can then communicate our plans to reduce the number of occurrences. Drawing on evidence from the risk of sewer flooding in a severe storm performance commitment there are approximately 25% of the population at risk with current estimates however we know from the BRAVA assessment that sewer flooding risk occurs in every Level 2 strategic planning area. And nearly every level three tactical planning unit contains some risk now and into the future.

What we also learnt from the development of solutions to meet a 2030 and a 2050-time horizon in the future was that the cost to achieve both end destinations at once with a two-stepped time frame everywhere was just too fast to meet the affordability pace which is currently being assessed as part of business planning. This indicates that we need to create greater detail around the milestones to be achieved when working at local areas and how these influence business targets and performance commitments in the short term compared with the long term.

A change to our approach is needed that will turn strategic direction solutions into delivery programmes, while also widening the approach to include all locations in our operating area.

The greatest benefit to this change of approach is to confirm that an area has already achieved a minimum standard. Setting the minimum standard during the first cycle gained agreement from customers and our stakeholders. The standard we were proposed at the draft was the equivalent to 6DWF or the more technical term to Formula A throughout the network and treatment works system. Our regulator did not support this approach, so we will look at it again in the next cycle.

11.3.2 Other Developing approaches

We are considering using our land to support carbon sequestration as this is the right thing to do but this would not be part of the long list approach but is worthwhile mentioning here that other approaches are being undertaken to develop an improved Environment. We are also making plans to use our land to support biodiversity and ecology improvements. These are included in our Biodiversity Action Plan from 2021. We are currently developing the next Biodiversity plans which will be published in December 2023. Some of the requirements for that plan are driven by the WINEP/NEP such as INNS.

Welsh Water have published two biodiversity plans since 2017 which contains thirty commitments to how the business will work towards the section 6 duty of the Environment Act (Wales) 2016. We will publish our next biodiversity plan (in line with the 3-year requirement from Welsh Government).

- As part of our section 6 duty, we produce a backwards looking report on what we have achieved against the commitments set out as part of the biodiversity plan. We are currently drafting our report to be published this year.
- We have a biodiversity strategy which was published earlier this year which sets out our high level mission, aim and objective for biodiversity. As part of the strategy, we have a detailed action plan to support this which incorporates our 2050 vision and journey plans, including research and horizon mapping.
- In order to understand priority species and habitats within our assets and land holdings, Welsh Water have started undertaking baseline studies. The studies will produce an essential base for all enhancement work and identify opportunities. It also helps raise awareness further across the business about our biodiversity duties.
- In addition to our baseline studies, we continue to work closely with our regulator NRW to build databases to further understand how we can protect and enhance opportunities for designated sites, protected species and habitats. Some of this is also driven through our AMP 7 NEP with plans to include further work into AMP 8 and beyond.

We have been involved in the COVID-19 monitoring programme at wastewater facilities and we will continue to support government while it is needed.

In Wales the Environment Act puts an additional ask on Welsh Companies to support the sustainable management of Natural Resources (SMNR). In this area we are supporting activities on the Wye, Teifi, Dee, Clwyd and Allyn rivers and will be adding Cleddau and Afon as these are SAC rivers too. This approach takes a wider view than normal Asset planning which is the normal function of a Water company. For all options in the DWMP we have included the principles of SMNR at the start of the process so that all our solutions can support this approach. The wider benefits to society are included in this principle such as health and wellbeing.

Nature-based solutions are where we use nature to work with us and develop options using it. We are also developing our approach to support catchment management specifically to support the reduction of phosphorus in our rivers. Nutrient Management Boards have been set up in the Wye, of which we are a member to coordinate its reduction. Different types of options are being driven in these specialised circumstances that will inform other areas in the future. For example, the development of offsetting nutrient management schemes and using the polluter pays principles. These area trials are developing wetland management schemes for treatment works, and storm overflows. We have developed a tool to help assess where the approach can be applied, and we will continue to develop our understanding with trials of the next few years. We will also link this area to other nutrients such as nitrates too and look to include areas with multiple nutrient risks as soon as possible.

We are currently delivering solutions to reduce nutrients and our first scheme has been delivered. Figure 105 shows the new wetland jointly developed and now owned by Herefordshire Council, and aims to reduce phosphorus, before returning the effluent to the local river. It is the first wetland of its kind that will be generating ‘nutrient credits’ for local housing sector. The aim of this particular wetland is to deliver betterment to the river Wye to return the Wye back to ‘favourable status’.

Figure 105 - An Example of a Nature Based solution delivered In Herefordshire

We recognise that to address climate change, we cannot meet the challenge alone. We need to work together to change the drainage systems and to recognise that systems that the water company own is not the whole drainage system. We will need to ensure that our sewerage system has a minimum standard and that then our drainage system and those of others work seamless together.

We plan through the DWMP to task the Level 2 programme boards as the place where we discuss the integrated approach to drainage systems and the joint needs to ensure drainage is more naturally redirected to groundwater and streams and rivers. It is estimated that support to create opportunities will require resource costs in the realm of £400k. We have also prepared two programmes of work, sustainable urban drainage solutions (SuDS) for schools that build on our work in Llanelli and a new opportunity to work in public spaces such as car parks, and government owned buildings. These are suggested opportunities as places where we can learn how to make retrofitting an easy well-developed solution so that we can then turn the approach into a policy to manage drainage to support any landowners.

