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DWMP TECHNICAL REPORT

TABLE OF ACRONYMS

Acronym	Definition
BE$T	CIRIA B£ST tool for assessing green benefits
BAU	Business As Usual
BE$T	CIRIA B£ST tool for assessing green benefits
BGI	Blue Green Infrastructure
BRAVA	Baseline Risk and Vulnerability Assessment
BSG	Board Sub Group
C&NBS	Catchment Based Approach
CaBA	Capacity Assessment Framework
CAF	Capacity Assessment Framework
CAPEX	Capital Expenditure
CCTV	Closed circuit television
C-Mex	Customer Experience Measure
CIRIA	Construction Industry Research and Information Association
DC	Drainage Community
dDWMP	Draft Drainage and Wastewater Management Plan
Defra	Department of food and rural affairs
DRIVE	Dynamic Risk Index and Visit Effectiveness
DWF	Dry Weather Flow
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
EDM	Event Duration Monitoring
EPA	Environmental Performance Assessment
FCERM	Flood and Coastal Erosion Risk Management
FOG	Fats, Oils and Grease
FRMP	Flood Risk Management Plan
HRA	Habitats Regulation Appraisal
ICW	Integrated Constructed Wetland
km	Kilometre
L1	Level 1 - Company Level – Whole NWL Region
L2	Level 2 – Strategic Planning Areas – 7 River Basins
L3	Level 3 – Tactical Planning Units – Drainage Area
L4	Level 4 – Local Planning Needs – Drainage Community
LTDS	Long-Term Delivery Strategy
MMB	Mott MacDonald Bentley
MCZ	Marine Conservation Zone
NECH	North East Catchment Hub
NIC	National Infrastructure Commission
NIDP	Northumbria Integrated Drainage Partnership
N TAL	Nitrogen Technical Achievable Limit
NWL	Northumbrian Water Limited
ODA	Option Development and Appraisal
OFWAT	The Water Services Regulation Authority
OPEX	Operational Expenditure
OST	Option Screening Tool
PC	Performance commitment

PCC	Per Capita Consumption
PR24	Price Review for period 2025-2030
RBCS	Risk Based Catchment Screening
RBD	River Basin District
RBMP	River Basin Management Plan
RCP	Representative Concentration Pathway
Rt-DSS	Real Time Decision Support Systems
SCADA	Supervisory Control and Data Acquisition
SEA	Strategic Environmental Assessment
SHLAA	Strategic Housing Land Availability Assessments
SLM	Sewer Level Monitoring
SNIPeR	Sewer Network Information and Performance Reporting
SO	Storm Overflow
SOAF	Storm Overflow Assessment Framework
SODRP	Storm Overflows Discharge Reduction Programme
SPA	Strategic Planning Areas
SPG	Strategic Planning Group
SPS	Sewage Pumping Station
SR21	Strategic Review of Charges 2021
SSSI	Sites of Special Scientific interest
SuDS	Sustainable Drainage Systems
TAL	Technically Achievable Limit
TVWT	Tees Valley Wildlife Trust
TOTEX	Total Expenditure (Capex and Opex)
TPU	Technical Planning Unit
TriM	Trigger Management Process
TSR	Time Series Rainfall
UK	United Kingdom
UKCP18	United Kingdom Climate Projections 2018
UKWIR	UK Water Industry Research
UWWTD	Urban Wastewater Treatment Directive
WASC	Water and Sewerage Company
WFD	Water Framework Directive
WINEP	Water Industry National Environment Programme
WISER	Water Industry Strategic Environmental Requirements
WRMP	Water Resource Management Plan
WwTW	Wastewater Treatment Works

1.0 FOREWORD – BY RICHARD WARNEFORD, WASTEWATER DIRECTOR, NWL

Thank you for reading our first Drainage and Wastewater Management Plan (DWMP). This is a critical document as we aim to make sure our region's drainage and wastewater system remains reliable and resilient for the years ahead, ready to meet challenges including changes to our climate and population growth.

The DWMP represents a step change in our planning for the future and it will form an important part of our business plan submission for the next regulatory periodic review covering 2025-30. It also integrates with our Long-Term Delivery Strategy (LTDS), due to be published in June 2023, which brings together our long-term planning processes across our business, including the DWMP.

As we have developed this plan, we have recognised there has been a cultural shift among many stakeholders and customers, and a renewed interest in our local environment. We welcome this. The water environment is not only critical to our business, but a major factor in making our communities great places in which to live and work. We often ask our customers to play their part in taking care of it, such as through committing to 'Bin The Wipe' to avoid blockages that can lead to pollution. However, we understand that our customers also expect us to continually improve our own processes and services.

We are committed to building on our strong environmental performance. In the North East of England, 32 out of 34 bathing waters are classed as excellent or good and we have overseen dramatic reductions in pollution in the past decade with zero serious pollutions in 2022. This performance has underpinned our achievement of a 4-star performance, the highest possible, in the Environment Agency's latest Environmental Performance Assessment (EPA).

In 2022, we published A Vision for our Coasts and Rivers, containing nine ambitious pledges to contribute to further improvement of our water environment to benefit local communities. In April this year, we published an update on progress demonstrating that we are on track to meet all of these pledges, including a 20% reduction in average spills from storm overflows by 2025. Our DWMP includes detail on how we will meet the requirements of the Government's Storm Overflow Discharge Reduction Plan (SODRP), which sets limits on the number of times overflows can discharge to rivers and bathing waters.

We are one of many organisations and individuals with the potential to influence river water quality. A joined-up approach through which stakeholders can collaborate towards our shared objectives will therefore be essential to realise improvements. We have engaged extensively through the development of this plan and are excited about the opportunities identified for partnership working that can deliver multiple benefits for our communities.

This final plan has been produced following a period of consultation on the draft DWMP (dDWMP) which we published last year. The comments we received were of great benefit as we seek to meet our customers' and stakeholders' expectations – including on how we appropriately balance future investment with maintaining affordable bills for customers.

We would like to thank all those who have participated in this process, especially members of the Strategic Planning Group, and those who attended the many stakeholder and customer workshops we have held in the last few years. We intend to build on the successful collaboration already taking place to deliver the interventions that have been identified in the final plan, while making sure we achieve best value for customers and the environment.

We have learned a lot through the development of this, our first DWMP, and we will take this learning into future planning cycles. Thank you for taking the time to read and engage with our plan, and I look forward to working with you as we take this forward.

2.0 EXECUTIVE SUMMARY

The Drainage and Wastewater Management Plan (DWMP) Framework represents a significant step change in how long-term planning for drainage and wastewater infrastructure is undertaken. For the first time, a national Framework has been produced, which outlines the steps that should be taken to produce long-term plans, over the period to 2060, to create sustainable and resilient drainage and wastewater systems.

The DWMP will outline the investment that is required over future decades to ensure that drainage and wastewater systems are able to cope with the coming pressures associated with climate change, population growth and increased impermeable hard standing in urban areas (known as urban creep).

Northumbrian Water's DWMP outlines the level of investment that is required to achieve a number of planning objectives associated with flooding, and the environmental impact of storm overflow discharges and wastewater treatment. Our sewage networks are designed to use storm overflows (SOs) as an important release value in the system. Through the monitoring we have in place on our SOs, we know that they are operating as they were designed to and within the permits set by the Environment Agency, and we are able to take action to rectify any instances where this is not the case. Because of the increased intensity of rainfall that we are experiencing through climate change, the growth in population, and increased plastic litter in our sewer pipes, the number of discharges from SOs has increased over time. We share the view of the public and the Government that this is unacceptable and so one of the key priorities of this plan is to reduce reliance on SOs. We are clearly part of the solution and are determined to help; all the options in this plan allow us to meet the targets set out in the Government's Storm Overflow Discharge Reduction Plan (SODRP), which aim to reduce discharges and harm to the environment.

We have developed a preferred plan that incorporates all of the significant investments to meet new statutory requirements and additional investments to improve performance where required. These include:

- Storm overflows:
    - Bathing water quality
    - River water quality
- Wastewater treatment:
    - Nutrient neutrality
    - Water framework directive
    - Continuous river water monitoring
    - Sewer flooding – internal and external
    - Northumbria Integrated Drainage Partnership (NIDP)
    - Bluespaces
    - Dry weather flow compliance
- Wastewater networks:
    - Sewer collapses

- Sewer flooding – internal and external
- Pollution
- Resilience

- Further investigations:
  - Bathing water investigations
  - Shellfish water investigations
  - Marine Conservation Zones

This plan does not include all activities undertaken in our base plan (base maintenance and routine maintenance activities to manage performance and risk). Our plan also does not include the management of sludge, which will form a separate part of our PR24 business plan submission to Ofwat in October 2023.

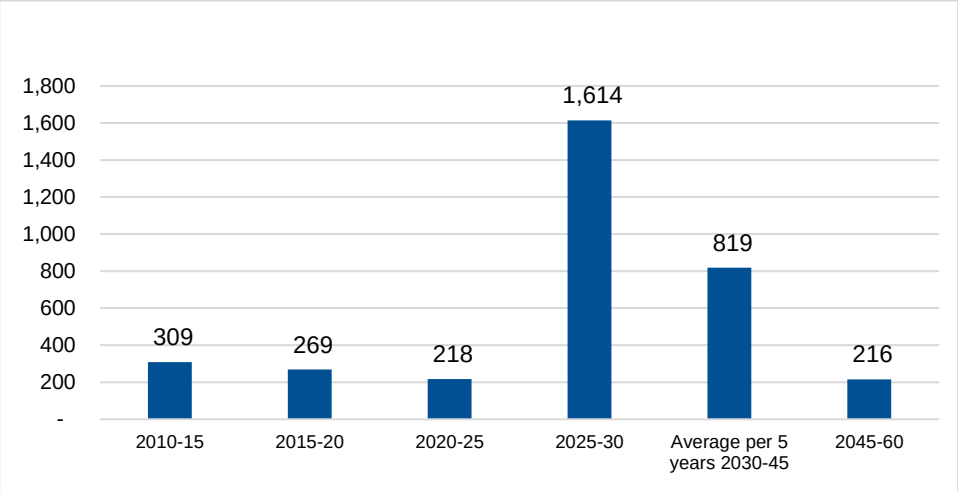
The capital cost of our plan is:

- £1,614m in the period 2025-2030
- £2,457m in the period 2030-2045
- £647m in the period 2045-2060

We have assessed the levels of investment required that would result from our preferred plan, including money we would need to borrow, equity injections from shareholders and the likely impact on customer bills, By 2060 we expect this investment from DWMP would mean that customers' annual wastewater bills will increase by £166 from the current bill of £187. Bills will start to increase in 2025 with a year on year increase over and above the normal inflationary increases. Our LTDS, due to be consulted on during June, will look at long-term bills in more detail and across all parts of water and wastewater.

Nonetheless, it is evident that the scale of the investment needed to deliver our DWMP is significant. We can see below that the future investment programme up to 2045 is almost 4 times larger than the historical average.

Figure 1: Wastewater Enhancement Capex prices



Historical data source: https://www.ofwat.gov.uk/wp-content/uploads/2022/05/long_term_data_series.xlsx

Our plan has already been informed by substantial stakeholder and customer consultation but we are gathering further customers' views on this plan further in the coming weeks.

There are a number of aspects of our plan that remain under review by our regulators and the government. These aspects are therefore subject to change in the coming months. It is likely that we will publish an updated version of our DWMP along-side our draft business plan in October 2023.

We are committed to reviewing our plan annually and resubmitting every 5 years or sooner if a major change occurs.

This report forms the DWMP Technical Report and is split into three sections:

Part A: Background

This sets out background to Northumbrian Water, our aims and objectives and our business activities as well as background to the DWMP;

Part B: Our DWMP

This focuses on our DWMP.

Part C: The Plan

This sets out our plan on a regional and catchment basis

Alongside this report we are publishing the following documents:

- Customer Facing Report
- L1 Region Summary
- L2 River Basin Summary – 7 number
- Drainage Area Plans – one per drainage area
- Methodologies
- Strategic Environmental Assessment
- Strategic Environmental Assessment Non-Technical Summary
- Habitat Regulations Appraisal
- Customer Engagement Reports
- Statement of Response
- Ofwat Data Tables
- Option Development Register

All of the documents listed can be viewed at www.nwl.co.uk/dwmp.

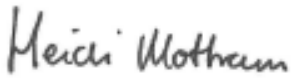
3.0 BOARD ASSURANCE STATEMENT

Board Assurance Statement to OFWAT, DEFRA and the EA

The Board is satisfied that:

- The guiding principles and the DWMP technical framework are being followed and applied.
- The planning objectives are being met (both common and bespoke).
- There are clear links and processes in place to ensure the appropriate DWMP interventions, including partnership and co-funded schemes, will be put forward for investment in PR24 business plans.
- Measures are in place to achieve objectives set in the Government's Storm Overflows Discharge Reduction Plan; and
- Many elements of our plan include new statutory obligations which we must deliver. Within these constraints our DWMP is a best value plan for customers and the environment for managing and developing drainage and wastewater services and is based on robust evidence and costing processes.

Approved by the Board of Directors of Northumbrian Water Limited and signed on its behalf.



Heidi Mottram CEO

31 May 2023

4.0 WHO WE ARE

4.1 SETTING OUR PURPOSE, VISION, AND VALUES

Our Purpose is caring for the essential needs of our communities and environment, now and for generations to come. We do this by providing reliable and affordable water and wastewater services for our customers. We make a positive difference by operating efficiently and investing prudently, to maintain a sustainable and resilient business.

Our Purpose is the reason we exist, and it guides our strategy.

We redefined Our Purpose in 2021 by engaging with employees, customers, stakeholders and our Board to develop a relevant, enduring and shared understanding of why our company exists.

The resulting statement of Our Purpose sets out the reason why we do what we do each day. The role we have as a provider of essential services is a privilege, and it places us at the heart of our communities and environment; Everyone in our operating area makes use of our services, and our assets run up and down every street; We rely on the environment around us for our raw material and have responsibility for returning water back to our environment in a sustainable way, while converting waste into energy and other valuable products; and we must deliver our services in a way that everyone can afford to use them.

Our Purpose is well understood throughout our business, with our dedicated colleagues committed to delivering for our customers, communities and environment every day. As nearly every one of our employees lives in our operating areas, and is a customer of our services, it's not surprising that they care deeply about the service we provide to our communities. Everything we do is focused on maximising benefits for our customers and achieving the best possible outcomes for our communities and environment.

We report transparently on these outcomes in an annual 'Our Purpose' report, which seeks to measure and communicate how we truly live Our Purpose.

Figure 2: NWL Business Model

4.2 OUR LONG-TERM VISION AND GOALS

We want to leave a positive legacy in the areas we operate. Our role as a water company places us at the heart of our communities and our natural environment and caring for them is always our priority. Taking a long-term view enables us to future proof ourselves, our environment, society, communities and economies.

Our long-term vision is to be the national leader in the provision of sustainable water and wastewater services - that is, to be the best water company in the UK. We clearly define, with metrics, what this means to us.

How do we define being the national leader?

When we achieve average or better in all the measures that are most important to our customers, and have the most measures in upper quartile in the sector (top 25% of companies) we would define this as being the national leader. In addition we would want to be in the top two for C-MeX (Ofwat's measure of customer service). We have been in upper quartile for C-MeX since its inception.

Our vision is well understood in our business with 91% of our people reporting that they support Our Vision and Our Values[1].

Our vision helps us all to focus and drive towards common goals, enabling us to achieve success where, in some areas, we have already achieved our 'national leader' vision; We are one of the best water companies for customer service and environmental performance. In other areas, we have improved steadily and will continue to do so. Our 'national leader' vision is the starting point for setting our ambition into the long-term.

Figure 3: Business themes

4.3 LIVING OUR VALUES

If Our Purpose defines who we are, and Our Vision defines what we do, then Our Values define how we do it.

Our Values are:

- Customer focused - We aim to exceed the expectations of our external and internal customers.
- Results-driven - We take personal responsibility for achieving excellent business results.
- Ethical - We are open and honest and meet our commitments with a responsible approach to the environment and our communities.
- Innovative - We continuously strive for innovative and better ways to deliver our business.
- One team - We work together consistently, promoting co-operation and mutual support, to achieve our corporate objectives.

[1] Ref: Our latest GPTW survey

How every one of our employees behaves underpins our reputation and building trust among our customers and wider stakeholders is crucial to achieving Our Purpose. Our Values set out the behaviours we expect our people to demonstrate, supporting them to take the right decisions and actions to deliver Our Purpose and Vision.

We know that we have a strong positive culture because of our clear Purpose, Vision and Values. This is evidenced with our appearance 12 times as the only water company named on the Ethisphere Institute's World's Most Ethical Businesses list and being the first water company to achieve the Good Business Charter, an independent assessment supported by the Trades Union Congress (TUC).

This strong culture, underpinned by Our Values, is echoed in how our customers experience our services. We were delighted to be ranked first in the industry for C-Mex (Ofwat's measure of customer experience) in 2022/23 because of the way that customer service is embedded in our culture, and we credit our focused investment on digital, skills/training, new services, and partnerships for supporting our journey from the middle of the industry to the top. In 2022 we (Northumbrian Water) ranked top water company out of 15 and fourth utility overall out of 35 in the latest Institute of Customer Service's UK Customer Satisfaction Index (UKCSI), while Essex & Suffolk Water (ESW) ranked seventh water company overall and thirteenth in the utilities sector. These are our highest results to date and ESW was also named as one of the most improved companies. The Consumer Council for Water (CCW) annually assess how well water companies are performing in a number of areas that matter the most to customers. In the most recent CCW Water Matters Report, Northumbrian Water is the most trusted water and sewerage company in England. Our trust score in Essex & Suffolk is above the industry average.

4.4 A PLAN SET WITHIN THE CONTEXT OF STATUTORY REQUIREMENTS AND LONG-TERM SCENARIOS

Our DWMP, although a stand-alone document, is shaped by our Purpose, Vision, and Values, and sits within the wider context of our long-term delivery strategy (LTDS) as well as a number of statutory or legal requirements and targets. For example, the Government's Storm Overflows Discharge Reduction Plan (SODRP) requires us to invest to:

- Protect our designated bathing waters and most of our most sensitive and protected habitats from storm overflow sewage discharges by 2035.
- Eliminate all adverse ecological impact from storm overflows by 2050.
- Make sure that storm overflows discharge in fewer than an average of ten rainfall events per year by 2050.

In addition, the Government's 25 Year Environment Plan (25YEP) also requires us to invest to:

- Reduce nitrogen and phosphorus pollution, through catchment and nature-based solutions where possible.
- Improve drainage and environmental water quality, and reduce surface water flooding risk, through our Drainage and Wastewater Management Plan (DWMP)

We have other long-term statutory requirements, and must:

- Decarbonise to meet the national Net Zero target by 2050.
- Adapt to climate change, working with the UK National Adaptation Programme.
- Play our part in implementing the Environment Act 2021, including local nature recovery strategies and delivering biodiversity net gain.
- Deliver the Water Industry National Environment Programme (WINEP) every five years, including our role in protecting and restoring water bodies and blue spaces, protecting from and removing pollutants, biosecurity, flooding, waste reduction, and other priority areas.

- Protect 30 of land by 2030, where we need to invest in habitat restoration across our protected areas and beyond.