11.4 What constrains the programmes within a management plan?

When creating options within a management plan the options are created without consideration of the four main constraints as the process is assessing what needs to be done to meet a milestone across the operating area and not what is affordable to achieve. Our programme optimisation results show this issue based on a prioritised subset of areas.

What we can deliver is limited by the 4 main constraints which are affordability, deliverability disproportionate Benefit and finance ability. More information on this is discussed in section 7.2.5.

Our planning approach will consider these constraints again at a localised level and identify if, when and where these defer solutions.

11.5 The programmes of investment

In terms of what is needed to be done we can conclude that what the industry does, and has been doing, is still the right thing to do in the company strategy shown in Figure 106 below.

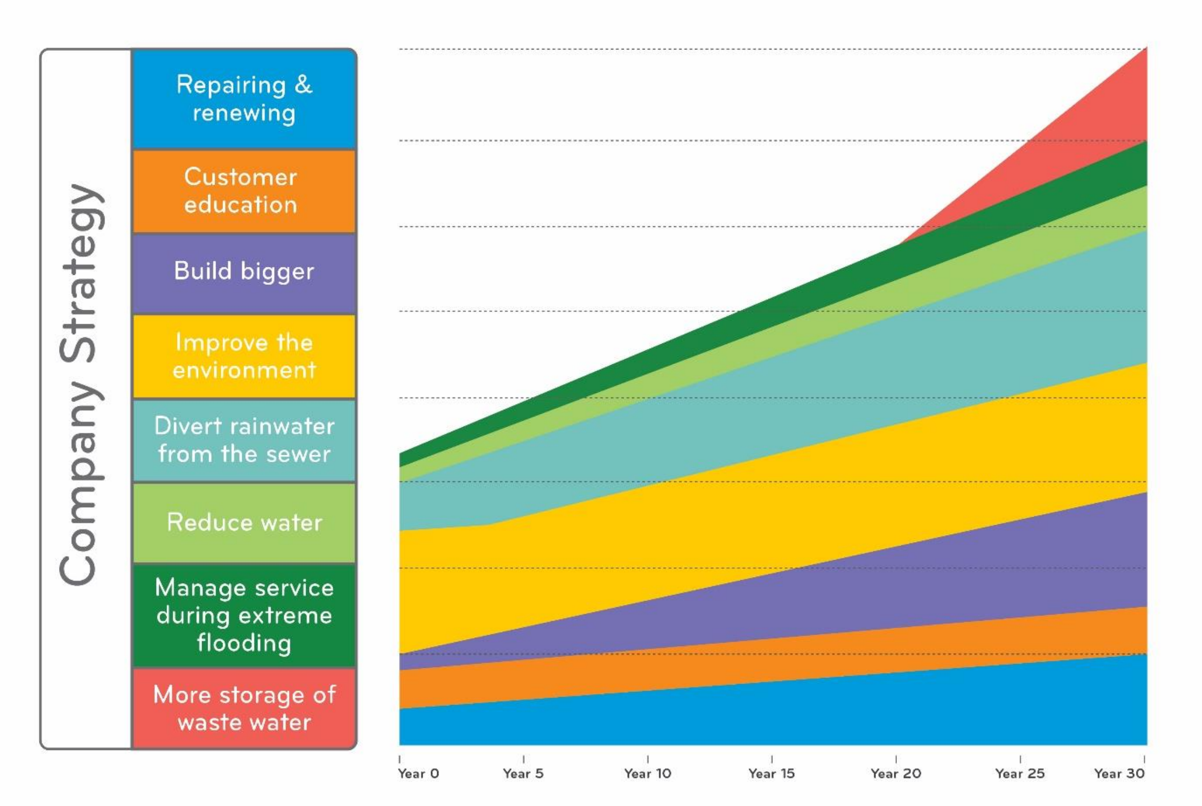


Figure 106 – indicative Programme of work that is being delivered at a company level.

Figure 106 details the programme of work that is being delivered at a company level:

- We need to keep monitoring the size of our pipes and pumps through the network so that they remain large enough to convey diluted sewage every day while also ensuring that where a new development is built that the size of the pipe and pump continues to have the same headroom or resilience.
- We need to keep monitoring our treatment works and increasing their efficiency to reduce the impact on the environment from the process and keep reassessing the fitness of the processes within the treatment work to ensure they continue to keep up with the new developments built in the area.
- We need to predict where maintenance is likely to be needed and plan replacements and refurbishments just in time.
- We need to continue to support our customers to understand the consequences of their actions. By providing information nationally or locally on topics such as water use, wet wipes, fats oils and greases, misconnections, culverted water course and building over jointly owned sewers.
- We need to monitor, locate and repair areas of infiltration.
- We need to evaluate the impact of historical trade permits and refresh them as part of review in the planning process.
- We need to evaluate reassess our current consent to discharge into the environment in a systematic review of consent process.
- We need to monitor and reassess and reduce the impact from our storm overflows.
- We need to work with others to understand where and how we impact others and reduce that impact such as removing barriers to fish migration.
- We need to work with others in a river catchment so that we monitor, identify and remove where possible, routes for further spread of invasive species.

- We need to provide areas where biodiversity can flourish and develop with other routes for biodiversity to cross human created barriers.
- We need to work with others to understand the hydrological cycle so that we as a society can redirect rainfall back to the environment where that rainfall fell, or much closer to where it fell.
- When all of the above is carried out it is only then should we consider traditional storage to manage rainfall.

The strategic investment required to carry out the company strategy is provided in the graph below.

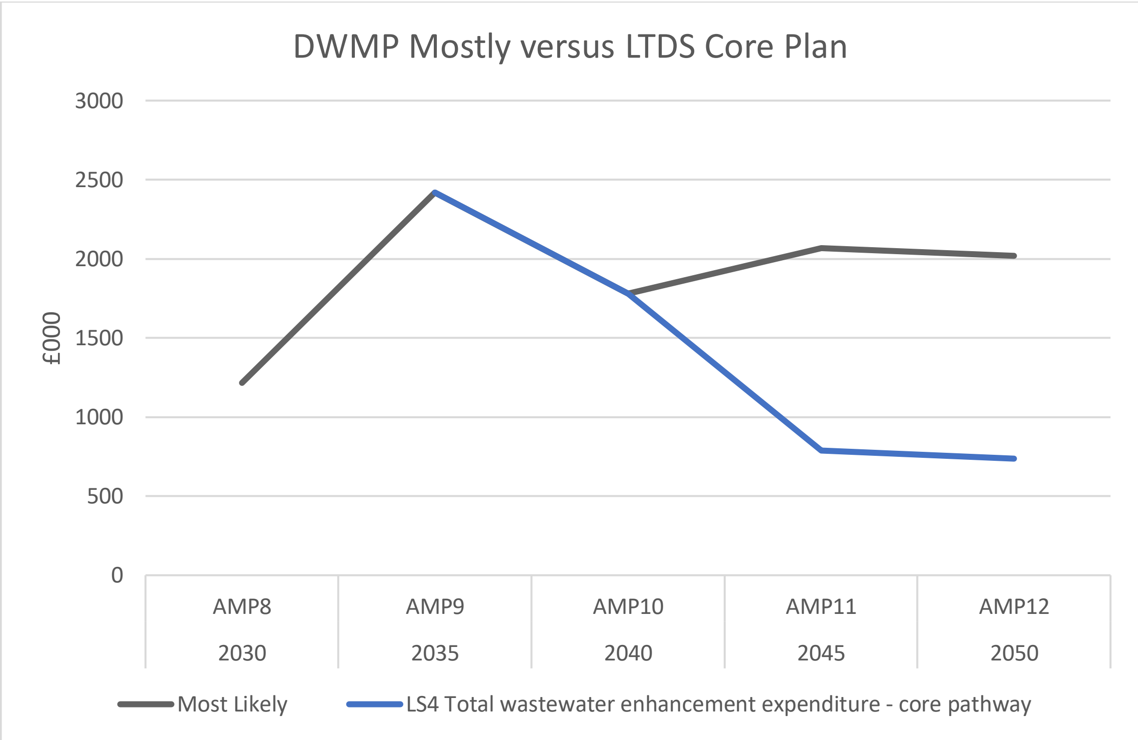


Figure 107 - DWMP Most likely scenario versus LTDS Core Plan

We have combined the work from the DWMP and Long-Term Delivery Strategy and estimated that investment at a company level will need to increase to £1.2bn in AMP8 and continue to rise over the 25 years to around £2bn. This includes all aspects that have been discussed relating to storm overflow improvements, improvements to the environment and improvements to those that are flooded by sewage. More on the programme of work during AMP8 is discussed in our price review. Additional information on the programme of work between 2030 and 2050 will be published as the DWMP develops.

11.6 Turning the plan into a funded Delivery plan

By applying the management plan principles to our price review process, which includes both business planning and asset planning approaches, we have created the contextual understanding of why we need to carry out work to drive changes and where those changes are required to meet the future aspirations of our customers combined with the limitations of affordability.

We have sectioned the plan into two halves, split by activities to maintain our service and activities to deliver our obligations under the national environment programme. We can assume that there will always be both drivers over the next 25 years, even if the detail beneath these drivers change. We have forecast that the latest estimate will continue unchanged over the 25 years so that we will continue to require 56% to maintain our service for today and for the future and 44% to continually deliver improvements to the environment by reducing our impact on it from intermittent discharges, our assets such as those that cause barriers to fish migration and improving water quality with the management of nutrients at our sites via offsetting approaches. We will review this divide again in the next cycle.

It is anticipated that our business can currently deliver at a pace of change that is affordable to customers and deliverable based on the supply chain available to us at a rate of £1bn every 5 years. If we assume that the percentages assumed are continually applied our plans can then travel at differing paces set by the funding available to us however the programmes discussed in this chapter will change their progress to meet the new pace.

11.7 Annual Review of the plan – Monitoring progress

Twelve months after the publication of the DWMP, the first annual review of the plan will be required, and annually on the same date each year until the next DWMP plan is published. The annual review steps, which are outlined in the national framework (WaterUK, DWMP Framework, 2018), and are summarised below, make sure that any new information is reviewed and assessed in a timely manner. Any new information that alters the direction of the DWMP sufficiently to alter the policies or direction from government will trigger the production of a new (interim) plan.

This annual review will:

- Collate information on any material changes in the area, arising from new evidence or expert knowledge that changes our forecasts.
- Consider the progress of any projects, or other expected information to support the next iteration of the plan.
- Assess whether the material changes or the anticipated progress on initiatives will influence the conclusions of the published plan.