We must also maintain our ongoing obligations in the long-term, including:

- Serving and protecting customers – providing a better and fairer water and wastewater service for all and meeting the needs of vulnerable customers.
- Supporting markets to deliver for customers, especially where these can drive long-term sustainable investment.
- Maintaining a resilient water and wastewater system, including a healthy asset base.
- Delivering high quality water and providing effective drainage.

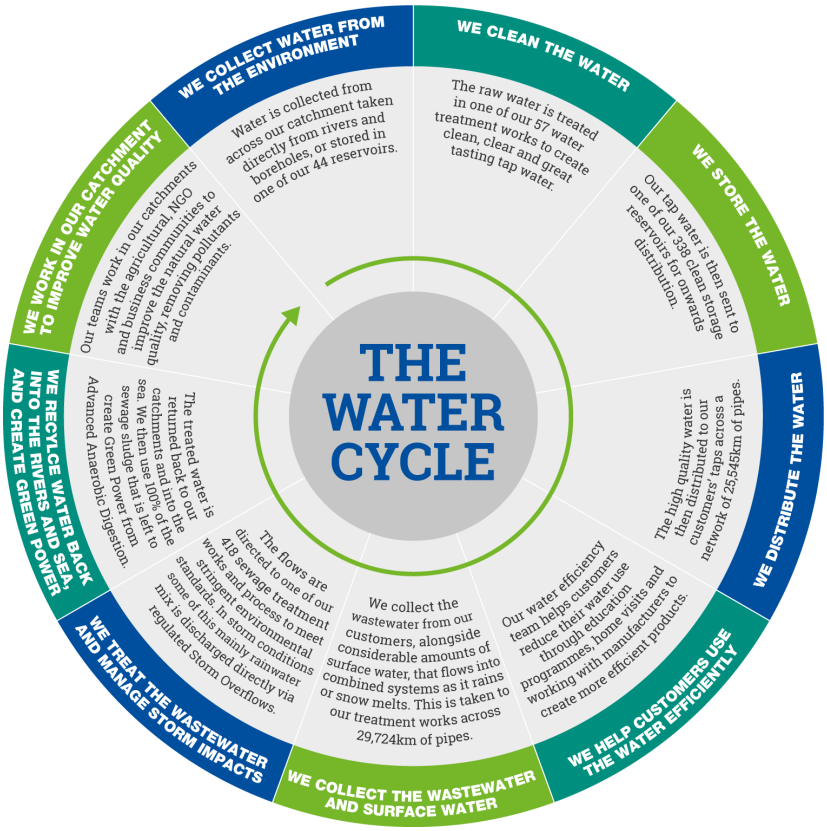
These considerations are reflected throughout our DWMP and more detail can be found in our Business Plan for 2025-2030 and our Environment Strategy to 2050.

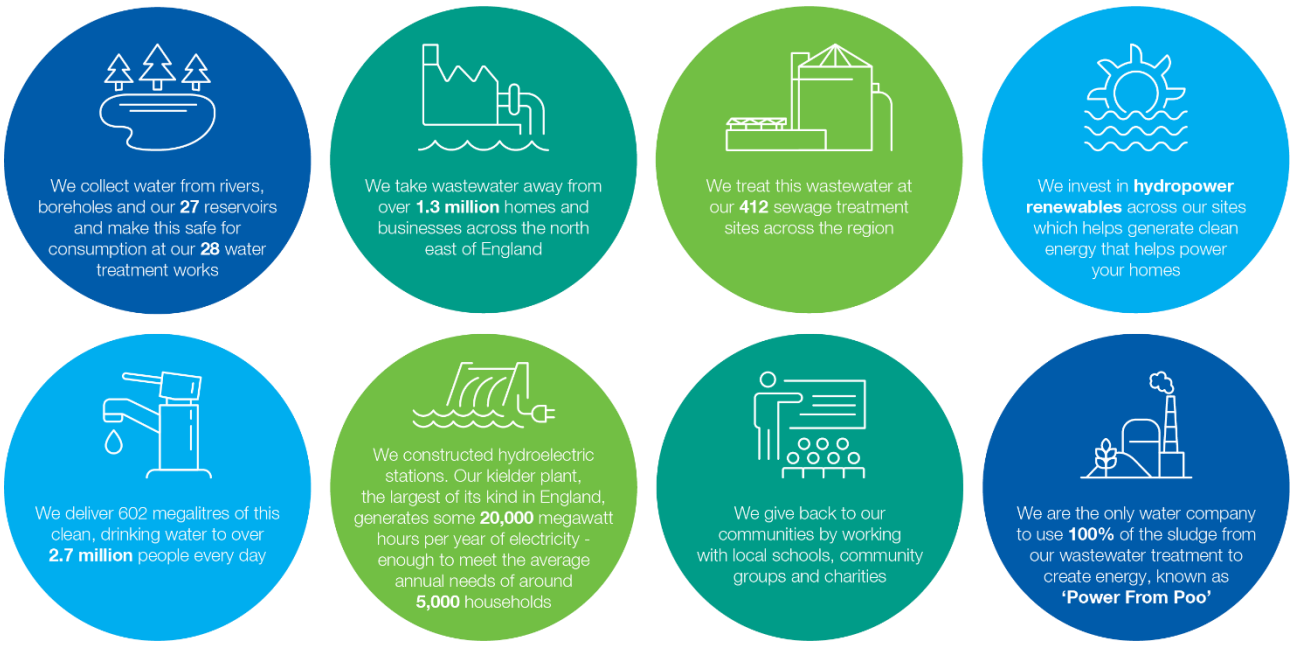
[Business Plan 2025-30 (nwg.co.uk)]

4.5 CUSTODIANS OF THE WATER CYCLE

The wastewater services that we deliver today form part of our responsibilities as custodians of the whole water cycle. As a water and wastewater operator, we have a significant interaction with rivers and coastal waters. We take water from nature, then restore it back after a long journey through treatment, working constantly to make sure we protect and enhance the environment, often going beyond regulatory obligations.

Figures 4 and 5: The water cycle and our activities





In the North East region, Northumbrian Water Limited (NWL) treat around 900 million litres of wastewater every day in serving our 2.7 million customers who live in the major population centres of Tyneside, Wearside, and Teesside, and the large rural areas of Northumberland and County Durham. We collect this wastewater from our domestic and commercial customers' properties via our sewerage network and pumping stations. Our wastewater system is complex – we manage more than 30,000km of sewers, over 1,000 sewage pumping stations, 410 sewage treatment works, 1,561 storm overflows and more than a million manholes across our region.

Our network consists of combined sewers that carry sewage and rainwater in the same pipe, as well as separate surface water and foul (sewage) only sewers. The combined sewers were designed in the 1880s to include storm overflows (SOs), which are release valves that spill into waterways at times of heavy rainfall and minimise the risk of sewer flooding in our homes and businesses. Before any spill event, the wastewater is typically screened to 6mm, meaning any solid material including faecal matter, toilet tissue household waste is removed from the water being discharged. SOs are heavily monitored and the circumstances in which they can spill is permitted and regulated by the Environment Agency. The system has developed over the past 40 years with the construction of large interceptor systems, underground storage tanks and full sewage treatment to bring about significant improvements in river and coastal bathing water quality.

We have set out ambitious goals for our operating area to have the best rivers and beaches in the country, and to have zero pollutions as a result of our assets and operations.

We are well on the way to achieving our ambitious goals, with 32 out of 34 bathing waters in our North East region classed as Excellent or Good, while we have delivered a substantial reduction in pollutions in the past decade. We have achieved a Four-Star performance, the highest possible rating, in the Environment Agency's latest Environmental Performance Assessment (EPA) for the last two years.

We have invested significantly in a programme to improve the quality of our wastewater treatment works (WwTW) discharges. We also have plans for further nutrient removal, making sure that water industry investment in our region is an enabler for further ecological status improvements.

We are the first, and remain the only, water company in the UK to use 100% of the sludge from its wastewater treatment to create green power through advanced anaerobic digestion - or as we like to call it, 'power from poo'.

In our publication, A Vision for our Coasts and Rivers, we set out our plans to meet the expectations of our customers and communities, and to enable our region to benefit from the best rivers and beaches in the country. It contains nine ambitious pledges that we believe will contribute to enhancing our unique water environment and make a real difference to our communities:

1. We will work with the Environment Agency, Natural England, The Rivers Trust and Catchment Partnerships to identify, and have plans in place to eliminate, all impediments to our rivers achieving good ecological status caused by our operations.
2. We will invest in monitoring to provide 100% near Realtime Data on all Storm Overflows by 2023.
3. We will introduce final effluent, in-river upstream and downstream monitoring to get a greater understanding of environmental impacts of treated water by 2030.
4. We will implement Water Quality monitoring at the highest priority Storm Overflow locations by 2025.
5. We will reduce spills from storm overflows (SO's) to an average of 20 per year by 2025.
6. We will work closely with The Rivers Trust through our strategic partnership and North East Catchments Hub to focus on river needs for investment through catchment and nature-based solutions, and to identify at least 2 inland bathing water sites where applications for designation can be made at the earliest opportunity. We are proud that already 95% of the NE population lives within an hour's drive from a beach with Good or Excellent bathing waters.
7. We will work with partners to achieve 100% of coastal bathing waters at Good or Excellent by 2030.
8. We will work in partnership to improve 500km of blue spaces (such as river banks and accessible water environments) for the public to enjoy in our regions by 2030.
9. We will double the number of our Water Rangers – our citizen scientist volunteers who are trained to help us monitor environmental conditions around rivers and take action to address wider river issues such as littering, fly tipping or signs of pollution.

In April 2023 we published an update to this report, demonstrating that we are on track to meet all of our pledges. These reports can be found at https://www.nwg.co.uk/responsibility/environment/a-vision-for-our-coasts-and-rivers/

We recognise that environmental standards and requirements are increasing all the time. We know there is always more we can do, which is why over the last two decades, we have invested significantly in upgrading our wastewater network and treatment works and will continue to do so to remain at the forefront of the industry. We will always target our investments in the most efficient way possible and seek to innovate so that we maximise the outcomes for our customers whilst trying to keep the impact on their bills as low as possible. We are confident in our ability to do this as we have a long track record in successful innovations in our wastewater operations, for example in converting 100% of our sewage sludge into renewable energy. Further, we are recognised as the industry leader in innovation, having achieved the most successful bids in Ofwat's innovation fund competition and due to our globally renowned annual Innovation Festival which generates successful innovative solutions for our business.

5.0 OUR CURRENT ACTIVITIES AND OPERATIONS

Our commitment to providing the best possible service to our customers is reflected in our purpose, vision, and values, and this is reflected in our day-to-day operations. We seek efficiencies and strive to be at the forefront of innovation to both reduce costs and improve service levels for our customers. We work hard to understand both the short and longer term needs of our customers and take multiple approaches to understand their preferences, including engagement in our planning and processes.

In order that we can deliver this work, NWL receives an allowance of 'base' funding through the price review settlement. This funding is meant to cover operating costs as well as capital maintenance activities across the wastewater service – our Business as Usual (BAU) activities.

This section outlines our approach to making best use of that. We are developing a package of service levels (known as Performance Commitments, or PCs) which are designed to make sure that:

- We have stretching service levels for the 2025-30 period offering levels of service that are consistent with our purpose and our vision of being the 'National leading' water company.
- We focus on providing service improvements that reflect the preferences and priorities of our customers in our different operating areas.
- Our PCs are consistent with our Long-Term Delivery Strategy (LTDS – see Section 6.2), making sure that the targets we propose set us on the right trajectory towards our long-term goals.

Our existing PCs are related to:

- Internal sewer flooding
- External sewer flooding
- Pollutions
- Wastewater treatment works compliance
- Sewer collapses
- Risk of sewer flooding in a storm
- Sewer blockages
- Repeat sewer flooding
- Bathing water compliance
- Water Industry National Environment Programme (WINEP)

In addition, in 2025 we will adopt PCs relating to:

- River water quality
- Storm overflows

PCs are not present in the DWMP framework as they are a measure of existing performance rather than an indication of future risk. Future risks are identified by Planning Objectives which are described later in this report.

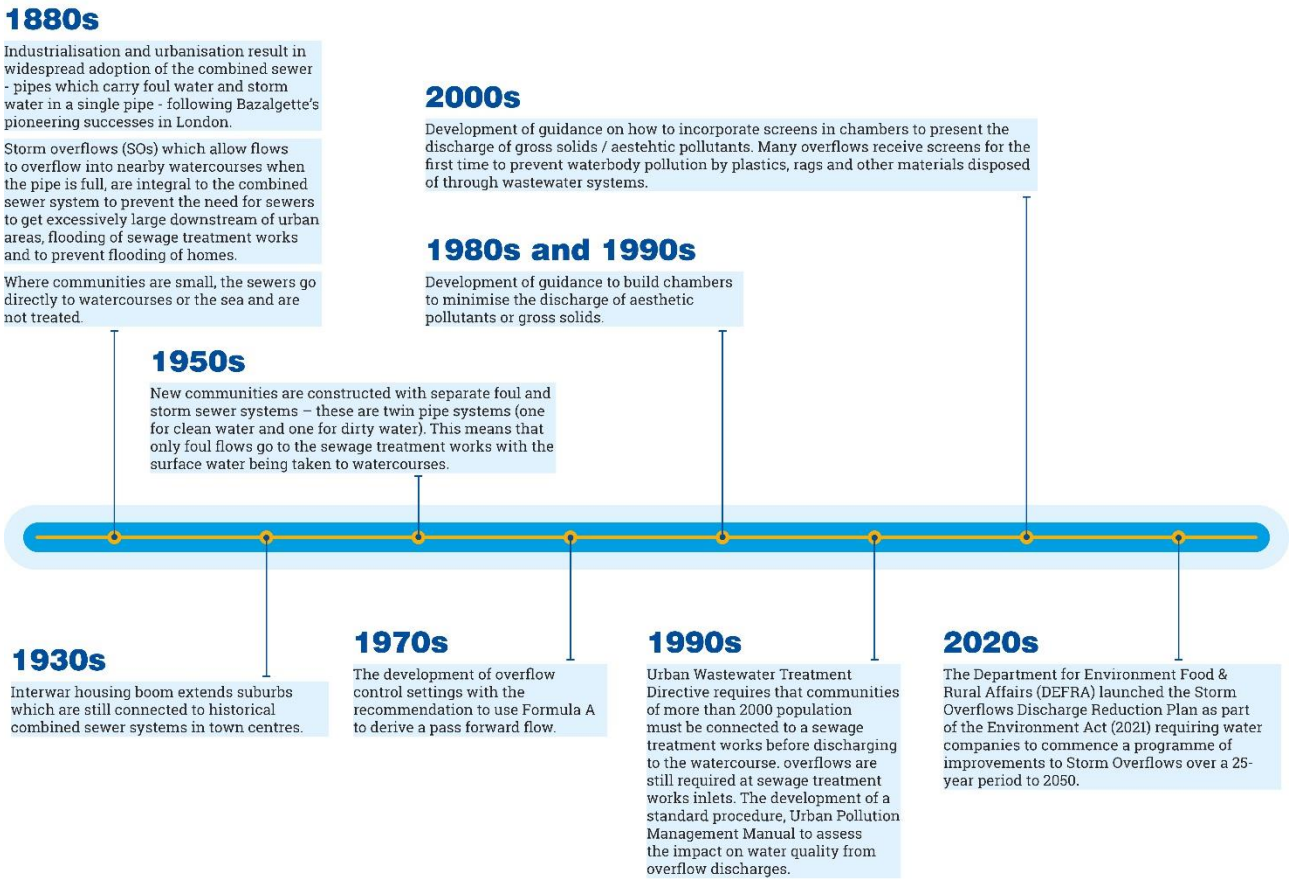
Below are some of the business as usual (BAU) tools and activities we currently undertake to help us deliver these PCs.

Storm Overflows

Storm Overflows (SOs) have formed part of our water network since the 1880s, carrying water away to nearby watercourses in order to minimise the risk of flooding in our communities. The EA permits how and when we can use SOs. Before any spill event, the effluent is typically screened to 6mm, meaning any solid material including faecal matter, toilet tissue household waste is removed from the water being discharged.

A brief history of SOs is outlined below in figure 6 and an animation explaining how they operate can be found at: https://www.youtube.com/watch?v=xFTYJLO5rjw

Figures 6: Storm Overflows – a brief history



We have existing programmes of work to invest in SOs. These include:

- Our existing Water Industry National Environment Programme (WINEP) which identifies a number of overflows where we will undertake Storm Overflow Assessment Framework (SOAF) investigations and then carry out interventions schemes to meet 10 spills per year
- Base maintenance programmes (e.g., for growth)

Our *A Vision for our Coasts and Rivers* report includes a pledge to reduce spills to 20 on average by 2025 and in addition to the programmes above, we are investing £7.3m in activities designed to achieve this pledge. Our aim is to reduce the total number of spills from the storm overflows in our region by 8,000 per year to deliver an average spill per overflow of

20 spills by 2025. The activities focus on the SO asset types responsible for the majority of spills – SOs in the sewerage network and at sewage pumping stations (SPSs). The main actions are:

- Network SO Spill Reduction Programme to CCTV, cleanse and fix any issues (e.g. remove tree roots and lining sewers) downstream of high spilling overflows.
- Network SO Flow Controls Programme is to inspect every flow control device at SOs to make sure they are calibrated correctly and make any necessary improvements, such as modifications or renewals.
- Sewage Pumping Station SOs Flows and Spills Programme to assess the flow pass forward at high spilling overflows and make necessary changes to pumps, such as new impellers or pump sets.
- Enhanced SO reporting that is focused on tracking all SO and spill reductions, this includes company scorecard targets and forecast spill performance for every SO.
- Use of Stormhavester smart network management system using advanced machine language learning, together with hyperlocal rainfall forecasting, to predict performance of our assets, provide accurate alerts of issues occurring and relearn performance after spill reduction activities have been implemented.

The delivery of the action plan is being tracked to understand benefit of the activities and to set future maintenance programmes to maintain reduced spill levels. Whilst we see some scope to improve performance from these activities, which are predominantly base maintenance work, we believe that our plans to 2025 will largely exhaust these opportunities given our industry leading position on efficiency.

Wastewater Treatment Works Compliance

Our Wastewater Treatment Works (WwTWs) need to comply with permits, which cover issues including the volume and the quality of the treated effluent they discharge.

To improve performance, we make sure we carry out work at any sites with a history of any level of sample failures, in order to prevent a reoccurrence. We also strive to continuously improve how we scrutinise our compliance data for wastewater works.

Our aim is zero failures. This is challenging but is vital for us to meet our environmental goals and our objective to be a 4* company in the Environment Agency's Environmental Performance Assessment (EPA), which we achieved in 2020 and 2021.

ACTION	DESCRIPTION
Address known risks	We have carried out extensive investigations to find the root cause of any failures or observed compliance risks and are implementing measures at specific sites to prevent a reoccurrence. These include improving operating procedures and introducing preventive maintenance schedules along with extra infrastructure. By taking regular samples that are analysed for compliance, including phosphorous and ammonia, and specific substances that may accumulate to cause a problem in the water environment, we can also take a more proactive approach. We remain committed to achieving maximum compliance and are focusing on targeting known risks by putting in place interventions at sites with one or more individual sample fails (previously it would have been three). This includes investing in cleaning, filtration and investigating ammonia issues.
Continuous improvement	We're running a programme of compliance controls including further improving visibility and scrutiny of compliance data, via a new 'compliance hub', including data from retailers to facilitate trade effluent management.