The annual review process has yet to be defined. The National DWMP Implementation Group is expected to develop that process, based on the principles of WRMP annual reviews associated methodology. We will prepare our approach in readiness to work with the industry.

11.8 The Plan conclusion

We have discussed through this document how the plan has been developed. Its accomplishments and areas to improve. We concluded that this first plan has aimed to develop new methodologies and challenge what has happened before. As this plan is published, November 2023, Government, Regulators and water companies are meeting to discuss the next steps for drainage and wastewater planning in the Statutory Phase.

This plan has achieved:

- Delivery of its strategic message,
- confirmed our approach to planning.
- Supplied the quantum of investment expected over the next 25 years.

The company has considered this information during the business planning process and provided feedback to this process to inform the development of DWMP2029; the next plan.

To reach our two end destinations, resolve Customer flooding and remove storm overflow operation, investment would be needed in the region of £13bn. We are unable to reach these destinations in 25 years we need to create achievable milestones to get there everywhere and for all customers.

12 Bibliography

Atkins. (2017). Retrieved from Atkins. (2017, November). Retrieved from https://www.water.org.uk/wp-content/uploads/2018/12/Developing-and-Trialling-Wastewater-Resilience-Metrics-Atkins.pdf

CDRC. (2020). Dwelling Age Group Counts.

CIWEM. (2016, March). Retrieved from https://www.ciwem.org/assets/uploads/CIWEM-UDG-Rainfall-Guide-2015.pdf

CIWEM Urban Drainage Group. (2017). Code of Practice for the Hydraulic Modelling of Urban Drainage Systems. London: CIWEM.

CIWEM, U. D. (2016). Rainfall Modelling Guide. Retrieved from https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/CIWEM-UDG-Rainfall-Guide-2016.pdf

Crown Estate. (2022). Crown Estate. Retrieved from https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/coastal/

David Butler, J. D. (2010). Urban Drainage (Third Edition). Abingdon: SPON TEXT.

DCWW. (2018). DWMP Strategic Context.

DCWW. (2018, September). PR19 Investment Case: Wastewater Network Maintenance. Retrieved from https://corporate.dwrcymru.com/-/media/Project/Files/Page-Documents/Corporate/Library/PR19-Reports/Supporting-Details/58M-Wastewater-Network-Maintenance-WSH.ashx

DCWW. (2018, March). Welsh Water 2050. Retrieved from https://corporate.dwrcymru.com/en/about-us/our-plans/water-2050

DCWW. (2021). DWMP Growth Model Central Estimate Metodology TN v1.

Defra. (2020, January). Enabling a Natural Capital Approach. Retrieved from https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca

Defra. (2021, September). Valuing Greenhouse Gas Emissions. Retrieved from https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation

Defra. (2022). Retrieved from https://www.gov.uk/government/publications/drainage-and-wastewater-management-plans-guiding-principles-for-the-water-industry/guiding-principles-for-drainage-and-wastewater-management-plans

Defra, W. E. (2021). Storm Overflows Evidence Project. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

EA. (2018, September). Water companies: environmental permits for storm overflows and emergency overflows. Retrieved from https://www.gov.uk/government/publications/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows

EA/NRW/OWS. (2020). Water resources planning guideline. Retrieved from https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

European Parliament. (2000). Water Framework Directive - 2000/60/EC.

Government. (2023, April). Water resources planning guideline. Retrieved from https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline#fnref:8 cited 25th May 2022

Government. (2007). Water Resources Management Plan Regulations 2007.

Government, U. (2021). National Strategy Action Plan. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/985128/FCERM_Strategy_Action_Plan_2021.pdf

Government, U. (2021). National Strategy for FCERM. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920944/023_15482_Environment_agency_digitalAW_Strategy.pdf

Government, U. (2021). NPPF. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

Government, W. (2015). Water Strategy for Wales. Retrieved from https://www.gov.wales/sites/default/files/publications/2019-06/water-strategy.pdf

Government, W. (2018). Retrieved from https://gov.wales/sites/default/files/publications/2019-06/statutory-national-standards-for-sustainable-drainage-systems.pdf

Government, W. (2021). National Strategy for FCERM. Retrieved from https://gov.wales/sites/default/files/publications/2021-03/the-national-strategy-for-flood-and-coastal-erosion-risk-management-in-wales.pdf

Government, W. (2021). The National Plan 2040. Retrieved from https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf

Government, W. (2022, July 6). Strategic Priorities and Objectives Statement for Ofwat (SPS). Retrieved from https://www.gov.wales/written-statement-strategic-priorities-and-objectives-statement-ofwat-sps

Governments, U. a. (2022). Guiding Principles for the DWMP. Retrieved from https://www.gov.uk/government/publications/drainage-and-wastewater-management-plans-guiding-principles-for-the-water-industry/guiding-principles-for-drainage-and-wastewater-management-plans#:~:text=The%20plans%20should%3A,and%20rising%20expectations%20of%

IAP2. (2018, November). Spectrum of Public Participation. Retrieved from https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/Spectrum_8.5x11_Print.pdf

ICE. (2022). UKCP18 Briefing Report. Retrieved from https://www.ice.org.uk/knowledge-and-resources/briefing-sheet/ukcp18-briefing-report

Murray Dale, J. C. (2021). Future Drainage: Guidence for applying rainfall uplifts. Retrieved from https://artefacts.ceda.ac.uk/badc_datadocs/future-drainage/FUTURE_DRAINAGE_Guidance_for_applying_rainfall_uplifts.pdf

NIC. (2019). Resilience Scoping Report. Retrieved from https://www.nic.org.uk/wp-content/uploads/NIC_Resilience_Scoping_Report_September_2019-Final.pdf

NIC. (2022). National Infrastructure Assessment. Retrieved from https://nic.org.uk/studies-reports/national-infrastructure-assessment/

NRW. (2020). Retrieved from https://naturalresources.wales/evidence-and-data/research-and-reports/state-of-natural-resources-report-sonarr-for-wales-2020/?lang=en

NRW. (2022). Operational Areas. Retrieved from https://lle.gov.wales/catalogue/item/NaturalResourcesWalesOperationalAreas/?lang=en

NRW (2021) Compliance assessment of Welsh Rivers SACs against Phosphorus Targets. https://naturalresources.wales/evidence-and-data/research-and-reports/water-reports/compliance-assessment-of-welsh-river-sacs-against-phosphorus-targets/?lang=en

NRW. (2023, June). Bathing Water Quality. Retrieved from https://naturalresources.wales/guidance-and-advice/environmental-topics/water-management-and-quality/water-quality/bathing-water-quality/?lang=en

Ofwat. (2013, May). Drainage Strategy Framework. Retrieved from https://www.ofwat.gov.uk/wp-content/uploads/2015/12/rpt_com201305drainagestrategy1.pdf

Ofwat. (2017). PR19 Framework and Methodology. Retrieved from https://www.ofwat.gov.uk/regulated-companies/price-review/2019-price-review/pr19-final-methodology/

Ofwat. (2019). Time To Act Together. Retrieved from https://www.ofwat.gov.uk/wp-content/uploads/2019/10/Time-to-act-together-Ofwats-strategy-1.pdf

Ofwat. (2021). PR24 and beyond. Retrieved from https://www.ofwat.gov.uk/wp-content/uploads/2021/11/PR24-and-beyond-Long-term-delivery-strategies-and-common-reference-scenarios.pdf

Ofwat. (2022). Delivering Welsh government priorities for the Welsh water sector through our 2024 price review final methdology. Birmingham. Retrieved from https://www.ofwat.gov.uk/wp-content/uploads/2022/12/PR24_final_methodology_Welsh_SPS.pdf

Ofwat. (2022, April). PR24 and beyond:Final Guidance on Long-Term delivery strategies.

Ofwat. (2022). Resilience in the round. Retrieved from https://www.ofwat.gov.uk/regulated-companies/resilience-in-the-round/

ONS. (2011). 2011 Census. Retrieved from https://www.ons.gov.uk/census/2011census

ONS. (2011). Rural Urban Classification. Retrieved from https://geoportal.statistics.gov.uk/

Parliament. (2021). Retrieved from https://bills.parliament.uk/publications/42717/documents/683

Pitt, M. (2008). Retrieved from https://webarchive.nationalarchives.gov.uk/ukgwa/20100702215619/http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/final_report.html

RPS. (2021). DCWW Drainage and Wastewater Management Plan: Natural Capital Approach - Tool Scoping Study.

Stantec. (2021, November). Storm Overflows Evidence Project. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

Stantec. (2023, September). Storm overflow evidence for Wales (SOEfW). Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1030980/storm-overflows-evidence-project.pdf

UKClimateRisk. (2021, June). CCRA3. Retrieved from https://www.ukclimaterisk.org/independent-assessment-ccra3/technical-report/

UKWIR. (2010). Impact of Urban Creep on Sewerage Systems. Retrieved from https://ukwir.org/reports/10-WM-07-14/66915/Impact-of-Urban-Creep-on-Sewerage-Systems

UKWIR. (2012). The relationship between per capita consumption and wastewater flows (12/WW/21/15).

UKWIR. (2015). Rainfall Intensity for Sewer Design - Technical Guide.

UKWIR. (2019). Catchment Management for Water Quality and Quantity (19/EQ/01/17).

UKWIR. (2020). Deriving a best value WRMP. Retrieved from https://ukwir.org/view/$KZrW2YG!

UKWIR. (2021). How should customers and stakeholders views be used in regulatory decisions? (21/CU/03/4).

Water Industry Forum. (2020, November). Natural Capital Principles. Retrieved from http://www.waterindustryforum.com/documents/uploads/WIF_Natural_Capital_Principles_for_the_Water_Industry.pdf

Water, D. C. (2020). Biodiversity Action Plan.