Sewer networks

Internal and External Sewer Flooding

Sewer flooding can sometimes happen during or after periods of heavy rain when our sewers are unable to cope with the amount of water going into them. More commonly, how the system is used and what is put down the drain causes sewer flooding due to blockages. It can happen inside the home from any of the drains in the property, such as the kitchen or bathroom, or from external discharges that enter the inside of a property. It can also happen outside, on private and public land.

Flood water can come from:

- Surface water
- Foul and combined sewers
- Rivers flooding into the sewerage network.

Flooding from sewers is extremely distressing and we work hard to reduce the risk of sewer flooding occurring. Each year we invest approximately £25m to reduce the risk of internal and external flooding. Since 2020, we have reduced the number of internal sewer flooding incidents by 77% and reduced the number of external sewer flooding incidents by 36%. This followed a strategic choice to invest in key interventions for this service area given our relative performance

from our base maintenance activities. In the future we will continue to invest in our business as usual activities and in initiatives identified in our sewer flooding tactical plans. The key performance initiatives associated with this plan are shown below.

Intervention	Description
1st Time Transferred Drains and Sewers investigations	Dedicated resource to investigating and validating the root cause of external first-time flooding located on our Transferred Drains and Sewer network
Increasing our business and usual resources	Resources associated with three key areas: • Network protection (Fats, Oil and Grease – FOG). • Flooding Other Cause – non hydraulic flooding root cause. • Technical investigations supporting our industry leading Service Level Agreements for attending flooding events (2hrs internal, 4hrs external).
Repeat Blockage Team	Creation of a dedicated team of Technical Support Advisors investigating and validating repeat blockages occurring within a 2-year risk window.
High Risk Properties	Proactive CCTV, root cause analysis and fixing of defects associated at high risk locations identified on our network.
Bin the Wipe	Team of 16 leading our award-winning Bin the wipe campaign (see below) educating, investigating and taking action to reduce the number of wipes being disposed of within our sewer network. The Bin the wipe campaign targets over 150,000 high risk properties per annum.
Enhanced Flooding Other Causes investigations	Increasing the length of proactive CCTV and network fixes that we undertake on our network.
Property Level Protection	Installation of measures at properties, including flood doors, air brick covers and flood barriers to help reduce the risk of internal flooding.
Flooding Volunteers	Team of volunteers from our company ready to help assist and help record evidence of flooding during busy and incident periods.
Out of Hours Attendance	Increasing resourcing support to ensure Technical Support Advisors can attend all out of hours external flooding events to validate and investigate root cause.
CCTV 1st Time Blockages	CCTV off all blockage events regardless of service impacts (i.e. even if no flooding has occurred) to investigate root cause and fix any associated network defects.
Hydraulic flooding investment	Increased level of funding provided per annum to reduce the risk of flooding caused by hydraulic overloading of our sewers. This will include investing in chronic repeat external flooding.

We will continue to monitor the success of these interventions at our Sewer Flooding Group and benchmark our performance with other water companies.

We will also continue to adopt innovative solutions to further improve our sewer flooding performance. We are currently undertaking a pilot project within our Tyneside catchment exploring the potential benefits and scoping the requirements for a smart network. A smart network on Tyneside will give us the ability to operate and maintain our sewerage assets and network by managing and controlling flows proactively to make timely decisions when managing performance and protecting the environment (see below).

Bin the Wipe

Our industry leading Bin the Wipe campaign has been highly successful in educating our customers around the potential impacts of flushing wet wipes. It aims to help people understand the problems caused by sewer blockages containing wipes that have been flushed down the toilet.

By helping people understand that this can cause waste to back up into people's homes, or be forced out into the environment, we hope to encourage people to put wipes into the bin. Customers receive letters explaining the issues, and how a team will be monitoring the area's sewers, finding flushed wipes, and tracking back up the network to the properties from which they were flushed.

As the team identify streets, or even individual homes from which wipes are being flushed, further letters and doorstep conversations will reinforce the need for people to stop using their toilets as bins and to explain the impacts further.

We launched Bin the Wipe in 2020 as an innovative approach to tackling the problem of wipes in sewers, the leading contributor to blockages in the sewer network. Since the launch, blockages have reduced by 52% in the areas our teams have worked, with a 64% reduction in the number of home flooding incidents.

We are proud of the success of our Bin the Wipe campaign and the support it has generated from customers, regulators and stakeholders including members of parliament, which has led to it being adopted by the water and wastewater industry as a whole. This has resulted in a national Bin the Wipe campaign to change customer behaviour and stop blockages. You can find more information here.

Figures 7: National Bin the Wipe communications collateral

Due to the success of Bin the Wipe, and the positive impact it has had on our wastewater network, we are now planning a pilot for the second biggest issue within our wastewater network: fats, oils and grease, also known as FOG.

We have had some great success in reducing the amount of FOG entering our network from Food Service Establishments to date, with an example of this being the work we have done in partnership with UK Bakery chain, Greggs. Our FOG advisors met with the Greggs team to discuss best practice at the outlets across the North East. After explaining the issues associated with Fats, Oil and Grease and the requirement to install suitable FOG management at those bakeries in hotspot areas, Greggs confirmed that the business had agreed to begin rolling out Grease Recovery Units at over 200 outlets across the North East.

Sewer collapses

Our Service Delivery Strategy sets out how we manage our network to help reduce the risk of sewer collapses. This strategy reviews the root causes associated with failures and confirms the intervention we have in place to reduce risk and manage performance. In the past five years this has helped us to reduce the number of sewer collapse we report by 50%.

As part of this, we invest approximately £20m per annum associated with sewer network collapses and rising main bursts. This investment includes:

- Proactive and reactive inspection and rehabilitation of our sewer network.
- Strategic sewer investigations and inspection.
- Condition inspection and monitoring.
- Annual investment to replace rising mains.

Our tactical plan also includes a number of operational and procedural improvements, including training needs, development of tactical and strategic decision support tools. This includes working closely with our contract partners to develop right first-time investigations and long-term solutions.

How we manage growth

Understanding how housing growth and demographic change will affect the future provision of water and wastewater services across our area of operation is a critical element of the business planning process.

We work in partnership with local government, developers, landowners, local communities and other key stakeholders to ensure every opportunity is taken through the planning system to protect our operational assets and fully support growth within our region by ensuring that infrastructure capacity is available by influencing decisions.

Whilst we are not technically a statutory consultee in the development management planning process, our opinion is sought by all Local Planning Authorities across our region as they recognise the importance of our role in providing comments on capacity of utility infrastructure and flood risk. We respond to these authorities within a set deadline providing them with a substantive response on the availability of water and sewerage services and any physical protection measures for the application in question.

We are a statutory consultee on all emerging planning policy. Each local authority prepares a high level strategic “Core Strategy” or “Local Plan” which determines overall levels of new development and considers the extent to which the authority will commit to sustainable water management, flood risk and surface water generation.

To assist developers and landowners through the planning process, we provide a pre-development enquiry service which carries out a water and drainage capacity study for a proposed development. This provides information regarding the impact a proposed development will have on our existing water and sewerage network and its ancillary assets, together with identifying any associated costs involved with upgrading or diverting our assets to provide water and sewerage services for the new development. Through this service we also provide information on the current availability of sewage treatment capacity.

Through the processes listed and our non-statutory work we have developed excellent relationships with stakeholders who trust us and are happy to liaise with us to ensure new development in the region is effectively managed.

How we manage groundwater

We effectively manage our interaction with groundwater in providing our water and wastewater services.

For our sewerage network, normal groundwater levels means that the main impact is from infiltration and ingress into our sewers from defects, such as joints and cracks. We use various methods and tools to assess infiltration impacts to maintain compliance with our permits (e.g., Dry Weather Flow at sewage works) and to drain effectively. These include a regionwide infiltration model using various data sources to assess infiltration levels for our sewage treatment works catchments that enables us to analyse and act on this data. We also operate a smart network management system using our Stormharvester’ and SNIPeR tools to assess infiltration and ingress from our wealth of monitoring data, such as from Event Duration Monitoring and flow measurement devices.

Our maintenance programmes address the integrity of our sewers with provision of rehabilitation. This typically consists of CCTV, cleansing and an initial tree root cut to maintain hydraulic capacity. Sewer lining is then used to repair structural issues and prevent regrowth of tree roots. We also fix other issues, such as collapsed sewers and structural issues.

Newly laid sewers, including those that are adopted from developers, are constructed to recognised industry standards, such as in the use of correct pipe bed materials.

At some of our smaller WwTWs, our permits support the use of discharges to groundwater called soakaways. They are designed and constructed following a defined process with the EA to assess environmental impacts to groundwaters and in protecting groundwater aquifers.

Our approach to groundwater continues to develop as we look at extending our current knowledge and approach to managing our wastewater service. This includes the identification of low flows at WwTWs via our DWF compliance business as usual process. We also use different datasets, such as those on soil characteristics, groundwater and mine water levels, to identity risks to our service and to protect the environment.

Monitoring

We use a number of systems and techniques to monitor the performance of our wastewater systems, enabling us to take action where there are potential service issues. Some of these are outlined below:

Trigger Management Process

In order to achieve industry-leading performance, we have adopted an innovative proactive and preventative approach. We have applied techniques from leading companies in other industries to develop a total quality management culture. For example we have implemented a trigger management process (TriM), which produces automated reports if performance starts to deteriorate and before failure occurs. As well as triggering immediate operational responses when required, TriM incorporates principles such as 'lean' (eliminating waste) and 'six sigma' (reduced defects and improved process control) to support teams in creating a culture of continuous improvement. This approach has improved compliance at our Wastewater Treatment Works (WwTWs) and the quality of the region's rivers.

Dynamic Risk Index and Visit Effectiveness

DRIVE (Dynamic Risk Index and Visit Effectiveness) is a tool that allows us to understand real-time compliance risk across all of our WwTWs. Failure to comply with our permits at WwTWs can cause pollution incidents orimpact on treatment works compliance. DRIVE uses data from TriM and combines this with asset health data so that we can identify high-risk sites in real time. This provides visibility to allow us to reallocate resources effectively from areas of low to high risk and take action to improve treatment.

Sewer Network Information and Performance Reporting (SNIPeR)

The Sewer Level Monitoring (SLM) Team and Regional Control Centre predominantly rely on our innovative SNIPeR Supervisory Control and Data Acquisition (SCADA), Rain Radar and off-line analysis/manipulation of data to:

- Identify the probable cause of a flooding event / network discharge (root cause analysis)
- Call out a Sewerage crew to clear a blocked sewer
- Request the monitoring unit supplier to perform maintenance on a data logger
- Call out a Wastewater crew to deal with a fault or a blockage at a pumping station.
- Call out a Sewerage crew to manage the impact of an expected flooding or pollution incident.
- Understand where to send a crew and the priority need
- Avoid false alarms and call outs

Daily SNIPeR notifications are triaged, investigated, and responded to appropriately. For example, SNIPeR calculates and displays alarms if a storm overflow is discharging or if a discharge is imminent, together with a probable cause. For example rainfall, obstruction, or SPS failure.

The SNIPeR establishes if each SO would be expected to alarm at that time, given the rainfall intensity (based on rainfall depth-duration analysis for the SO catchment area). Monitors at SOs typically report at two trigger levels (Discharge 100%, High 80%)

The investment in sewer level monitors at SOs has increased our capability to respond to problems at an 80% warning level. Sewerage Maintenance Operatives are dispatched with a 2-hour response time and are able to resolve a problem before a polluting overflow has occurred or provide containment.

Additional management reporting allows regular scrutiny of SO performance and adjustment of preventative maintenance routines, additional maintenance, and further root cause analysis to be undertaken.

Smart networks

It is essential that we identify and make use of new and emerging technologies that will improve delivery of our goals. One such opportunity is through smart networks and we are piloting this approach in the Tyneside area with our partner, HydroDigital. This supports the work we have done in our DWMP.

We are working to introduce a Smart Network that uses our data to give us increased visibility of the network. This data will feed a Real Time Decision Support Systems (RT-DSS) which will give the ability to intelligently operate and maintain our sewerage assets and network by actively managing and controlling flows, allowing us to proactively adapt to current and predicted conditions, making timely decisions when managing performance and also protecting the environment over the long term.

We are planning for how to best operate our system to reduce SO spills and help reduce flood risk despite more severe storms and higher storm peaks due to climate change and other environmental pressures.

The RT-DSS framework consists of a three-step process:

1. **Turn On the Lights:** This step attempts to determine the historical (trending) and real-time status of the sewer system. To do this a network of strategically located sensors is deployed to determine important parameters such as level, flow, and, in some cases, water quality. The data is typically sent wirelessly and in real-time or near real-time to a central repository where the data is collated, controlled for quality, analysed, and stored.

2. **Develop Digital Twin:** A digital twin is capable of using the data obtained by the sensor network and build a dynamic model of the system which is used to predict the sewer system behaviour. This is especially useful when different control strategies can be simulated, and its impact measured. The digital twin represents the RT-DSS knowledge of the sewer network. As the sewer infrastructure changes (e.g. new infrastructure, debris accumulation, dry weather flows, etc.), so does the digital twin.

3. **Implement Dynamic Control:** Once a method to evaluate the outcome of a particular strategy using the digital twin, dynamic control can be implemented. Dynamic control is essentially a search for the optimal strategy to control the sewer system. A number of optimisation algorithms exist to perform this task such as: genetic algorithms, market-based optimisation, model-predictive control, mixed integer non-linear programming, and heuristic rule-based control. It is common to use more than one methodology depending on the level of complexity of the controlled process.

Figures 8: RT-DSS framework

Our pilot study for Tyneside will be completed in late 2023 and will be used to help inform our final business plan.

Driving improvement

Our customers expect us to operate efficiently and invest prudently. That includes making the best possible use of our 'base' expenditure, which funds our operating costs and capital maintenance activities.

The scope for improvement from 'base' expenditure

Where we can achieve better performance, including a greater reduction in spills to the environment from SOs, from spending base allowances better, for example through innovation or doing things differently this represents by far the best outcome because better service is delivered to customers without any additional investment or increase in customer bills. We seek to optimise our investment across all of our asset types to ensure that we are maintaining or improving services to customers without increasing risk of asset (and service) failure in the future. We always want to get the most out of our base maintenance allowances either by allocating investments better or through innovation and efficiency improvement.

The work we have done to assess sedimentation and other operational network conditions will allow us to prioritise maintenance needs and investments in a targeted manner to ensure our investment continues to meet the targets set out in the SODRP. An example of this is our pledge to reduce spills to 20 on average by 2025.

Our DWMP modelling identifies those locations on our network where, as a result of growth, climate change, urban creep and other factors, we expect capacity constraints that will lead to service failures, in the future including spills to the environment from CSOs. To drive improvements in service it considers a range of interventions. The solutions identified consider maintenance investments as well as other interventions we could make to deliver the service outcomes we want to see for the lowest cost or best overall value – so the plan already identifies more maintenance where this is likely to be the best solution.

Our modelling starts from an assumption that the wastewater network is fully 'clean' – i.e. that there are no blockages or ingress issues – and therefore the network is already as well maintained as it would be possible to achieve. This means that the analysis only identifies a need for new investment where there is a capacity constraint in the future to meet planning objectives rather than proposing new investment to improve the overall maintenance and cleanliness of the network. This approach was undertaken as it is challenging to predict where individual defects are going to occur on our entire wastewater

network. In practice, we know it is unlikely that the network will remain clean at all times. Significantly more maintenance will be needed to get the network up to the level we assume in this modelling.

There is already a gap between the allowances we get for base maintenance and the economic replacement rate of our assets

The table below highlights the allowances we have received from our regulator in each price review since 2000 and the total expenditure we made on the maintenance and replacement of our assets over the last 22 years.

Figure 9: Our wastewater maintenance expenditure versus allowances (2000-2022, 17/18 prices)

Wastewater Capital maintenance 17-18 prices, £m	AMP3 (2000-05)	AMP4 (2005-10)	AMP5 (2010-15)	AMP6 (2015-20)	AMP7 (2020 to 2022)	Total (2000-22)
FD allowance	£252.8	£303.6	£451.4	£314.7	£128.4	£1,450.9
Actual spend	£263.9	£410.8	£346.4	£328.4	£125.7	£1,475.2
Overspend	**£11.1**	**£107.3**	**-£105.0**	**£13.7**	**-£2.8**	**£24.3**
Company share of overspend (%)	100%	100%	30%	50%	55%	
Company share of overspend (£)	**£11.1**	**£107.3**	**-£31.5**	**£6.9**	**-£1.5**	**£92.2**

Source: NWL analysis of reported costs

As can be seen from the table, NWL has spent its capital maintenance allowances in full over the period. In fact, we have spent over £92m more than the allowances from 2000 to 2022. There is therefore, no opportunity to utilise an underspend in order to deliver improved outcomes, such as in performance or reducing spills to the environment. In its Strategic Review of charges 2021 (SR21), the Scottish Water regulator, WICS, recognised that Scottish Water was insufficiently funded to maintain its assets to an economic replacement rate and decided to increase the capital maintenance allowances to c.180% of their historical levels. In 2022 we carried out an exercise to review our own assets in conjunction with Scottish Water. We described our findings from this analysis in a paper that we published in 2022. This can be found at www.nwg.co.uk/regulating-for-the-long-term

This paper demonstrates that the level of investment on different asset classes was around one-third of the level that would be needed to maintain and replace assets to their economic lives (the expected life of an asset). Our results were consistent with the findings for Scottish Water from SR21. This is available at Asset Replacement.pdf.

This is illustrated in the table below which shows the life expectancy of different asset types, the typical amount of annual investment that would be required and the current annual spend.