Water, D. C. (2021). Where we want to work with you. Retrieved from https://www.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/DWMP/English/DWMP-Where-we-want-to-work-with-you.ashx

WaterUK. (2018, December). 21st Century Drainage Programme. Retrieved from https://www.water.org.uk/wp-content/uploads/2018/12/21CD-Context-doc.pdf

WaterUK. (2018). DWMP Framework. Retrieved from https://www.water.org.uk/wp-content/uploads/2021/10/DWMP_Framework_Report_Main_Report_September_2021.pdf

WaterUK. (2020). National Planning Objectives. Retrieved from https://www.water.org.uk/wp-content/uploads/2020/07/BRAVA-planning-objectives-for-the-first-cycle-of-DWMPs.pdf

Welsh Government. (2019, March). A Million Welsh Speakers. Retrieved from https://gov.wales/sites/default/files/publications/2019-03/cymraeg-2050-a-million-welsh-speakers-action-plan-2019-20.pdf

Welsh Government. (2019, November). Climate Conscious Wales. Retrieved from https://gov.wales/prosperity-all-climate-conscious-wales

Welsh Government. (2019). Climate Emergency. Retrieved from https://gov.wales/welsh-government-makes-climate-emergency-declaration

Welsh Government. (2019, June). Water Strategy For Wales. Retrieved from https://gov.wales/sites/default/files/publications/2019-06/water-strategy.pdf

Welsh Government. (2020, December). Reducing Emissions Progress Report. Retrieved from https://gov.wales/reducing-emissions-wales-progress-report-2020

Welsh Government. (2021, August). Retrieved from https://gov.wales/sites/default/files/publications/2021-09/adapting-to-climate-change-guidance-for-flood-and-coastal-erosion-risk-management-authorities-in-wales.pdf

Welsh Government. (2021). Climate change targets and carbon budgets. Retrieved from https://gov.wales/climate-change-targets-and-carbon-budgets

13 Appendices

13.1 Appendix A – Glossary of Terms

Terminology	Description
Annual Performance Report (APR)	Water companies in England and Wales must provide an annual performance report to the economic regulator, Ofwat. The report allows Ofwat to compare across the sector on common metrics but also to measure individual company performance against the targets set at each Price Review. Information from the APR process is made available on the Ofwat website.
Area Statement	The seven Welsh Area Statements are a collaborative response to the Natural Resources Policy, published by the Welsh Government in 2017, which sets out the key challenges and opportunities for the sustainable management of Wales's natural resources into the future.
Asset Management Period (AMP)	An AMP, sometimes referred to as the 'Price limit period' (see 'PR') is a 5-year period beginning on 1 April in years ending in 0 or 5; the current period is AMP 7 (2020-2025). Water companies prepare business plans before each AMP. In response to those plans the water industry regulator (Ofwat) sets price limits on customer bills, which define how much the industry can spend.
Baseline Risk and Vulnerability Assessment (BRAVA)	A step in the DWMP process that follows Risk Based Catchment Screening (RBCS) in the DWMP. It's used to collate information about known drainage issues, analyse current and future risks, and their causes.
Biodiversity Action Plan (BAP)	The UK Biodiversity Action Plan (UK BAP) was published in 1994 as the UK Government's response to the Convention on Biological Diversity (CBD), which the UK signed up to in 1992 in Rio de Janeiro. The CBD called for the development and enforcement of national strategies and associated action plans to identify, conserve, and protect existing biological diversity, and to enhance it wherever possible.
Climate Change Committee (CCC)	An independent, statutory body established under the Climate Change Act 2008. Its purpose is to advise the UK and devolved

	governments on emissions targets and to report to Parliament on progress made in reducing greenhouse gas emissions and preparing for and adapting to the impacts of climate change.
Combined Storm Overflow (CSO)	An overflow to the environment from the sewer system, which is aimed at reducing the risk of sewer flooding from combined sewers during periods of rainfall.
Company Operational Level [DWMP - Level 1]	A company level view of the DWMP reflecting the entire Welsh Water operating area. Information at this level is a consolidation of smaller Level 2 (SPU) & 3 (TPU) assessments.
Customer Challenge Group (CCG)	The CCG is an independent customer focused stakeholder group that provides scrutiny and challenge to DCWW, ensuring that the needs of current and future customers and communities are at the heart of how we operate.
Consumer Council for Water (CCW)	CCW is the independent voice for water consumers in England and Wales, helping consumers resolve complaints against their water company or retailer, while providing free advice and support. Their work is informed by extensive research, used to champion the interests of consumers and influence water companies, governments, and regulators.
Demand	The loading on our wastewater treatment systems, which in all systems is worsened by new development, and in combined and surface water networks is also impacted by urban creep and changes in climate.
Drainage	The entire water company network served by a WwTW, and interaction points with *non-water company drainage systems*. Drainage also includes water company surface water assets not draining to a WwTW.
Dry Weather Flow (DWF)	The average daily flow to a WwTW during a period without rain.
Environment Agency (EA)	An executive non-departmental public body in England, sponsored by the Department for Environment, Food & Rural Affairs (DEFRA). Its role is to protect and improve the environment, for example, adapting to climate change; reducing its impacts,

	including flooding, drought, sea level rise and coastal erosion, and improving the quality of water, land, and air by tackling pollution.
Flood and Coastal Erosion Risk Management (FCERM)	DEFRA strategy for a future resilient to flood and coastal erosion risk. The department provides funding for flood risk management through grants to the EA, local authorities, and internal drainage boards. These RMAs and others have their own responsibilities and powers that they can use to carry out these responsibilities.
Flood Risk Management Plan (FRMP)	FRMPs are statutory plans under the Flood Risk Regulations 2009, which explain the risk of flooding from rivers, the sea, surface water, groundwater, and reservoirs, and set out how NRW/EA, LLFAs and other RMAs work together, including with communities, to agree priorities and manage those risks. These plans are only produced in Flood Risk Areas where flood risk is considered significant.
Habitats Regulations Assessment (HRA)	An assessment, required under the EU Habitats and Species Directive (as incorporated into The Conservation of Habitats and Species Regulations 2017), of the potential effects of a proposed plan, programme, or project on the designated National Sites Network.
Internal drainage boards (IDB)	Independent public bodies responsible for water level management in low lying areas (an internal drainage district – administered in Wales by NRW). They work in partnership with other authorities to reduce flood risk to people and property and manage water levels for agricultural and environmental needs within their district. They can make byelaws to ensure that a drainage system works efficiently, regulate the environmental effects of a system, or ensure that flood risk management work is effective.
Local Development Plan (LDP)	The LDP sets out each local planning authority's proposals for future development and use of land in their area. The plan is a primary consideration in the determination of planning applications for the development or use of land.
Lead Local Flood Authorities (LLFA)	LLFAs are county councils and unitary authorities. They lead in managing local