Figure 10: Analysis of replacement rates for NWL versus economic asset lives

Results from initial application of WICS methodology	Value	Life expectancy (years)		Replacement rate (£m /year)		Current annual spend
	£m	Low	High	Low	High	£m/year
Wastewater services						
Sewage collection	11,921	60	86	138	198	32
Sewage treatment	2,349	43	51	46	55	27
Sludge treatment	502	66	94	5.3	7.6	8

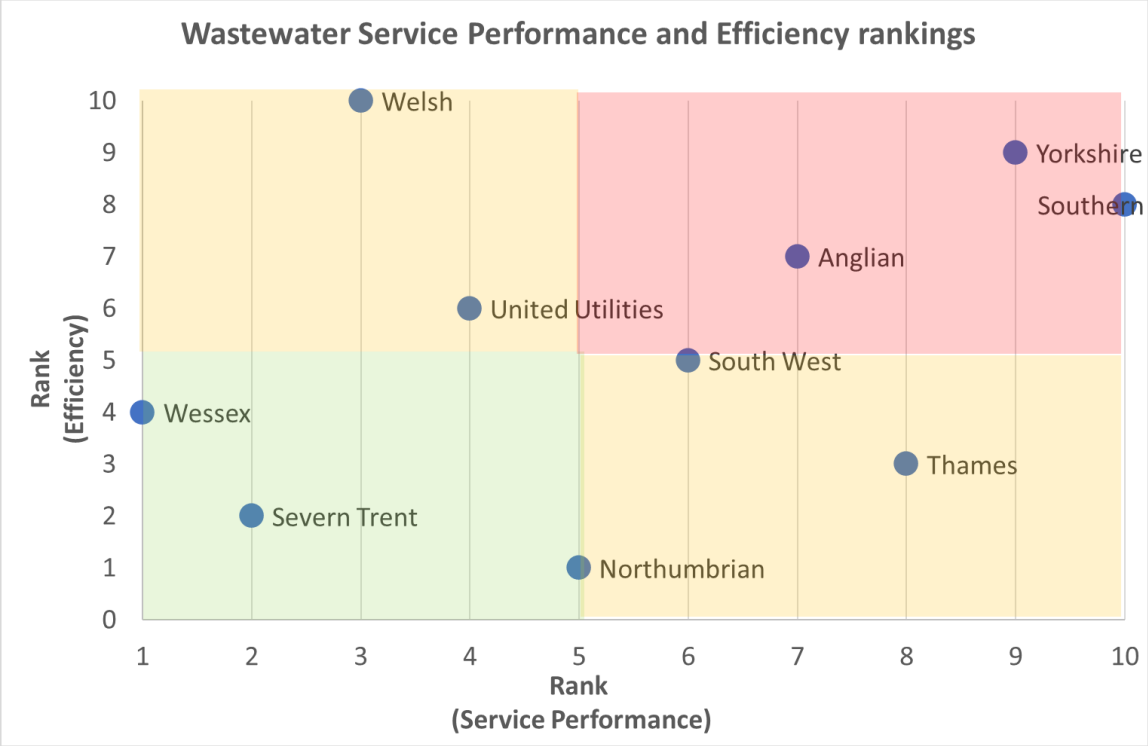
Source: NWL analysis

This analysis highlights that, we are spending the allowances in full but the allowances do not appear sufficient to maintain the asset base as it is. So there is likely to be negligible opportunity to reallocate investment as the allowed funding in aggregate is already too low.

Our performance is already amongst the best in the sector, suggesting limited scope for improvement through base expenditure

Our economic regulator, Ofwat, assesses the cost efficiency of wastewater companies. Independently of this assessment, Ofwat also examines the service performance of companies and benchmarks them. The graphic below plots the relative performance of NWL versus other companies on a cost efficiency and service performance basis using all the available AMP8 PCLs and information.

Figure 11: Sewerage company relative efficiency and service performance *(2022)*



Source: NWL analysis

As this analysis demonstrates NWL is upper quartile for both wastewater efficiency ranking and the service it delivers to customers. This comparative position implies limited opportunity to improve relative to other sewerage companies. We cannot 'catch-up' to other companies because we are already ahead of most of the sector and operating amongst the best performers.

We have a mature approach to innovation across the company and we are constantly seeking new and different ways to improve how we manage our wastewater assets. We have been successful in securing the most bids through Ofwat's innovation fund and our approach to innovation is widely recognised as amongst the best in the sector. There are several examples where we have managed to improve our performance through innovations which we highlight below.

NWL wastewater innovation examples

As part of our PR24 planning and Water Industry National Environment Programme (WINEP) we've started to explore how the use of industrial drones, already successfully used in offshore industries, can help us monitor and enhance the quality of our region's rivers and coastal waters. This is a world's first for the industry!

Working in collaboration with cloud data experts, Makutu, the desktop feasibility study will explore the use of cutting-edge drone technology to routinely sample and carry out large-scale, real-time river water quality assessments from all water bodies across our region contributing to fulfilling pending regulatory requirements.

This experience gives us significant confidence that we will be able to improve our performance through new innovations and ways of working.

As outlined earlier in this report our smart networks pilot working with an innovative organisation called HydroDigital is a great example of this. This work will not be fully complete in time for the submission of our PR24 business plan but we expect to have the findings from that work in the autumn of 2023. The use of smart networks with greater operational control could have a significant impact on the level of spills, particularly in larger integrated wastewater catchments in urban locations.

Other examples of innovation include in-house development of monitoring systems such as DRIVE and TRIM (WwTW compliance monitoring tools), SNIPeR (sewer level monitoring and alert system), the use of Artificial Intelligence for sewer defect recognition, rising main burst sensors, and network monitoring at high risk locations. Add to this some of our innovative partnership including NIDP, Bluespaces and NECH referenced earlier in this document.

We are already spending beyond allowances in the 2025-30 period and proposing to get down to 20 spills by 2025

In our *A Vision For Our Coasts and Rivers* report we propose a range of pledges to improve our environmental performance. One of the key pledges in that strategy is to get down to 20 average spills by 2025. To achieve this level of performance we are investing approximately £7m and that investment already represents an overspend against our wastewater allowances. While investment also seeks to take forward the most significant opportunities to improve performance from base maintenance expenditure and cannot materially be expanded.

Overall, the above evidence does not suggest that there is significant scope to improve our performance from base allowances. We will continue to examine the opportunities to drive improvements from base maintenance, including through our work with HydroDigital, but at present our plan does not consider that performance can be improved through different use of base maintenance as we believe such improvements will be negligible.

5.1 PARTNERSHIP WORKING

We recognise that we cannot deliver these activities effectively by acting alone. We exist in and contribute to an ecosystem with our regional communities. We rely on local suppliers to provide us with a wide range of goods and services, and the local community is our first port of call for recruiting people to our teams. We recognise the value of partnerships and building strong communities, which mean more people are willing and able to collaborate on shared objectives and strengthen opportunities for positive action.

We have a proven track record of partnership working and we intend to build on this to meet future challenges.

Northumbria Integrated Drainage Partnership

The Northumbria Integrated Drainage Partnership (NIDP) is a partnership of Northumbrian Water, the North East's 14 Lead Local Flood Authorities and Environment Agency and has been recognised as an example of leading practice which works together to reduce our communities' risk of flooding from all sources. The partnership is managed by a governance body with representatives from all the region's Risk Management Authorities. To meet the wider objectives of NIDP, the governance group have developed high level guidance and direction around:

- Agreeing and developing a strategic level risk-based prioritisation methodology for the identification of high risk drainage areas
- Promoting implementation of the prioritisation methodology to direct investment to the most needed areas
- Supporting and facilitating the timely sharing of data and information between parties for the purposes of understanding and managing integrated flood risk
- Managing the application of the methodology by sharing knowledge and experience
- Overseeing the delivery of detailed studies at high-risk locations as identified in the earlier prioritisation location
- Ensuring that suitable mechanisms are in place to communicate approach with other parties working on flood risk
- Championing the approach of first understanding the 'right thing to do'- ahead of the preference of any single organisation.

The NIDP has delivered a number of interventions in the region. It was highlighted as an example of best practice alongside the DWMP Framework.

North East Catchments Hub

Northumbrian Water is committed to working in partnership with others to protect and enhance the environment, which includes pursuing catchment and nature-based solutions (C&NBS). These are sustainable, multi-benefit approaches which harness natural capital, as alternatives to traditional hard-engineered methods of water and wastewater management and treatment. They deliver better and wider improvements for the environment, can be co-funded and should be more affordable for customers.

In our Water Industry National Environment Programme (WINEP), we include eight C&NBS schemes for phosphorus (P) within the Northumberland Rivers, Wear and Tees Management Catchments.

In order to support the development of C&NBS, we created a strategic partnership with The Rivers Trust (the national organisation providing support for the catchment-based approach) in April 2022. Through this partnership we established the North East Catchments Hub (NECH), a new, currently informal organisation, which has brought catchment resources, expertise and partner engagement capacity into the region to support our work.

The NECH has been working closely with strategic leads at Northumbrian Water, Catchment Partnerships and environmental partners to identify C&NBS opportunities. The NECH's held five workshops in the summer of 2022, follow-on conversations with partners, development of an online mapping portal to allow sharing of opportunities, review of WINEP needs and collation of partner ideas, and provision of a recommendations report to Northumbrian Water to highlight the most deliverable C&NBS opportunities.

This collaborative approach is ambitious and requires the development and agreement of shared environmental ambitions and catchment improvement plans across stakeholders, and the support of co-funding and green finance contributions. We look forward to working with partners across the region to improve the environment as our catchment activity grows.

Endorsing this work in February 2023, Rivers Trust CEO Mark Lloyd described the approach as industry-leading, and said: "We believe the scale of NWL's ambition, and its collaborative C&NBS programme, will have far reaching impacts for the water industry and beyond." An article describing this approach can be found at New partnership aims its focus on the North East environment - Water Magazine

Bluespaces to deliver water environmental improvements

Our customers have asked us to work in partnership with others to improve the water environment, focusing on a wide range of improvements in areas where they can access and enjoy water and its wildlife, and the associated health and wellbeing benefits. Since 2020 we have developed an approach to allow us to address this challenge and do more to protect and improve the water environment in the North East. This partnership is unique to Northumbrian Water and we will seek customer support to continue this in the future.

The Water Environment Team has identified over 3,800 km of bluespaces (accessible water environment) linked to streams and rivers, lakes and reservoirs, wetlands, coasts and beaches in the North East, which are open to the public to enjoy via public rights of way or other public access. Our company pledge is to improve 500 km of bluespaces in our Northumbrian Water and Essex & Suffolk Water regions by 2030. We have improved 48.3 km across the North East region through delivery of 12 partnership projects.

Our approach allows us to develop and deliver projects in partnership with organisations and community groups from the public, private, voluntary and education sectors in our region including the Till & Tweed, Northumberland Rivers, Tyne, Wear and Tees. This includes popular tourist locations and sites of value to local communities. Our approach focuses on packages of improvements across access and recreational facilities, wildlife and biodiversity, and water quality.

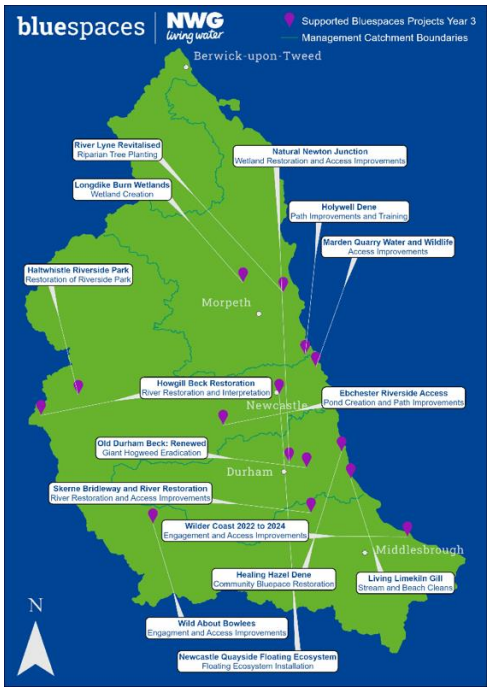
Wilder Coast Case Study

Work as part of the Wilder Coast project has improved 1 km of bluespaces at Coatham Marsh Nature Reserve. This project, delivered by Tees Valley Wildlife Trust (TVWT) in 2021/22, has included the removal and replacement of a dilapidated boardwalk with earthworks providing a new raised path surface which takes visitors directly past enhanced open water habitat. An additional 200m of footpath in the reserve has also been re-surfaced, and a new timber bridge has facilitated access for visitors to enjoy the enhanced wetland area.

In October 2021 contractors, TVWT staff and volunteers worked to improve 0.3 ha of silted reed swamp and ditches, re-balancing the extent of reed swamp and open water habitat in this area, creating more marginal habitat for ducks and wading birds and toads.

The locations where we intend to work in partnership with others in 2023/24 are highlighted in the map below.

Figure 12: Bluespaces partnership locations 2023/24



More information and case studies can be found on our website at [bluespaces (nwg.co.uk)]

6.0 FUTURE CHALLENGES

6.1 WHAT ARE THE FUTURE CHALLENGES?

Recent years have been characterised by significant levels of uncertainty and unpredictability in weather patterns and this is expected to remain the case as we plan ahead. We anticipate and understand that there will be many challenges over future planning cycles. In the DWMP, we have carried out work to assess future challenges for our drainage and wastewater management and identified the following key issues:

- The climate is changing but the rate of change is uncertain. The effects of climate change will impact our communities and operations through increased risk from extreme weather including:
    - Increased flooding at water and wastewater treatment works.
    - Storms causing local and regional power and communications outages.
    - Hotter summers causing equipment to fail.
    - Rising sea levels.
- In the DWMP, we are following the Met Office United Kingdom Climate Projections 2018 (UKCP18) representative concentration pathway (RCP) 8.5. This is the latest available assessment how the climate of the UK may change. This predicts that by 2100, the UK will experience 4 degrees of warming.
- The population is growing. We have included an assessment of the likely increase in population in the region in our DWMP.
- Urban creep is happening. This is the loss of permeable areas creating increased runoff during rainfall events. This can cause increased pressure on the sewer network and can contribute to flooding, increased spills from storm overflows and the capacity at treatment works. We have taken account the likely decreases in permeable area in our DWMP using the standard industry best practice.
- There is more pressure on the water environment. The UK government has stated that *"if the water sector continues to operate as usual, by 2050 some of our rivers could have up to 80% less water in summer, and it will not be possible to meet the growing demands of people, industry, and agriculture. There will be even greater pressure on the quality of rivers, lakes, estuaries, and wetlands from pollution. At the same time people's expectations of their local environment have increased, for example, more people want to swim outdoors or spend time near a local river."* In our DWMP, we have taken the environmental changes that will affect the water environment as well as new legislative requirements.
- New technology becomes available. There is an opportunity to utilise new technology to meet some of the other challenges listed above. In our DWMP, we have adopted new technology to help reduce the impact of the scale of our interventions. Examples of this approach include the adoption of Stormharvester and our desire to implement Smart Networks which are detailed later in this document.

In Part B of our DWMP, we outline how we intend to meet these challenges.

6.2 OUR LONG-TERM DELIVERY STRATEGY

As a long-term business, it is imperative that we seek to understand the potential challenges and opportunities we will face in the future, and plan today to be able to respond to what tomorrow might bring. We have therefore developed a long-term delivery strategy (LTDS) that brings together the outputs from the long-term planning processes across our business, including this DWMP and, our Water Resources Management Plan (WRMP) and other plans such as our plans to reduce emissions and reach net zero.

We have talked to our customers to understand their long-term ambitions for the service we provide and worked with futurologists and sector experts to develop plausible future scenarios against which we have tested those plans. Our LTDS will underpin our more detailed five-year regulatory planning process, starting with our regulatory Business Plan for 2025 to 2030. We intend to publish our draft LTDS for consultation in June 2023.

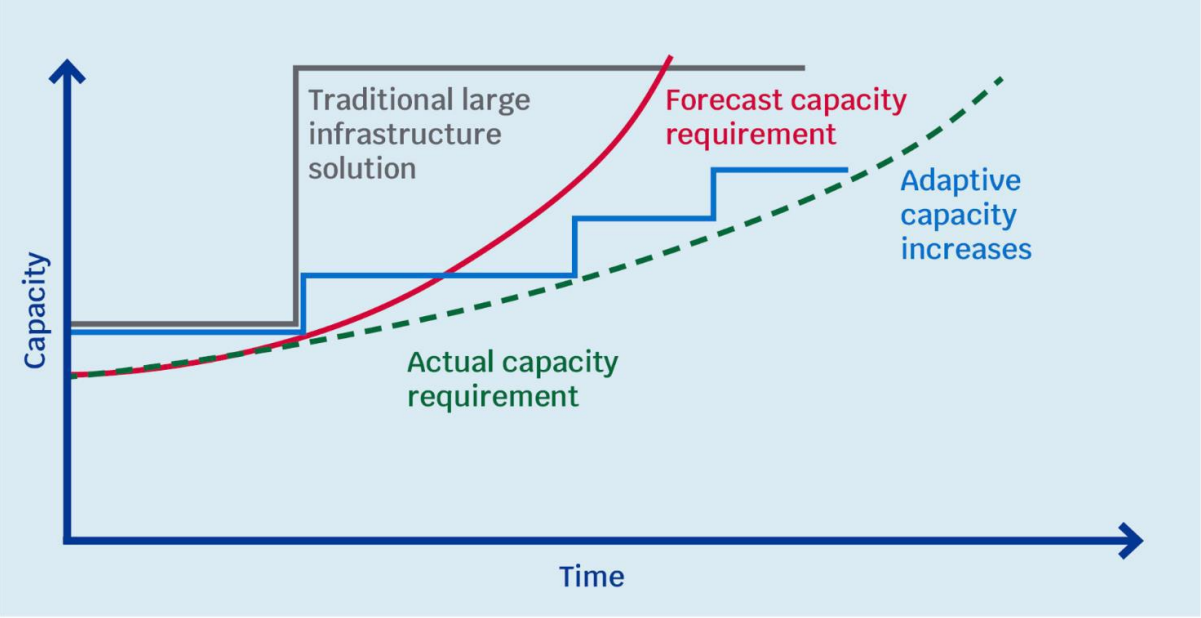
As we face an uncertain future, our long-term plans, and the investment decisions we make, need to set a solid foundation for delivering the service and the performance our customers expect from us over an uncertain future. We therefore need to maintain the right level of adaptivity and flexibility so that we can adjust our course over time.

This means making the necessary investment in the upcoming period from 2025-2030 that will be “no-regrets” – in other words, investment that will be required across many plausible futures. This is what we term our “core pathway”.

It also means taking a view, which will inevitably evolve over time, as to what might trigger the need for a different approach and investment profile. These are our “alternative pathways”.

This adaptive planning approach aims to optimise interventions over time, ensuring that options are kept open until there is sufficient certainty around the best course of action, while ensuring investment decisions are taken when needed. By looking across future investment requirements, we can also identify critical points and manage these by moving investment forwards or backwards within our investment portfolio. As Figure 13 shows, an adaptive planning approach can enable us to more closely meet the investment needs of the future.

Figure 13: Adaptive planning versus conventional planning



Following this adaptive planning approach, we have examined the scope for alternative investment pathways for the DWMP. However, the requirements set for the DWMP and in particular the Storm Overflow Discharge Reduction Plan (SODRP) do not leave much scope for strategic choices relating to the required investment. This is because the statutory requirements for storm overflow discharge reduction are already challenging and costly – and importantly will have a significant impact on the affordability of customers' bills.

There is some limited scope to go beyond the base requirements and in the draft LTDS we consider alternative pathways for the DWMP that:

1. Increase the speed of delivery of the SODRP requirements to be delivered by 2040. This pathway would increase affordability challenges in the short term and reduce the probability of being able to reduce costs and deliver better outcomes through innovative solutions as they are developed over time;

2. Decrease the speed of delivery of SODRP requirements. This would reduce the short-term affordability impact (in 2025-30) and increase the potential for innovation to reduce costs and improve service. But it would be out of line with current government and societal expectations, and

3. Increase the role of surface water separation and sustainable drainage solutions to target delivering a reduction of internal and external sewer flooding alongside storm overflow discharge reductions for the RCP8.5 scenario. This would deliver increased benefits but add £1 billion to costs. This forms part of our Preferred Plan in the DMWP.

4. Increase the role of surface water separation and sustainable drainage solutions to target delivering a reduction of internal and external sewer flooding alongside storm overflow discharge reductions for the RCP2.6 scenario.

We would need to decide in 2024 whether to accelerate or delay investment in storm overflow discharge reduction as this investment will need to be started in 2025. These pathways are explored further in the draft LTDS, but for this DWMP we have focussed on the preferred pathway.

Technological change is considered in general terms in the LTDS (rather than focussing on specific areas of innovation, such as smart networks) as alternative pathways because technological progress is a process of continuous improvement, the outcome of which is difficult to predict for any one area of our business, but which we can have some confidence will deliver benefits across our operations as a whole.

The draft LTDS looks at alternative pathways relating to other areas of wastewater that are not covered in the DWMP.

1. Alternative investments in bioresources resilience in dewatering or incineration of biosolids in response to potential changes to environmental requirements.

2. Potential additional investments required to address micropollutants including microplastics, persistent organic pollutants and anti-microbial resistance.

3. Accelerated environmental investment to improve river water quality.

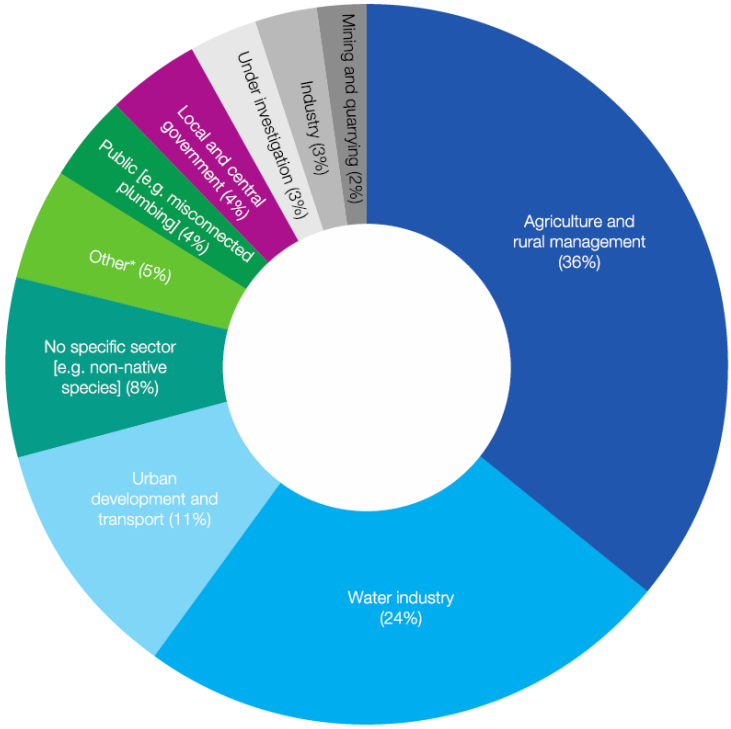
How these adaptive plans impact on our DWMP are discussed in Part C.

6.3 STORM OVERFLOW DISCHARGE REDUCTION PLAN

In developing and delivering this plan, we take account of how expectations on us from Government and our regulators are changing. In August 2022, Defra published the Government's Storm Overflow Discharge Reduction Plan (SODRP), which set out long-term targets for management of SOs. How we intend to deliver against the SODRP forms a major part of this DWMP.

It is important to note that there are multiple sources that impact on our water environment. Data gathered from the Environment Agency Catchment Data Explorer shows that agriculture (36%) is the biggest contributor to rivers not being in a good ecological state, with water companies the second biggest contributor at just under quarter (24%). The combined contribution of agriculture, highways, mines and local authorities represents more than half of the reasons behind good ecological status not being achieved. The Northumberland, Durham and Tees EA region contains a greater proportion of surface water bodies with Good or High ecological status than for England overall.

Figure 14: Rivers in England: Reasons for Not Achieving Good Ecological Status by Sector and Activity



We are supportive of the overall direction of travel and level of ambition set out in the SODRP. This will build on the environmental ambition contained in our 2020-25 Business Plan, and the pledges highlighted above. The guidelines in the DWMP framework encourage us to publish a plan based on the best value intervention for each drainage catchment identified within the DWMP. This would identify the "sweet-spot" of investment for each catchment, delivering multiple benefits including a reduction in overflow spills, reducing the number of properties at risk of flooding, reducing pollution while bringing the societal benefits of more Catchment and Nature Based Solutions (C&NBS).

The SODRP targets are based on individual assets. To deliver on these targets most effectively, we have grouped them into drainage communities to provide efficiency and reduce the impact on customers. We have therefore produced a preferred plan where we have identified solutions that are technically viable including an assessment of the impact of stored flows on the receiving wastewater treatment works.

Drainage Area Name	NIDP Scheme	Unique_REF	Current SCOPE COST	Is Full Storage Viable?	Storage Only	Keep original scope, replace high expense with storage	Maximise smart network and remaining is storage	Bank SWR, maximise SWS, then remaining storage (must include any bg corridor originally costed)	Maximise smart network, bank SWR, and remaining SWS (must include any bg corridor originally costed)	Treatment of Storm Overflow Discharges (UV or NBS)	Total Proposed Options	Least Cost	Least Cost Value
Guisborough	No	Teesside_MARSKE STW_Marske STW_DC_06	£5,278,525	Yes	£3,227,752	Not Applicable	£3,534,602	£5,151,526	£4,678,502		5	Storage Only	£3,227,752
Marske	No	Teesside_MARSKE STW_Marske STW_DC_08	£104,389,254	Yes	£1,342,360	£5,070,388	£1,582,110	Not Applicable	Not Applicable		4	Storage Only	£1,342,360
Marske	No	Teesside_MARSKE STW_Marske STW_DC_09	£341,155,437	Yes	£9,720,036	£96,402,259	£7,295,415	£89,422,089	Not Applicable		5	Maximise smart network and remaining is storage	£7,295,415
Marske	No	Teesside_MARSKE STW_Marske STW_DC_10	£22,576,270	Yes	£3,012,886	£7,931,532	£3,135,538	Not Applicable	Not Applicable		4	Storage Only	£3,012,886
Marske	No	Teesside_MARSKE STW_Marske STW_DC_16	£258,301,260	No	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Yes	1	Current SCOPE COST	£258,301,260
Redcar	NIDP Scheme	Teesside_MARSKE STW_Marske STW_DC_02	£7,688,952	Yes	£1,477,941	£1,477,941	Not Applicable	Not Applicable	Not Applicable		3	Storage Only	£1,477,941
Redcar	NIDP Scheme	Teesside_MARSKE STW_Marske STW_DC_04	£53,768,333	No	Not Applicable	Not Applicable	Not Applicable	Not Applicable	£54,687,275	Yes	2	Current SCOPE COST	£53,768,333

However, achieving the SODRP maximum number of spills from each overflow does reduce the opportunities for more nature-based options as sometimes the space available is not sufficient to achieve the targets. This leads us to produce options that require more traditional storage solutions, utilising concrete tanks with pumping stations, rather than the green solutions our customers may prefer us to implement.

The SODRP also sets out other targets which water companies are expected to achieve:

- Year on year reductions in the amount of surface water that is connected to their combined sewer network. This is included in the DWMP by our approach to surface water separation and maintaining future long-term risk. This target will largely be achieved from 2028 onwards when interventions are completed. The NIDP will deliver some smaller reductions from 2025 but this is reliant on matched funding from other collaborative parties.

- Removal of rainwater from the combined sewer system as part of effectually draining water company areas. This should include limiting any new connections of surface water to the combined sewer network, and any new connections should be offset by disconnecting a greater volume of surface water elsewhere within the network. Our approach will achieve this target but Government enactment of Schedule 3 of the Flood and Water Management Act 2010.

- Prioritising a natural capital approach, considering carbon reduction and biodiversity net gain, as well as catchment level and nature-based solutions in planning. A natural capital approach has been prioritised in our hierarchy for all aspects of the DWMP including flood risk reduction and river water quality improvements.

- Traditional solutions to reduce discharges, such as increasing storage capacity, are carbon intensive. The costs and benefits of such interventions must be considered in decision-making. Solutions should be effective over the long-term and account for future pressures. Our DWMP follows a total expenditure cost benefit analysis approach to ensure the right opportunity is identified.

- Consider treatment of sewage discharges as an alternative solution where appropriate. We have identified locations where treatment is an alternative solution and we will progress these in collaboration with regulators and stakeholders.

- Rainwater should be treated as a resource to be valued for the benefit of people and the environment, not mixed with sewage or other contaminants. Our DWMP identifies many surface water opportunities in our preferred plan.

- Rainwater should be discharged back to the environment as close as possible to where it lands or channelled to a close watercourse without first mixing it with sewage. Our DWMP identifies many surface water opportunities in our preferred plan.

- Preventing additional rainwater from entering the combined sewer network and remove existing rainwater connections where it is the best value solution. Our hierarchy approach to option development includes source control and surface water separation options.

In addition, we are required to ensure all storm overflows have adequate screening controls. Part C of our DWMP sets out how we intend to deliver against these requirements.

Our DWMP L1 report lists all of the 1561 overflows in the region and highlights whether work is required, and if it is, the date it will be undertaken. This can be found at www.nwl.co.uk/DWMP.

PART B: DEVELOPING OUR DWMP

7.0 INTRODUCTION TO OUR DWMP

This section outlines our approach to producing our first Drainage and Wastewater Management Plan (DWMP). It also outlines our preferred plan. We will carry out further research on customer support for this plan as part of our engagement for our PR24 business plan for 2025-30.

The WaterUK DWMP framework was published in September 2018 and was developed in collaboration with Defra, Welsh Government, Ofwat, Environment Agency, Natural Resources Wales, Consumer Council for Water, ADEPT and Blueprint for Water. The DWMP framework was a key recommendation of the 21st Century Drainage Programme. The vision of the 21st Century Drainage Programme is to enable the UK water industry, working in partnership with others, to make plans for the future that will ensure the sustainability of our drainage infrastructure and the services it provides to customers and the environment. The DWMP Framework has built on existing approaches developed by the water industry, local authorities and other stakeholders. It aims to facilitate the development of planning processes that are flexible, transparent and aligned to the requirements of a wider group of stakeholders and the needs of the environment. Our DWMP will provide a basis for short, medium and long-term planning of drainage and wastewater services. As part of the production of the DWMP, we have worked with other organisations with an interest or responsibility for providing services related to drainage. For example, the Environment Agency (EA), Local Authorities, Lead Local Flood Authorities, rivers trusts and housing developers.

These plans are based upon guidance from Water UK and are being produced industry wide.

8.0 REQUIREMENT FOR A DWMP

The DWMP shows how Northumbrian Water will:

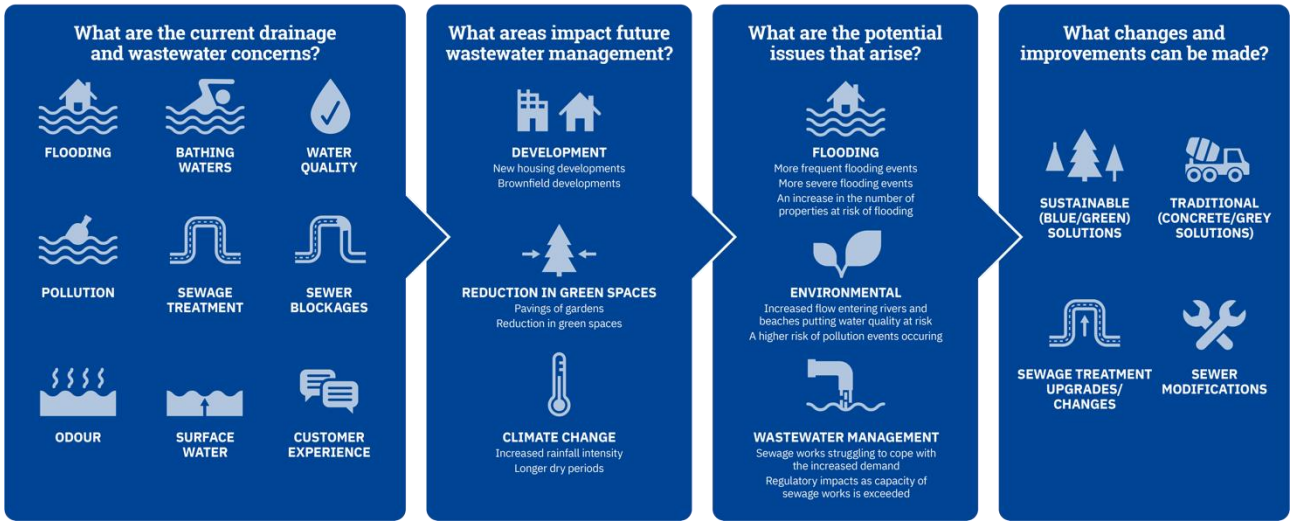
- Set out our assessment of long-term drainage and wastewater capacity and the drivers, risks and scenarios being planned for.
- Assess where (largely drainage) infrastructure managed by other stakeholders may impose additional risks to drainage and wastewater services.
- Identify those options that offer best value to customers and the environment, ensuring robust, resilient and sustainable drainage and wastewater services in the long-term. The benefits of our DWMP are:
    - To show how our long-term plans support economic growth and resilient communities, and how they protect and enhance the environment, providing greater environmental resilience and long-term sustainability.
    - To provide a systematic understanding of service and system risks and vulnerability.
    - To demonstrate a structured and auditable approach to identifying and developing options and presenting a robust best value investment plan.
    - To facilitate the integration of partnership working and co-creation of solutions to understand the related works of partners and deliver, where possible, integrated solutions that provide multiple benefits to achieve best value to the economy, society and the environment over the long-term.
    - To facilitate innovation (instigated by identifying future challenges that will need new approaches to address them) and the development of affordable, sustainable plans.
    - To provide a clear, transparent and consistent planning approach, with sufficient agility and adaptability to respond to long-term drivers for drainage and wastewater services
    - To promote informed debate about acceptability of different levels of risk.
    - To provide greater confidence to our customers, regulators and stakeholders in strategies identified, and resultant plans.
    - To provide the basis for effective engagement with our 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

9.0 OUR APPROACH TO THE DWMP

This DWMP has been produced following the guidance provided in the DWMP Framework and modified to meet the needs of the Storm Overflows Discharge Reduction Plan (SODRP).

The graphic below shows the general DWMP cycle.

Figure 15: DWMP cycle



The requirement for the DWMP to incorporate the SODRP meant that some of the stages needed modification.

The SODRP sets stringent new targets to reduce spills from SO's. This will require water companies to deliver the largest infrastructure programme in water company history.

Water companies will have to achieve targets set out in the plan:

- By 2035, water companies will have to improve all SO's discharging into or near every designated bathing water; and improve 75% of overflows discharging to high priority nature sites
- By 2050, this will apply to all remaining SO's covered by our targets, regardless of location

Overflows that are causing the most harm will be addressed first to make the biggest difference as quickly as possible, and water companies will be expected to consider nature-based solutions in their planning.

The stages of the DWMP that have been followed, together with key changes made to meet SODRP requirements, are summarised in the following table:

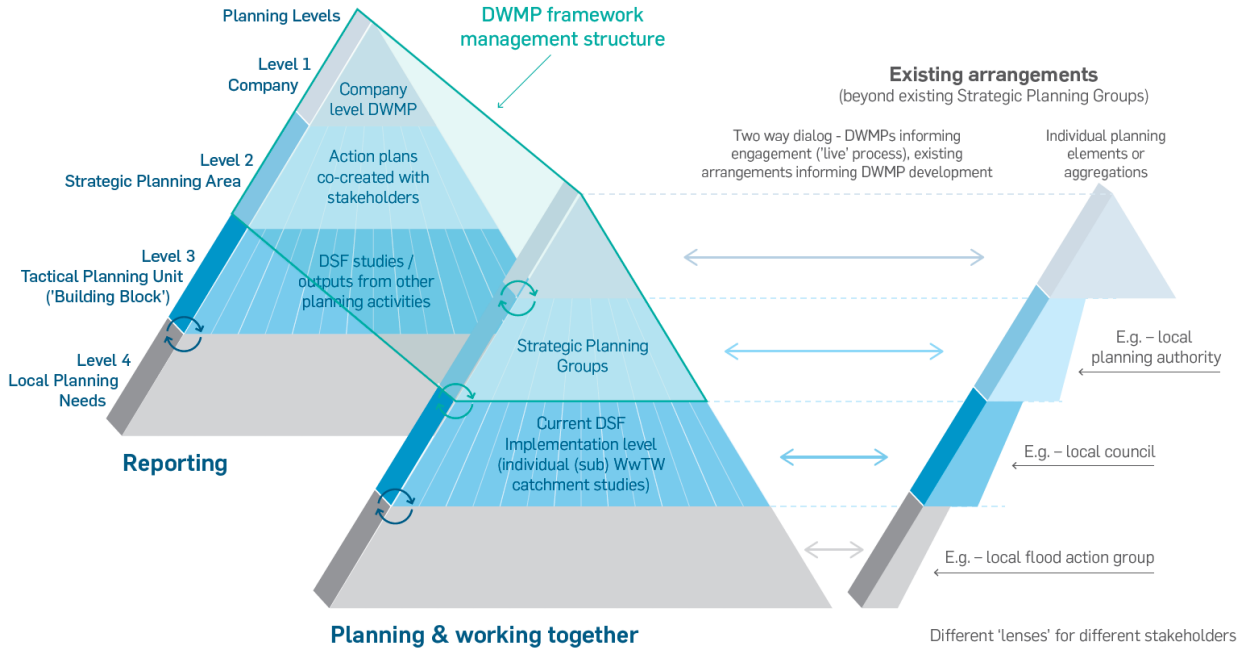
Stage	Framework Guidance	Key changes from framework to meet SODRP requirements
Strategic Context	The strategic context document outlines Northumbrian Water's intended approach to producing the DWMP.	The strategic context previously agreed with stakeholders has been largely superseded by the requirements of the SODRP.
Risk Based Catchment Screening	The Risk Based Catchment Screening (RBCS) process assesses catchments against a number of criteria in order to prioritise further investigation within catchments where there are likely to be risks that require options.	Following the SODRP, we have assessed all catchments that contain a SO, whereas previously in some locations these would have been screened out as not requiring assessment by the RBCS.
Baseline Risk and Vulnerability Assessment	The Baseline Risk and Vulnerability Assessment (BRAVA) uses hydraulic modelling to determine the existing performance of catchments and analyses the potential impacts of future pressures such as urban creep and climate change.	No change
Problem Characterisation	The Problem Characterisation process aims to identify the catchments that have higher levels of risk than others. The level of risk and potential benefit within a catchment will dictate the extent of option development that is required.	Identification of catchments where storm overflows are not meeting the SODRP criteria.
Option Development and Appraisal	The Option Development process aims to identify the list of generic options that are available within a catchment to address the problems that have been identified in the Problem Characterisation stage. Options Appraisal then aims to shortlist options based on set criteria to determine the most feasible options.	Options based upon reducing storm overflow spills with other benefits being subsidiary
Programme Appraisal	The Programme Appraisal process aims to identify the options that will be prioritised for delivery, as well as determining the timelines for delivery. The stage will take into account factors such as regulatory drivers and NWL's ambitious goals for performance.	Option prioritisation based upon catchments with the highest priority storm overflows to be addressed.
Strategic Environmental Assessment (SEA)	SEA provides an opportunity to consider ways by which the plan can contribute to improvements in environmental conditions; as well as a means of identifying and mitigating any potential adverse environmental effects that the plan might otherwise have. It informs the decision-making process through the identification and assessment of significant and cumulative effects a plan or programme may have on the environment. By doing so, it helps make sure that the proposals in the plan are the most appropriate given the reasonable alternatives. The SEA process is conducted at a strategic level and aids consultation on the potential effects of a plan with a wide range of stakeholders.	No Change
Draft DWMP	The draft DWMP was issued at the end of June 2022 and underwent a period of consultation and customer research.	n/a
Final DWMP	The final DWMP produced on 31 May 2023 forming part of the PR24 Business Plan.	Changed to accommodate DEFRA guidance

Planning areas

The DWMP has been prepared following the guidance provided in the DWMP Framework documents regarding the definition of planning areas. The approach we have taken to define planning areas at the different levels is outlined as follows.