	flood risks (risks of flooding from surface water, ground water and ordinary (smaller) watercourses). This includes ensuring co-operation between the Risk Management Authorities in their area (see LFRMS/P).
Level of Service (Los)	Water and sewerage companies within England and Wales report on their levels of service (LoS) for, providing transparency about company performance over a wide range of metrics. Level of service is defined as the quality of a given service. It is the combination of physical asset performance, customer expectation and satisfaction. The performance level of the service is a tactical LoS whereas customer perspective is a strategic LoS.
Local Flood Risk Management Strategy (LFRMS)	Under the Flood & Water Management Act 2010 LLFA's have a duty to develop and maintain a strategy for local flood risk management. The strategy only deals with local flood risk which is defined in the act as being a flood risk from: surface water runoff, groundwater, or ordinary watercourses (main river flooding remains the responsibility of Natural Resource Wales and the Environment Agency). In areas where there is also a FRMP in place strategies will complement or be integrated with the FRMP.
Local Planning Authority (LPA)	The local UK government body that is empowered by law to exercise urban planning functions for a particular area.
National Environment Programme (NEP)	The NRW water quality NEP outlines the improvements we need to make to comply with new or amended environmental legislation and identifies investigations and potential investment requirements to meet those requirements. The NEP is the counterpart in Wales to the EA WINEP.
National Infrastructure Commission (NIC)	The Commission carries out in-depth studies into the UK's major infrastructure needs and makes recommendations to the government, covering all sectors of economic infrastructure.
Natural Resources Wales (NRW)	A Welsh Government sponsored body, which became operational from 1 April 2013, taking over the management of the natural

	resources of Wales as a merger of the Countryside Council for Wales, Environment Agency Wales, and the Forestry Commission Wales, whose role is broadly comparable with that of the EA in England.
Non-water company drainage systems	Drainage systems that are not in the ownership of Welsh Water. These are often the responsibility of local authorities or land and property owners and could include highway drainage, private foul and surface water drainage, land drains and watercourses.
Ofwat	The Water Services Regulatory Authority is the water industry's economic regulator in England and Wales.
Per Capita Consumption (PCC)	The metric used to quantify the amount of water consumed per person, in terms of domestic consumption for a household. Units can typically be in litres / day.
Population Equivalent (PE)	A means of expressing the strength of organic material in wastewater. The amount of biodegradable matter whose oxygen consumption during biodegradation equals the average oxygen demand of the wastewater produced by one person. A comparison of the polluting potential of an industry with the population equivalent which would produce the same polluting load.
Price Review (PR)	Ofwat determines the price limits that water companies can increase or decrease the prices charged to customers over an AMP period. Each water company submits a business plan for the forthcoming 5-year period, which is assessed by Ofwat. Preparation is underway for the PR24 submission which will set out our investment proposals from April 2025 to March 2030.
Risk	A measure that combines an assessment of the probability of an event occurring with the magnitude of its impact if it occurs.
Risk Based Catchment Screening (RBCS)	The RBCS stage of the DWMP risk screening process uses existing, readily available data to identify where there is a potential risk or vulnerability in the sewer catchment to future changes. This enables effort to be focused on these catchments

	during the subsequent step of the DWMP (BRAVA).
River Basin District (RBD)	EA and NRW defined river basin districts or catchments for management planning (RBMP).
River Basin Management Plan (RBMP)	EA and NRW led River Basin Management Plans (RBMPs) describe the challenges that threaten the water environment and how these challenges can be managed and funded.
Risk Management Authorities (RMA)	An Authority defined within the Flood & Water Management Act 2010 with responsibilities for the management of specific risks. Other RMA include EA, NRW, LLFA, district council, highway authority or IDB.
Sewerage	See 'Wastewater'
Strategic Environmental Assessment (SEA)	A process of assessing the environmental opportunities and restrictions of a project and identifying and managing its implications.
Strategic Planning Unit (SPU) – [DWMP - Level 2]	An aggregation of Level 3 TPU into 13 larger Level 2 strategic planning areas, which are based on RBMP areas (revised to take account of sewers crossing those borders). We will be consulting with stakeholders and customers at this level about regional issues and our proposed responses to them.
Supply	The available capacity in our wastewater treatment systems to managing incoming flows, to treat them and return them to the environment whilst meeting performance requirements.
Supply-demand balance (SDB)	The calculation of total demand capacity against total supply capacity in our wastewater treatment works, which assesses whether there is either a positive or negative capacity overall.
Sustainable Drainage Plan (SDP)	An approach to Drainage Area Planning (DAP) developed by Welsh Water, which precedes the DWMP
Sustainable Management of Natural Resources (SMNR)	A principle introduced in the Environment (Wales) Act 2016 to promote the use of natural resources in a way and at a rate that