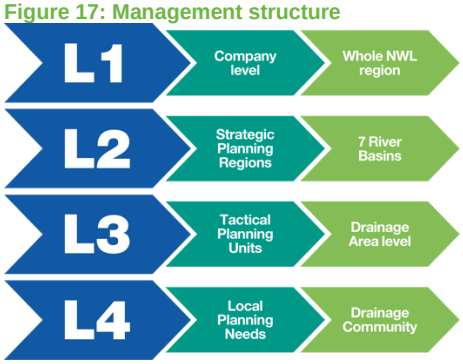
The figure below shows the DWMP framework management structure and the hierarchy of planning levels as outlined in the DWMP framework document.

Figure 16: DWMP framework management structure



The figure below shows how the management structure applies to Northumbrian Water.

Figure 17: Management structure



The approach taken by Northumbrian Water to define planning areas at the different levels is outlined as follows.

Level 1 DWMP Area

The Level 1 (L1) DWMP area is defined as our operating area in the North East of England.

Detailed analyses have been undertaken at a granular sub-catchment level of detail, which have then been brought together to create the Level 2 (L2) plans. The summation of the individual L2 plans is to be considered as the overall L1 DWMP.

Level 2 Strategic Planning Areas

The L2 strategic planning areas (SPA) have been defined through consultation with both internal and external stakeholders.

The DWMP Framework recommends that when defining the L2 SPAs, companies should endeavour to align these with River Basin District (RBD) management catchments. However, in our operating area, there are only two RBD management catchments (Northumbria and Solway Tweed). The spatial coverage of the RBD catchments is vast, which has required us to consider an alternative to the recommended approach.

We have defined seven L2 SPAs with boundaries that have an optimum combination of Northumbrian Water planning systems, Lead Local Authority (both Lead Local Flood Authority and Lead Local Planning Authority) boundaries and EA catchment areas, to facilitate engagement. The seven SPAs (as shown on the following plan) are:

- Northumberland
- Rural Tyne
- Tyneside
- Wearside
- Wear
- Teesdale
- Teesside

Overview of The L2 Strategic Planning Areas

Figure 18: L2 strategic planning areas

Level 3 Tactical Planning Units

The Level 3 (L3) tactical planning units (TPUs) were initially defined using Northumbrian Water's drainage areas, of which there are 478 in total. The majority of the drainage areas are sewerage catchments that are connected to a single WwTW. However, in some cases, there are multiple drainage areas connected to a single WwTW, e.g. the Tyneside system, which has 56 drainage areas all draining to Howdon WwTW. In these cases, individual drainage areas have been grouped together based on the WwTW to form the L3 TPU.

The Risk Based Catchment Screening (RBCS) process assesses catchments against a number of criteria in order to prioritise further investigation within catchments where there are likely to be risks that require options. Therefore, as part of this RBCS process, not all of the L3s were assessed as part of the BRAVA stage as described later in this document. However, following the publication of the SODRP, we have assessed all catchments that contain a SO, whereas previously in some locations these would have been screened out as not requiring assessment by the RBCS.

Level 4 Drainage Communities

Level 4 (L4) drainage communities have been defined within each L3 TPU.

The areas have been generated based on hydraulic connectivity of the sewerage network and are typically defined by hydraulic break points such as storm overflows (SOs), sewage pumping stations (SPSs) or WwTWs. The number of L4s within an L3 TPU varies depending on the size and nature of the sewerage catchment. Some L3s have a single L4 defined, whilst most have more than one and in some cases have more than 30 L4s.

The assessment of risk and potential benefit has been completed at a sub-L4 level of detail (i.e. asset level, property level), with risk and potential benefit accumulated at a 50m grid level covering the entire NWL region, as well as at the L4 level of detail.

Maps for the L3 drainage areas that include the L4 drainage communities can be found on the DWMP website www.nwl.co.uk/dwmp

10.0 COLLABORATION

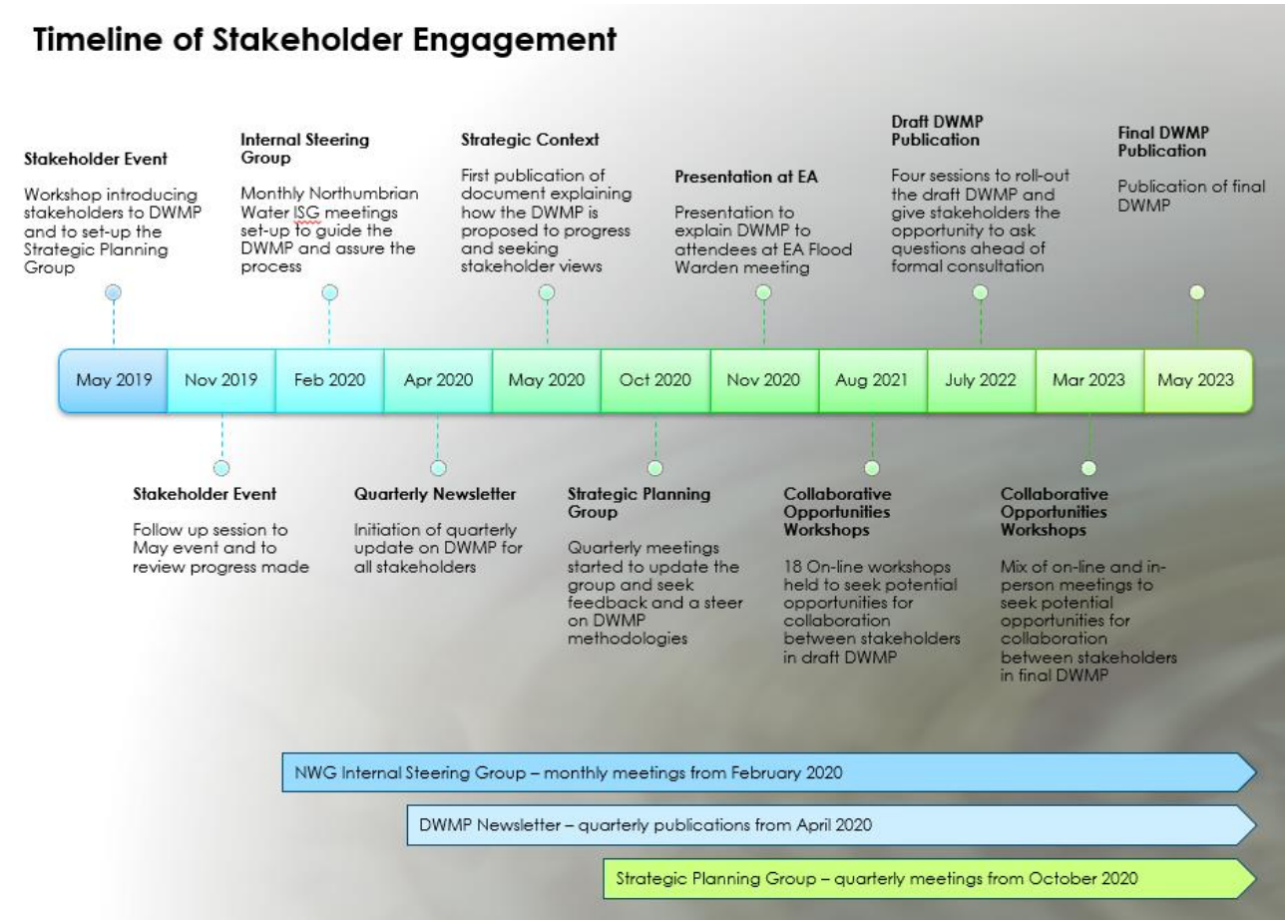
10.1 STAKEHOLDER ENGAGEMENT

It is widely recognised and acknowledged that drainage systems are complex and have numerous interactions, both known and unknown. It was therefore important that the DWMP was not created solely by Northumbrian Water. While we have been tasked with the delivery of the DWMP, it was critical that relevant stakeholders actively participated and offered support in its creation.

We have worked with a range of relevant stakeholders in the production of the DWMP, including the EA, Lead Local Flood Authorities, Local Planning Authorities, developers and environmental partners. A comprehensive list of the stakeholders we have engaged with as part of our DMWP can be found in the Acknowledgement section at the end of this DWMP. This has helped to shape certain aspects of our plan, in particular the development of interventions for Water Framework Directive, Nutrient Neutrality, and NIDP programmes of work.

Through different partnerships and strategies, we play an active role within the region, working collaboratively with stakeholders on a number of projects. The DWMP builds on the strong foundation of the Northumbria Integrated Drainage Partnership (NIDP), which consists of 14 Lead Local Flood Authorities, the EA and Northumbrian Water, and has been recognised as an example of leading practice. One of the key aims of the NIDP is to identify opportunities to deliver surface water management schemes within catchments to reduce the risk and impact of flooding. Catchments are taken from the investigation stages where opportunity areas are identified, through to the outline business case stage to determine funding sources. The award-winning partnership approach, which is based around collaboration to identify priority investment areas where benefits can be delivered for multiple stakeholders, provides an excellent platform for the DWMP.

A timeline summary of our stakeholder engagement is set out below:



In the first year of the DWMP process we held two initial **events** inviting both internal and external stakeholders. The first event was designed to introduce people the DWMP framework and describe the stages. The second event brought people up to date with progress and explained the proposed next steps. External attendees at these events were drawn from the NIDP.

Early in 2020 an **Internal Steering Group** (ISG) was formed. The group comprised senior managers from around the Northumbrian Water waste water sector and was put in place to provide guidance, governance and assurance to the core DWMP team activities. Meetings between the core team and ISG were held monthly throughout the DWMP process.

In Spring 2020, at the start of the coronavirus pandemic, we decided to publish a DWMP **newsletter** to our ever-growing list of stakeholders. The newsletter was a simple one-page update to keep people aware and informed regarding the DWMP. We asked for feedback on the first newsletter and whether people found it worthwhile or if they would like to see any changes to the format. Following the feedback we settled on quarterly intervals between newsletters. These continued beyond issue of the draft DWMP and a last one was sent out following issue of the final DWMP. The newsletter was also used to seek volunteers for the Strategic Planning Group.

The **Strategic Context Document** was sent out for consultation in May 2020. The purpose of the document was to set out our intended approach to the DWMP and gather stakeholders' feedback and suggestions to the approach. The feedback was compiled and a response document was issued.

In October 2020 we held the first of our single stakeholder **strategic planning group** (SPG) meetings. The single SPG covers all of the seven SPAs. The decision was taken, in line with the DWMP Framework recommendation, to create a single SPG to drive consistency and also to optimise the engagement process.

The SPG includes representatives from the following organisations:

- Northumbrian Water
- Environment Agency
- Northumbria Integrated Drainage Partnership
- Northumbria Regional Flood and Coastal Committee
- Consumer Council for Water
- National Farmers Union
- Royal Town Planning Institute
- The Rivers Trust

The group has met at least quarterly. These meetings have produced recommendations on the approach we have taken in compiling the DWMP, which have helped to shape the plan.

The SPG Terms of Reference, list of representatives, meeting records and presentation can be found in the Technical Report area of the DWMP website www.nwl.co.uk/dwmp

We can confirm that we have acted within the spirit and guidance of the DWMP framework. The SPG has carried out the duties under Section 3 of the DWMP framework, including:

- Enabled third party participation in the development of the DWMP
- Provided a focal point where potential risks are exposed and shared
- Facilitated external stakeholder engagement and promoted partnership working

- Provided challenge and oversight when appropriate

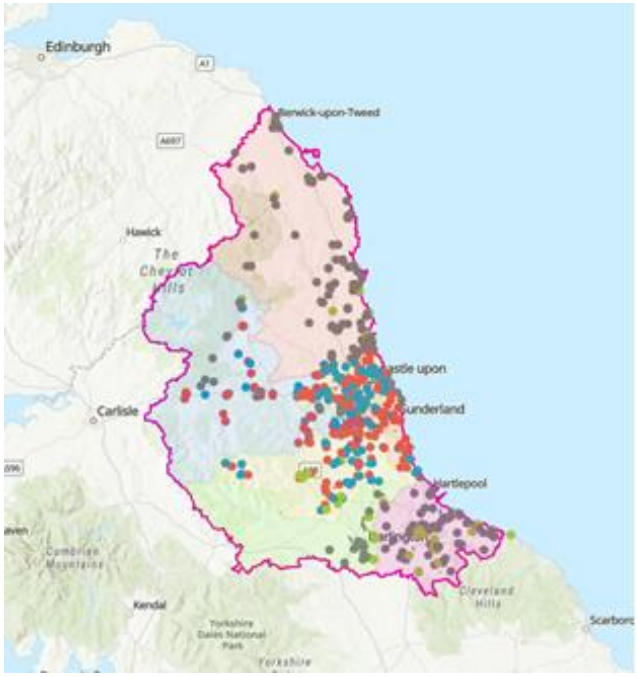
We have discussed an ongoing role for the SPG in monitoring delivery of the DWMP and future updates.

To ensure that existing and future opportunities for **working collaboratively with stakeholders** were included in the production of the draft DWMP, 18 engagement sessions were held in August and September 2021. The SPG gave guidance on groups to engage with. A selection of the stakeholders we engaged with are shown below:

During these sessions, all the geographical areas covered by the draft DWMP were reviewed to identify, record and map ongoing and future opportunities. More than 700 opportunities were captured with information on the owner, timescale, and further details. We then categorised these opportunities as 'Impact', 'Inform' or 'Record', depending on how they matched our identified risks. A description of these classifications is below:

Classification	Description
Impact	Opportunity that falls within a known risk area covered in the DWMP
Inform	Opportunity that falls outside of a known risk area but may be included in future cycles of the DWMP
Record	Opportunity falls outside of an area where NWL has assets but is useful to record for other third- party stakeholders.

The following image shows the 700+ opportunities that were recorded during these sessions.



In March 2023 we met again with 18 of the organisations and **discussed the opportunities** specifically relating to AMP 8 areas. The summary of these discussions can be found in reports and drawings located on our website at www.nwl.co.uk/dwmp.

It is worth noting that opportunities and potential to collaborate are in a range of forms (not necessarily monetary) such as offers of help to liaise with landowners and offers of land.

Customer Engagement

From the launch of the DWMP in 2019, we have actively sought customers' views on what the DWMP should include and the types of solutions we should investigate.

This approach has ensured that our DWMP meets customers' expectations and is easy for them to understand and provide feedback on.

During production of the draft DWMP, we published quarterly newsletters.

In Autumn 2020, we engaged with customers through a series of interactive activities in relation to the DWMP. The results from this research have helped shape the plan. The four broad goals that we wanted to achieve through this research were to:

- Understand what customers want the plan to aim for, and which aims are most important to them
- Understand how customers would prefer us to improve wastewater services
- Understand how customers would like us to go about prioritising the DWMP
- Understand how customers think they should be involved in developing the DWMP

The research was conducted online where current and future bill payers passed through two phases:

Phase 1

An introduction and education stage which informed participants about DWMPs, and collected their views.

Phase 2

Group discussions where participants came together in small online deliberative workshops. Customers were exposed to competing points of view, allowing their own view to evolve based on the experiences of others. Additionally, in-depth telephone calls were held with some customers. This approach ensured that the opinions of both those living with conditions that make them vulnerable, and those who could not access the internet, could be included in the research.

By the end of the investigation, it was possible to arrive at an understanding of what views our wider customer base hold when they are informed about the DWMP.

Later in 2020, we carried out further customer focus group sessions to gain views on what our DWMP webpage should look like and include.

In 2022, before and after the publication of our draft DWMP, we held a number of focus group sessions to understanding what customers were happy to see presented in our final DWMP.

How customer feedback has shaped our DMWP

Following publication of the draft DWMP (dDWMP) we consulted with NWL customers to understand their views on our draft proposals. This strand of work ensured that we employed multiple forms of engagement and therefore included as wide a range of customers in the consultation as possible. Qualitative work also enabled 'in-person' explanation of the potentially complex dDWMP documents. In order for this research to be independent, we commissioned our partners, Explain to undertake the work.

The aim of the research was to understand customers' views on the customer summary dDWMP. Specifically, we sought to understand:

- Participants' views on the clarity of the customer summary in the dDWMP. In particular, we sought understanding of whether the customer summary of the dDWMP achieved the following:
    - Provides confidence that existing service levels to current and future customers will be maintained in the face of increasing population; economic growth; climate change; tightening environmental standards; and rising expectations of customers; Clear indication of the improvements required where the service levels are not currently good enough;
    - Clear description of the risks that remain to long-term resilience for customers and if these are acceptable to customers, as far as possible;
    - Explanation of the potential risks that can be created by customers, such as the impact of the incorrect disposal of single-use items.
- Participants' preferences regarding the four options presented in the customer summary dDWMP. The reasons underpinning these preferences was also understood. Emphasis was placed on understanding the following:
    - Which option offers best value;
    - Which option is considered the most affordable;
    - Which option is the most acceptable in terms of their priorities;
    - Which option is the most acceptable in terms of appetite for risk.

Participants were asked questions relating to the clarity of wording, ease of understanding, relevance of information and thoughts on the presentation of the information in both the background and four options sections, as well as their understanding of differences and similarities between the options. A multi-strand qualitative approach to the methodology was taken to seek to achieve the objectives of the research, consisting of the following:

- Deliberative on-line workshops with NWG customers
- Face-to-face focus groups in communities with high rates of digital exclusion. Digital exclusion was defined as having never used the internet, having used the internet but not having regular access to it or, having to ask a friend/family member to help them access the internet. Participants were invited if they said that they met one of the criteria of being digitally excluded. Despite this, some digitally capable customers did attend. - Telephone interviews with customers that had experience of a wastewater failure- Telephone interviews with non-household customers.

Participants who took part stated that options that included Least Cost and NIDP were the ones they could afford, considering their current financial situations. However, they preferred options that represented Best Value and included Green infrastructure and wished these were more affordable.

Customers clearly support using natural solutions, working with others (i.e. NIDP), and reducing internal flooding. They were concerned about overall cost and affordability. In response, we have scaled back our original ambition on sewer flooding but have retained NIDP and included some additional nature-based solutions where these were not too expensive compared to concrete tanks. We've also done a lot of work to reduce the cost of the plan in other areas using innovative solutions such as catchment and nature based solutions for Water Framework Directive, Nutrient Neutrality and SODRP.

In our Business Planning PR24 pre-acceptability research carried out in February 2023, we asked customers about their priorities and views on timing for the storm overflows programme – including delaying some of the work and risking not meeting our statutory obligations. We explained the benefits and risks of different options, and the impact this would have on bills.

We had mixed feedback from customers, with some considering it important to invest now and others concerned about affordability. Customers agreed that we should prioritise areas of higher risk, and the majority of customers thought we should invest part now, and part later. As a consequence of this research, we developed additional phasing options for customers and have proposed two alternatives in our ongoing affordability and acceptability testing – both of which would deliver the 2035 statutory obligations but with an option to push more of the investment back to 2030-35. Our DWMP reflects our "preferred plan" in this ongoing research.

For more information on how we have engaged with customers, refer to our Business Plan for 2025-2030:

Business Plan 2025-30 (nwg.co.uk)

10.2 INTEGRATING OUR DWMP WITH OTHER PLANS

Our DWMP has wherever possible aligned with significant programmes and plans undertaken by others. These are identified below.

Flood Risk Management Plans

Many of the areas included in the EA's Flood Risk Management Plans (FRMPs) are focused on areas already identified in the NIDP and are therefore included in our DWMP programme to help reduce flood risk.

However, during the consultation process for the FRMP we questioned why other areas in the North East had not been identified as significant flood risk areas and committed that we would be keen to work with the EA and other risk

management authorities to evaluate the trigger criteria so we can help capture any gaps in future flood risk and partnership opportunities.

Our final DWMP and the future opportunities we have identified with stakeholders provide a great platform to further align activities over the long term.

Alignment of our DWMP with the NIDP and the FRMP is something that our stakeholders and customers encouraged us to do from our draft consultation. One LLFA commented that "they *support the collaborative working of Northumbria Integrated Drainage Partnership and catchment partnerships: recognising the benefits of flood alleviation and environmental schemes for our residents, businesses and wildlife".*

National Infrastructure Commission – Reducing the risk of surface water flooding

The National Infrastructure Commission's report 'Reducing the risk of surface water flooding' highlighted the importance of a national approach to tackle flooding, and the costs and challenges of eliminating sewer flooding. Given this, and the greater insight we have gained from developing our DWMP, we have adjusted our ambition for our draft long-term delivery strategy to what we consider a stretching but achievable level that would be economically beneficial to deliver.

Our long-term targets, which are now included in our final DWMP include:

- Reducing internal sewer flooding by 60% by 2050.
- Reducing external sewer flooding by 60% by 2050.

Flood and Coastal Erosion Management (FCERM)

The EA's FCERM National Strategy sets out 3 core ambitions:

- Climate resilient places.
- Today's growth and infrastructure resilient in tomorrow's climate.
- A national ready to respond and adapt to flooding and coastal change.

As well as the partnership opportunities we have aligned within our DWMP, particularly around the NIDP, we continue to deliver good practice in line with WISER which is built into our policies and into the development of the DWMP.

Examples of this are:

- Valuing and promoting green infrastructure that brings societal benefits in the DWMP
- Stakeholder management and opportunity mapping for DWMP
- Embracing innovative solutions and approaches
- DWMP uses GIS tools to screen early-stage blue/green corridors and other green
- infrastructure
- A catchment approach to optioneering including input from other stakeholders
- including EA, Lead Local Flood Authorities and National Farming Union.

We work with others to meet the core ambitions of the FCERM through the DWMP. NIDP projects and the DWMP are both collaborative plans that take account for projected climate change and growth models. Both promote green

infrastructure to maximise environmental benefits and reduce reliance on traditional grey infrastructure which in turn positively impacts on carbon.

We have also been strong participants in the national DWMP steering group which meets quarterly and includes OFWAT, EA, water and sewerage companies (WASCs) and other national stakeholders such as ADEPT and Blueprint for Water. We are also a core member of the DWMP Implementation Group, where WASCs share their best practice and challenge points with respect to delivering the DWMP. We work together to provide consistency and transparency.

This has also yielded several Task and Finish Groups looking at specific parts – for example National Planning Objects and option development and appraisal. Northumbrian Water has helped chair some of these groups, including BRAVA (common planning objectives) and Cycle 1 to Cycle 2 working group A (risk assessments).

NWL also actively participate in formal and informal benchmarking activities and are a member of several best practice working groups. This includes the Surface Water Management Group, Sewerage Infrastructure Network Group and Sewerage Network Abuse Partnership. Recent examples of sharing and learning include companies approaches for hydraulic flooding and customer campaigns with respect to network protection and these have help us develop of DWMP narrative and options.

The work we are also doing on wider resilience and specifically climate resilience affecting our asset base is a core element to our alignment with the FCERM strategy. This is discussed further in our Resilience section in this report.

River Basin Management Plan

We have actively engaged with a range of partners to promote investment principles in line with the River Basin Management Plan, working with others to deliver multiple benefits not possible by working alone.

We play a leading role in the Catchment Based Approach (CaBA), at catchment level through the Catchment Partnerships, particularly within the North East region, and at national level, representing water companies on the CaBA National Support Group and CaBA Urban Water Group and we have used these groups to help shape and inform our DWMP.

Flood and Coastal Innovation Programme

In the North East region, five projects were successful in being included in Defra's Flood and Coastal Innovation Programme. This is excellent news for the region. The successful projects are:

- Durham County Council: Community sustainable drainage systems (SuDS) innovation accelerator
- Northumberland County Council: Empowering rural communities through smart technology - next generation flood resilience
- South Tyneside Council: Stronger Shores - Marine habitats protecting coastal communities
- Stockton-on-Tees Borough Council: Tees tidelands
- Gateshead Council: Northumbria groundwater flooding

Presently we are on the steering groups for both:

- Durham County Council SuDS+
- Gateshead Council Northumbria groundwater flooding

We will continue to participate in these projects and look forward to contributing to their successful conclusion. In addition, we will seek involvement in the remaining, and any future projects, if our input is required.

11.0 HOW WE HAVE DEVELOPED OUR DWMP

11.1 STRATEGIC CONTEXT

Approach to strategic context

A Strategic Context Report "Planning the Outcomes that can be achieved by working together" was produced to set out our approach to the DWMP. The document was prepared to:

- Outline Northumbrian Water's vision for the first DWMP for the North East of England
- Raise stakeholders' awareness and of the objectives and anticipated outcomes of the DWMP
- Identify the key drivers that will be considered that will challenge drainage and wastewater systems in the future
- Identify a set of planning objectives to enable co-understanding and co-creation of best-value solutions to manage risk
- Outline the planning tools that will be utilised to produce the DWMP.

Following a period of stakeholder consultation in early 2020, we gathered responses to help shape the direction of the DWMP. The final version of the Strategic Context Report was published in May 2020.

The Strategic Context Report and Strategic Context Document Responses report can be found in the "Setting the Context" area on the DWMP website. www.nwl.co.uk/dwmp

11.2 RISK BASED CATCHMENT SCREENING

Approach to Risk Based Catchment Screening (RBCS)

Risk based catchment screening (RBCS) was carried out on all catchments within the Northumbrian Water operating area.

For the purposes of RBCS, a catchment was defined as an individual Northumbrian Water drainage area. Within our operating area, there are a total of 478 drainage areas currently defined that went through the RBCS process. (As described above, some these areas are combined to form L3 TPUs.)

The outcome of the RBCS phase is to identify which drainage areas are potentially susceptible to future pressures and where further stress-testing is required as part of the Baseline Risk and Vulnerability Assessment (BRAVA) stage of the DWMP process.

Screening criteria

Appendix B[2] of the DWMP Framework outlines the mandatory screening indicators to be used in the RBCS phase. A total of 17 screening indicators are outlined in the DWMP Framework. These include:

- Catchment Characterisation (Tier 2)

[2] https://www.water.org.uk/wp-content/uploads/2020/01/Water_UK_DWMP_Framework_Appendices_September-2019-B.pdf

- Bathing or Shellfish Waters
- Discharge to Sensitive Waters (Part A)
- Discharge to Sensitive Receiving (Part B) (Tier 2)
- Storm Overflow Assessment Framework (SOAF)
- Capacity Assessment Framework (CAF)
- Internal Sewer Flooding
- External Sewer Flooding
- Pollution Incidents
- WwTW Quality Compliance
- WwTW Dry Weather Flow Compliance
- Storm Overflows
- Other Risk Management Authority Systems
- Planned Residential Development
- Water Industry National Environment Programme (WINEP)
- Sewer Collapses
- Sewer Blockages

We included three further indicators, which looked at:

- Customer complaints
- SPS capacity
- Odour

Screening indicators were classified into two tiers, which provided a mechanism to differentiate between the priority of each indicator. When determining whether further assessment of a drainage area is required (progression to BRAVA), the following aggregate scoring was considered:

- If two or more indicators are breached (excluding sewer collapses and blockages), then a BRAVA is required
- If one Tier One indicator is breached (excluding sewer collapses and blockages), then a BRAVA is required

Following the completion of the initial RBCS stage, a total of 332 out of 478 drainage areas were found to breach one or more of the above criteria, requiring a BRAVA to be undertaken.

As a result of the SODRP, we have assessed all catchments that contain a SO, whereas previously in some locations these would have been screened out as not requiring assessment by the RBCS.

In order to further prioritise investigations, we added further screening criteria to ensure that the highest priority catchments were promoted for BRAVA, whilst ensuring that the process was not watered down.

The following criteria were considered as high priority and any drainage areas that breached the screening criteria were promoted for BRAVA:

- Bathing or Shellfish Waters
- Discharge to Sensitive Waters (Part A)
- Storm Overflow Assessment Framework (SOAF)
- Internal Sewer Flooding
- External Sewer Flooding
- WwTW Effluent Quality Compliance
- WwTW Dry Weather Flow (DWF) Compliance
- Storm Overflows
- Planned residential development

Following the application of the additional screening criteria, a total of 257 drainage areas out of 478 were promoted for BRAVA. The drainage areas promoted for BRAVA represented almost 99% of the total population served by NWL and formed a total of 138 L3 TPUs.

The RBCS process can be found in the “DWMP Methodologies” area of the DWMP website www.nwl.co.uk/dwmp.

11.3 BRAVA

Approach to Baseline Risk and Vulnerability Assessment (BRAVA)

Where an L3 drainage area has been identified as triggering further investigation following the RBCS stage, the current and future performance of the planning area has been assessed as part of the BRAVA stage.

Following the publication of the SODRP, we extended our investigations and modelling to include all drainage areas that include a SO that does not meet the SODRP targets. This extended the number of models produced and is against the ethos of identifying baseline risks and vulnerabilities.

Overview of Modelling Approach

To undertake BRAVA, sewer network models of the L3 TPUs were utilised. In instances where an existing sewer network model was not available, a new model was created for use in the assessment. All models were updated to ensure they were compliant with NWL’s internal wastewater modelling specification.

The detail of the approach that has been followed for sewer network model updates and simulation parameters can be found in the “DWMP Methodologies” area of the DWMP website.

DWMP hydraulic models are based on clean systems. In 2022 we carried out an assessment to try to quantify the impact of non-clean drainage systems on storm overflow spills. 10% and 20% silt was added to the pipes for all of the drainage area models containing high priority overflows to be addressed in the period 2025-2030. On average 10% silt increased spills by 3.8% and 20% silt increased spills by 10%. The assessment demonstrates that the clean hydraulic models show the best achievable spill frequency. There would be no reduction in modelled spills from increased maintenance activities.

The results also show that spills from some individual assets can remain the same or decrease. This indicates asset specific vulnerability and implies that a cleaner network does not always drive lower spills.

Planning Horizons

The BRAVA analysis has been completed for five planning horizons, as outlined in the following table.

BRAVA Planning Horizons

Planning Horizon	Year	Overview
Baseline	2020	Base year of assessment.
5 year planning time frame	2025	Updated for projected growth, urban creep and infiltration over a five-year time frame.
10 year planning time frame	2030	Updated for projected growth, urban creep and infiltration over a ten-year time frame.
25 year planning time frame	2045	Updated for projected growth, urban creep and infiltration over a 25-year time frame.
40 year planning time frame	2060	Updated for projected growth (calculated rate of increase), urban creep and infiltration over a 40-year time frame.

Addressing challenges

The BRAVA analysis uses the environmental factors in the framework to assess the future challenges facing our wastewater systems for each of the planning horizons outlined above. These factors are:

- Climate change.
- Population Growth.
- Urban creep.

In addition, we have used the business planning methodology for the period 2025-2030, to understand the likely additional factors around the following two areas:

- Protecting the environment
- New technology

How we are planning to deal with climate change

Following the publication of UKCIP18 in November 2021, we have created new rainfall models to ensure that our results are up to date. Using UKCIP18 models has changed the results for many drainage areas.

The sewer network models have been simulated with design rainfall and time series rainfall (TSR), all of which were produced specifically for use in the development of the DWMP.

Design rainfall events are individual area specific model generated events that represent rainfall for a particular return period. The rainfall depth, duration and intensity characteristics are based on historical rainfall records for the specific location. For the DWMP, we have used a return period of 1 in 20 years to predict locations of hydraulic sewer flooding risk.

Time series rainfall (TSR) are multi-year rainfall series that represent the typical rainfall patterns for a location over a defined time period. They are created using location specific historic records (e.g. EA rain gauge records) and allow hydraulic models to be simulated with longer rainfall events, often spanning up to ten years and in some cases longer, to understand performance of the network over a longer time period.

For the DWMP, a three-year TSR has been used to analyse modelled storm overflow performance.

A total of 19 TSR series covering the period of 2010 to 2020 (11 years of rainfall data) were generated to ensure there was sufficient coverage of the regional variations in rainfall patterns caused by location and topography.

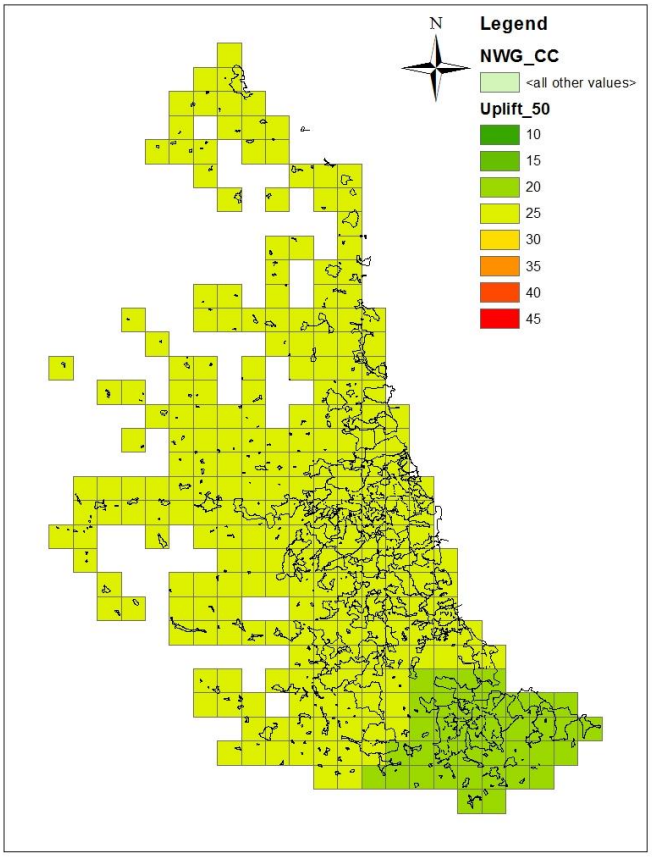
Impact of Climate Change on Sewer Networks

The 25-year (2045) and 40-year (2060) planning horizon models were simulated with rainfall events that have been modified to represent the potential impact of climate change on rainfall.

Design Rainfall Events

In line with the DWMP framework, design rainfall events have been uplifted to represent the potential impact of climate change on peak rainfall intensities.

Figure 19: 2050 FUTURE DRAINAGE Uplifts for NWL Region (30-year return period – 60 minute storm duration)



The uplifts applied are summarised in the following table.

L2	2045 Lower Estimate	2045 Central Estimate	2045 Higher Estimate	2060 Lower Estimate	2060 Central Estimate	2060 Higher Estimate
Northumberland	11	18	30	12	20	34
Rural Tyne	11	18	30	13	21	34
Tyneside	10	16	30	11	19	34
Wearside	10	16	30	11	19	34
Wear	10	16	29	11	19	33
Teesdale	10	17	29	12	20	33
Teesside	9	15	30	10	17	34

Note – climate change uplifts are not applied in the 2020, 2025 and 2030 design horizons as specified in the DWMP framework.

Time series rainfall

For use in the 2045 and 2060 planning horizons, a 2050 and 2080 version of the 19 TSR datasets has been generated which has been updated for the impacts of climate change using the UK Water Industry Research (UKWIR) climate perturbation tool, 'RedUP V3'. The draft DWMP, used the previous version of RedUP as at that time version 3 had not been published. RedUP V3 varies significantly in some drainage areas as they predict an increase in spill frequency for future planning horizons which was not the case when using RedUP v2.

Moving to the latest available rainfall generating software and climate change models ensures that the risks and opportunities identified in the DWMP are as robust as possible.

Further detail regarding the methodology followed for the creation and modification of rainfall used in the DWMP can be found in the BRAVA Methodology located in the "DWMP Methodologies" area of the DWMP website.

Impact of change in sea level

There is a single regional allowance for each time frame for sea level rise. This has been included in our modelling exercise and more information can be found in the BRAVA methodology on our DWMP website at www.nwl.co.uk/DWMP

Impact of Climate Change on Wastewater Treatment Works and Sewage Pumping Stations

In 2018, we created our resilience framework to consider threats and how we might address them across the whole business, encompassing corporate, financial, and operational resilience. To ensure our resilience framework remains fit for purpose into the future, ARUP supported a comprehensive review of that framework. Our Long-Term Delivery Strategy (LTDS) also considers these long-term risks to resilience.

We know how to address some of these risks now, and our short-term investment will be focused on "no regrets" investments – repairing and replacing the poorest condition assets at water and wastewater treatment works and service reservoirs and protecting equipment from flooding and power failures in storms. These investments tackle issues now that are well understood, and that have an immediate impact on risk and service for customers. Our core pathway in the LTDS is to maintain current levels of service, against increasing levels of risk.

The costs of maintaining the current level of service will vary greatly, depending mostly on climate change and technology. We also need to prepare for the future, investing in asset intelligence and testing as well as working with others across the sector to better understand and measure asset health and the impacts of extreme heat on our systems.

Investments in innovation now, along with increased partnership working to find "whole system" solutions to these problems, are likely to help to reduce future costs by finding alternative approaches.

Asset intelligence and innovation are critical now, along with the sector working together to recognise and tackle this problem. Our plan therefore contains targeted investment in these areas to better address future resilience risks.

Our existing “Too Critical to Fail” programme is designed to reduce the severity of various low probability high impact incidents. These include failures are particular wastewater treatment works and pumping stations due to flooding and exceptional storms.

In the period up to 2025, we are committed to deliver investment that increases its wastewater resilience by reducing the flooding risk to 141 WwTWs and SPSs to protect against severe events such as Storm Arwen.

We are producing our future resilience plan for wastewater for the period 2025-2030 and these will be included in our draft business plan. Presently, the plan is based around the disruption caused by climate change affecting weather patterns resulting in more frequent and higher intensity storms and rainfall. This includes winter storms with associated high winds, which occurred during storms Desmond and Arwen and these will be more frequent and intense in the future, increasing the risk of damage to the power network, affecting the power to our sites.