	maintains and enhances the resilience of ecosystems and the benefits they provide.
Tactical Planning Units (TPU) – [DWMP - Level 3]	A typical TPU will be the medium sized wastewater treatment works and its catchment. For smaller communities this may be an aggregation of catchments, and for larger communities may reflect a discrete sub-catchment area.
Wastewater (sewage)	Wastewater and other excrement that has been produced in the home, in a business, or as part of an industrial process and which is normally discharged into a foul or combined drainage system.
Wastewater Treatment Works (WwTWs)	A site for the processing and treatment of wastewater, to separate out solid matter for reuse and to remove contaminants from the effluent before it's returned to the environment.
Water and Sewerage Companies (WaSCs)	There are 10 WaSCs in England and Wales, regulated by Ofwat, NRW and the EA. Welsh Water is one of the 10 WaSCs and operates across much of Wales and parts of neighbouring England. Welsh Water is the only WaSC in England and Wales to operate to a not-for-profit model.
Water Framework Directive (WFD)	The Water Framework Directive is a piece of EU legislation that establishes a framework for the protection and improvement of inland and coastal water bodies. It is designed to return all surface waters, groundwater and transitional waters into good chemical, physical and biological condition by 2027.
Water Industry National Environment Programme (WINEP)	The programme of work water that WaSCs who operate in England are required to do to meet their obligations from environmental legislation and UK government policy. A 5-yearly programme (currently 2020-2025) of environmental investment in asset improvements, investigations, monitoring and catchment interventions. It sets out how the water industry will contribute to improving the natural environment and is mirrored by the NEP in Wales.
Water Resource Management Plan (WRMP)	Water Resource Management Plans (WRMPs) are statutory documents that all water companies must produce at least

	every five years. They set out how the water company intends to achieve a secure supply of water for their customers while protecting and enhancing the environment. The plan must forecast the expected water supply and demand (for public water supply) over, at least, 25 years and determine a preferred programme to meet the water resource deficit by identifying and appraising a range of options.
Water UK	Water UK are the representative body for the water industry in the United Kingdom. It engages with companies and regulators to ensure customers receive high quality tap water at a reasonable price and that our environment is protected and improved. It promotes the conditions by which the water sector can provide world-class services and enhance the UK's quality of life and commissioned the Framework for the DWMP.

13.2 List of Level 4 catchments taken through ODA

Catchment ID	Catchment/Model Name	Total Population Equivalent
466	BETWS-Y-COED	734
467	CAPEL CURIG	226
486	HENLLAN (NR DENBIGH)	755
495	LLANARMON DYFFRYN CEIRIOG	102
511	CAERNARFON	11,437
547	LLANBEDR (GWYNEDD)	2,297
661	GREENFIELD	15,553
675	FIVE FORDS (WREXHAM)	123,046
699	CAERWYS	1,070
701	CEFN-MAWR	6,336
705	ABERSOCH	2,959
719	BETHESDA	5,035
776	FLINT	17,497
795	DOLGELLAU	4,295
801	DYFFRYN ARDUDWY	2,184
846	LLANASA (NR PRESTATYN)	30,575
858	CHESTER	116,582
932	QUEENSFERRY	55,888
945	RHUDDLAN	10,132
956	RUTHIN	5,875
972	PORTHMADOG	4,030
973	ST ASAPH	3,732
995	BUCKLEY TY GWYN	15,538
3137	KINMEL BAY	58,582
3219	BEAUMARIS & LLANFAES (ANGLESEY)	1,766
3242	BANGOR TREBORTH	29,477
3333	GANOL	70,489
70011	PENMAENMAWR	4,573
30808	COSLECH	51,704
30843	CILFYNYDD	76,835
30861	CYNON	65,632
30900	HAY-ON-WYE SWK	1,859
30903	HEREFORD EIGN	106,545
30948	LLANFOIST WWTW	17,077
30996	NEWPORT NASH (Cae Brinton)	293,005
30996	NEWPORT NASH (Caerleon)	
30996	NEWPORT NASH (Caldicot)	
30996	NEWPORT NASH (Chepstow)	
30996	NEWPORT NASH (Magor Pill)	
30996	NEWPORT NASH (Malpas)	
30996	NEWPORT NASH (Newport East)	
30996	NEWPORT NASH (Newport West)	
31050	PONTHIR WWTW	98,731
33726	COG MOORS (Barry East)	214,936
33726	COG MOORS (Cardiff West)	
33726	COG MOORS Barry West	

33726	COG MOORS Penarth	
33726	COG MOORS Sully and Dinas	
33785	CARDIFF BAY (Cardiff Central)	897,336
33785	CARDIFF BAY (Cardiff East)	
33785	CARDIFF BAY (Lower Rhymney)	
33785	CARDIFF BAY (Upper Rhymney)	
33785	CARDIFF BAY (Rhondda)	
33785	CARDIFF BAY (Y & P)	
33785	CARDIFF BAY (WV)	
50621	GARNSWLLT	30,303
50628	GOWERTON	56,772
50679	LLANNANT	16,111
50743	PEN-Y-BONT (MERTHYR MAWR)	159,828
53100	SWANSEA BAY	185,873
53154	AFAN	139,433
	TOTAL:	3,012,745