The options we are developing are categorised according to the 4Rs of resilience which is linked to vulnerability assessments we have undertaken on our assets. These are:

- Resistance – prevent damage or disruption by providing assets to resist the hazard.
- Reliability – assets designed to operate under a range of conditions include severe weather.
- Redundancy- Duplicate or provide backup facilities to ensure continuity of service examples include dual supply.
- Response and recovery – Fast effective response to recovery from disruptive events examples include generator sockets to rapidly install mobile generators

For wastewater our assessment takes into account:

- The consequence (flooding): duration of permit failure or pollution incident (banded) and population equivalent
- The consequence (power failure): duration of flooding or permit failure or pollution incident (banded) and population equivalent
- The likelihood (flooding): the number of times the site has flooded historically and the likelihood that flooding will occur in the future, based on the flood risk assessment
- The vulnerability (flooding): The proportion of the site that is likely to flood (not all sites have assets which are of the site to flooding in terms of proportion of the site functionality that would be diminished due to flood as assets are set a different heights)
- The likelihood (power): the number of times the site has lost power historically due to factors outside of our control and whether that lead to an impact. The likelihood that power outages will occur in the future based.
- The vulnerability (power): the proportion of the site functionality that would be diminished due to power outage.

We are working with stakeholders to align our resilience activities to maximise the benefits that can be achieved.

How we are preparing for an population increase (growth)

Growth data was provided by the region's local authorities. For each L3 TPU, the following information was provided;

- Detail of residential and non-residential developments, including phasing, for inclusion in the hydraulic models for the baseline and each of the planning horizons up to the 25-year (2045) planning horizon;
- Processed Local Authority Strategic Housing Land Availability Assessments (SHLAA) information showing the location and scale of potential development sites.

For the 2060 planning horizon, we have used the values used in the water resource management plan. This uses data provided by Edge Analytics and allows a consistent approach to future planning. Edge Analytic data has also been used to assess the impact of growth on WwTW Dry Weather Flow compliance.

The 40-year (2060) planning horizon is beyond the available data for projected development sites. An approach that is consistent with Water Resources Management Plan (WRMP) population growth estimates was followed to define the anticipated population in the 2060 planning horizon model for each L3 TPU. This involved calculating a rate of increase value for each L3 TPU and uplifting the 2045 planning horizon population by that value.

Further detail regarding the methodology followed for the application of residential and non-residential growth in the planning horizon sewer network models can be found in the BRAVA Methodology document located in the "DWMP Methodologies" area of the DWMP website. www.nwl.co.uk/dwmp

How we are planning to deal with Urban Creep

Urban creep is the loss of permeable areas creating increased runoff during rainfall events, which has the potential to increase the loading on a sewer network during rainfall events and can contribute to flooding issues. Water industry research3 concluded that whilst urban creep values vary with drainage system type, development type and density, it typically applies to all residential areas where property boundaries allow for extensions or other additional impermeable surfaces (e.g. paving of gardens).

Urban creep was applied to all of the planning horizon sewer network models;

- 2025 (five-year projection from baseline)
- 2030 (ten-year projection from baseline)
- 2045 (25-year projection from baseline)
- 2060 (40-year projection from baseline)

Further detail regarding the methodology followed for the application of urban creep in the planning horizon sewer network models can be found in the BRAVA Methodology document located in the "DWMP Methodologies" area of the DWMP website. www.nwl.co.uk/dwmp

How we are protecting The Water Environment

The UK government has stated that "if the water sector continues to operate as usual, by 2050 some of our rivers could have up to 80% less water in summer, and it will not be possible to meet the growing demands of people, industry, and agriculture. There will be even greater pressure on the quality of rivers, lakes, estuaries, and wetlands from pollution. At the same time people's expectations of their local environment have increased, for example, more people want to swim outdoors or spend time near a local river".

3 "The Impact of Urban Creep on Sewerage Systems", UKWIR

The DWMP Strategic Context highlighted a number of Planning Objectives that link to the water environment. These are explained further in the section below.

In addition, The Water Industry National Environmental Programme (WINEP) sets out actions that water companies need to take to meet statutory environmental obligations. The companies WINEP covers many aspects of the drainage and wastewater system and is outlined below

Programme	Scope
Storm overflows	Meeting targets of the Storm Overflow Discharge Reduction Plan
Urban Wastewater Treatment Directive (UWWTD)	Flow monitoring, Septic tanks, phosphorus removal
Water Framework Directive (WFD) Phos and chemicals	Phosphorus removal and chemicals
Environment Act Continuous Monitoring	Monitoring the quality of water upstream and downstream of assets
25 year Environment Plan, River bathing water	Addressing Blue spaces, NIDP and catchment project Needs, pledges to have at least 1 river bathing water.
Nitrogen Technical Achievable Limits (N TAL)	Addressing nutrient neutrality
Shellfish and bathing water investigations	Addressing European Sites / Sites of Special Scientific Interest (SSSI), nitrogen technically achievable limit, shellfish waters and bathing waters
Habitats directive & Marine Conservation Zones (MCZ)	Investigations in marine areas

In October 2022, Ofwat wrote to all company CEOs providing consultation feedback on the draft DWMPs. This letter outlined a new requirement for DWMPs to provide a robust evidence base for water companies' business planning investment proposals. To provide this evidence, our DWMP has been expanded to include our plans to meet the requirements by including aspects of our WINEP programme outlined above.

11.4 PROBLEM CHARACTERISATION

The Problem Characterisation approach developed for our DWMP prioritises catchments where options for intervention are required.

The approach taken to quantify the level of risk and potential benefits within each catchment against each of the Planning Objectives is outlined in the following sections.

Planning Objectives

The DWMP framework recommends the definition of Planning Objectives 'against which catchment constraints are to be assessed and options developed'.

Planning objectives are used to measure future performance. These differ from Performance Commitments identified earlier in this report. We have established planning objectives against which catchment constraints are to be assessed and interventions developed, some of which reflect performance commitments that are relevant to drainage and wastewater services.

The DWMP is focused on long-term planning at both national and local levels, and as a result companies have classified planning objectives as either:

- Common planning objectives (applied to all companies and reported at a national level) or
- Bespoke planning objectives (applied by individual companies and reported at a local level).

Common planning objectives

The six common planning objectives were at the time of the publication of the DWMP framework intended to provide stakeholders with an informed overview of current baseline performance, and the long-term risk for three of the planning objectives, under a 'do nothing' scenario, considering future challenges including climate change, urban creep and growth.

Our final DWMP we have republished all of our common planning objectives in accordance with Ofwat's Datatables and have included forecasted information up to 2050.

The table below shows describes the common planning objectives:

Common Planning Objective	Definition	Data table reference
Internal sewer flooding	The measure is calculated as the number of internal sewer flooding incidents normalised per 10,000 sewer connections including sewer flooding due to severe weather events.	9a, 9b, 9c
Pollution risk	The total number of pollution incidents (categories 1 to 3) per 10,000km of sewer length for which the company is responsible in a calendar year.	1a, 1b, 1c
Sewer collapses	Sewer collapses is defined in the reporting guidance - sewer collapses per 1000km (updated), published on 4 April 2019:	8a, 8b, 8c
Risk of sewer flooding in a 1 in 50 year storm	The performance commitment risk of sewer flooding in a storm is defined in the reporting guidance – risk of sewer flooding in a storm, published on 4 April 2019: https://www.ofwat.gov.uk/publication/reporting-guidance-risk-of-sewer-flooding-in-a-storm/. This measure will record the percentage of the region's population at risk from internal hydraulic flooding from a 1 in 50-year storm, based on modelled predictions.	3a, 3b,3c
Storm overflow performance	As per the SODRP	4a, 4b, 4c 5a, 5b, 5c 6a, 6b, 6c 7a, 7b, 7c
Risk of wastewater treatment works compliance	Treatment works compliance is defined in the reporting guidance: Environment Agency water and sewerage company Environmental Performance Assessment (EPA) methodology (version 9) for 2021 to 2025. https://www.ofwat.gov.uk/publication/environment-agency-water-and-sewerage-company-environmental-performance-assessment-epa-methodology-version-9-for-2021-to-2025 The discharge permit compliance metric is reported as the number of failing sites (out of the total number of discharges) and not the number of failing discharges.	2a, 2b,2c

Bespoke planning objectives

In addition to the common planning objectives, we also developed eight bespoke planning objectives in collaboration with our stakeholders which is described in our Strategic Context.

These bespoke planning objectives have been derived to help be more forward looking and measure risk and consequence associated with climate change, urban creep and growth as assessed in the BRAVA stage.

Risk has been calculated and assessed using modelled information (hydraulic or otherwise) across the planning horizons and scenarios we describe in Section 6.4 BRAVA. The result of this analysis is described in further detail in our L2 summary reports, on our L3 plans and within Part C of this report.

The table below describes our Bespoke Planning Objectives.

Planning Objectives

Strategic Planning Category	Planning Objective	Method of Assessment
FLOODING	**PO1 Internal Property Flood Risk**	Assessment of internal property flood risk in a 1 in 20 year return period rainfall event as a result of hydraulic incapacity within the sewer network.
	PO2 External Property Flood Risk	Assessment of external property flood risk in a 1 in 20 year return period rainfall event as a result of hydraulic incapacity within the sewer network.
	PO3 1 in 50 Year Population at Risk	Assessment of population at risk of flooding in a 1 in 50 year return period rainfall event as a result of hydraulic incapacity within the sewer network. This is as per the common planning objective.
ENVIRONMENTAL	**PO4 Bathing Water Quality**	Assessment of storm overflow spill frequency at assets linked to a bathing water, using time series rainfall.
	PO5 River Water Quality	Assessment of storm overflow spill frequency at inland assets, using time series rainfall.
	PO6 Pollution	Assessment of pollution risk from manholes close to watercourses that are predicted to flood during a 1 in 5 year return period rainfall event.
COMPLIANCE	**PO8 WwTW DWF Compliance**	Assessment of 80th percentile flows being treated at WwTWs compared with the consented values, using time series rainfall.
DELETED PLANNING OBJECTIVES	**PO7 Asset Resilience**	Assessment of SPS operating durations during a typical dry weather day. This was removed as it was found to add no value as many SPSs are designed to exceed the identified threshold.

The following explains how we have addressed each of our bespoke planning objectives in accordance with the structure of the DWMP

Storm Overflows

In response to publication of the Government's Storm Overflow Discharge Reduction Plan, the Problem Characterisation of storm overflows was completed in a way that allowed us to determine the scale of the investment potentially required to achieve the targets outlined in the consultation.

The SODRP has resulted in us moving away from the DWMP Framework as it requires interventions to take place at individual assets and not at a drainage area level. We have sought solutions to opportunities at a L3 Drainage Area level to ensure we reduce the impact on customers and also allow for partnership opportunities to be developed.

All the storm overflows modelled in the BRAVA stage have been categorised based on their location and their potential to have a negative impact on the environment, in the spirit of the guidance provided in the storm overflow consultation document. It is not currently possible to determine for all SOs whether they are having a negative ecological impact on the receiving watercourse. The spill frequency targets applied in the option development phases are outlined in the following table.

Storm Overflow Categorisation

Year	2030	2035	2040	2045	2050
% of high priority site storm overflows improved	38% (138)	75% (252)	87% (293)	100% (335)	100% (335)
% of total storm overflows improved	14% (143)	28% (286)	52% (530)	76% (775)	100% (1017)

Targets in red are statutory whilst others targets are classed as an “indicative trajectory”.

In addition to the previously outlined targets, we aim to:

- Complete 54 bathing water storm overflows by 2035;
- Total High Priority overflows & Bathing Water overflows – 160 by 2030, 310 by 2035:

This may change by 2030, when further investigations into whether an overflow causes harm to a water body are completed.

WwTW Dry Weather Flow Compliance

The characterisation of the risk of non-compliance of WwTWs in terms of dry weather flow (DWF) treated effluent consents has been completed using the sewer network model results from the BRAVA stage. For each WwTW, the following information has been collated:

- Identification of WwTWs where the 80th percentile (typical DWF) flow from the actual flow data gathered over a continuous 3-year period is close to the works exceeding the current DWF treated effluent consent.

This allowed for the identification of WwTWs where the risk of non-compliance was predicted to change in the short- and long-term planning horizons and where options would be required to manage and reduce the level of risk.

Our ambition is to continue to reduce per capita consumption (PCC) and decrease this to 110 litres per person per day by 2050. This ambition is used as the basis for our preferred plan for future time horizons.

Further detail regarding the technical methodologies followed to assess the Problem Characterisation for each of the Planning Objectives using the outputs from the sewer network models can be found in the Problem Characterisation Methodology located in the “DWMP Methodologies” area of the DWMP website www.nwl.co.uk/dwmp

Flooding

The characterisation of the risk of flooding within catchments has been completed using the sewer network model results from the BRAVA stage. For each L3 TPU, the following information has been collated:

- Count of properties at risk of internal flooding (greater than 150mm 2D flood depth) during a 1 in 20 year return period rainfall event (PO1), normalised per 10,000 property connections within the L3 TPU

- Count of properties at risk of external flooding (less than 150mm 2D flood depth) during a 1 in 20 year return period rainfall event (PO2), normalised per 10,000 property connections within the L3 TPU
- Count of properties at risk of internal flooding during a 1 in 50 year return period rainfall event (PO3), normalised per 10,000 property connections within the L3 TPU, following a 1D assessment approach

This allowed for the identification of L3 TPUs where the risk of flooding as a result of hydraulic incapacity within the sewer network was predicted to change in the short- and long-term planning horizons and where options would be required to manage and improve the levels of performance.

Pollution

The characterisation of the risk of pollution incidents within catchments has been completed using the sewer network model results from the BRAVA stage. For each L3 TPU, the following information has been collated:

- Count of manholes located within close proximity to a watercourse that are predicted to flood during a 1 in 5 year return period rainfall event (PO6)

This allowed for the identification of L3 TPUs where the risk of pollution incidents as a result of hydraulic incapacity within the sewer network was predicted to change in the short- and long-term planning horizons.

Further requirements from Ofwat draft DWMP consultation response

In October 2022, Ofwat wrote to all company CEOs providing consultation feedback on the draft DWMPs. This letter outlined a new requirement for DWMPs to provide a robust evidence base for water companies' business planning investment proposals.

To provide this evidence, our DWMP has been expanded to include our plans to meet the requirements of:

- the Urban Waste Water Treatment Directive (UWWTD)
- the Water Framework Directive (WFD)
- the Environmental Act Continuous River Water Monitoring
- a 25 Year Environment Plan
- Bathing Water Investigations
- Shellfish Investigations
- Marine Conservation Zones

12.0 OPTION DEVELOPMENT AND APPRAISAL

To identify the options for inclusion within the plan, an option development and appraisal (ODA) stage was completed using the information that was developed as part of the BRAVA and Problem Characterisation stages. For all of the L3 TPUs that had a BRAVA and Problem Characterisation exercise completed, it was possible to determine:

- The scale of the problem against each of the Planning Objectives
- The timing of the problems
- Whether an option was required to manage and improve levels of performance
- The cost and direct/associated benefits of options required to manage and improve levels of performance

Following feedback on the draft DWMP, we have changed our approach to include how we have assessed and scored risks. This change is included in our Problem Characterisation methodology on the DWMP webpage. www.nwl.co.uk/dwmp

The ODA stage of the DWMP follows on from the Baseline Risk and Vulnerability Assessment (BRAVA) and Problem Characterisation stages. The BRAVA and PC stages of the DWMP provide an understanding of the current modelled performance and level of risk within catchments and how this is projected to change in the future.

The approach that was adopted to identify the needs of catchments with regards to current performance and performance in the future against the SODRP and DWMP Planning Objectives.

The options screening and development process that was applied to enable the scoping of options to resolve catchment Needs with the priority being to address storm overflows not meeting SODRP criteria.

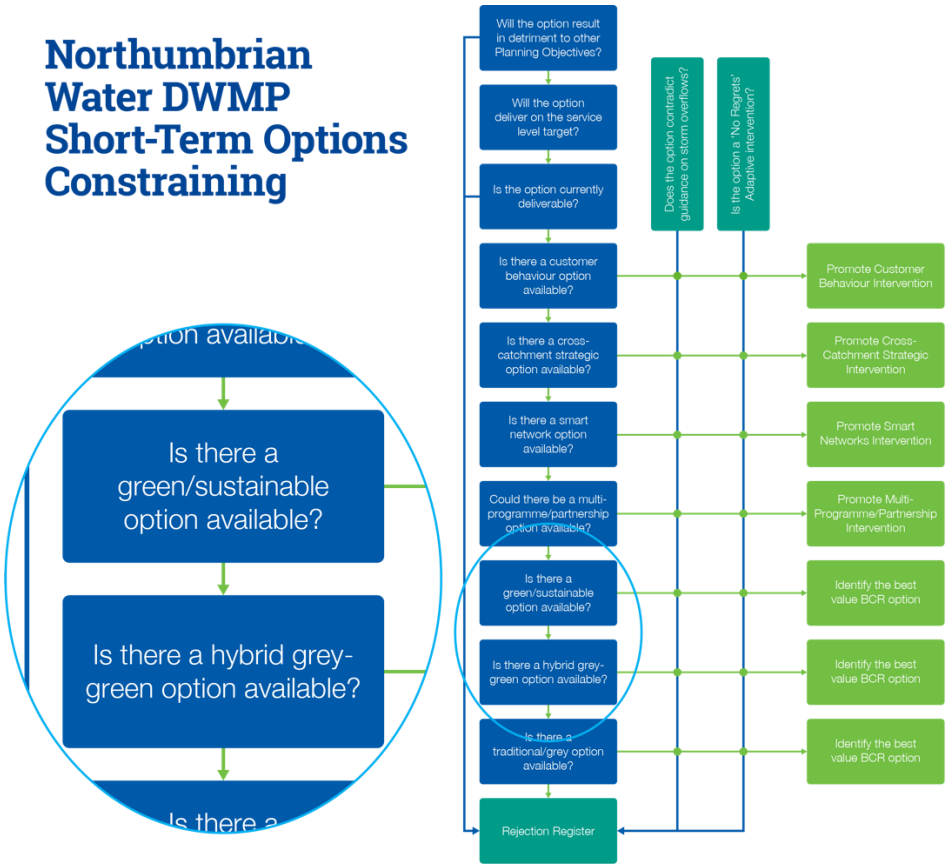
The methodology that was applied to assess costs and benefits/dis-benefits of options to support the identification of Least Cost and Best Value options.

Our approach to identifying opportunities to meet future challenges uses a Total Expenditure (TOTEX) hierarchy approach. This orders interventions so that where costs and benefits are equal we prioritise:

- Customer behaviour interventions
- Green infrastructure
- Multi-benefit solutions
- Collaboration
- Grey infrastructure as a final option

We assess costs and benefits using our Value Framework, discussed below, which builds on the approach introduced in the WINEP methodology to ensure that we account for a broad range of private, environmental and societal costs and benefits in our decision-making process.

Figure 20: our hierarchy approach to ODA



In the ODA process, we have identified and discounted a significant number of options. These are summarised in our option developed register that can be found at www.nwl.co.uk/DWMP

The range of options considered to improve WwTW compliance will be published with our draft business plan.

To find out more about the approach to ODA, go to the ODA methodology on the DWMP webpage. www.nwl.co.uk/dwmp

13.0 HOW WE HAVE IDENTIFIED COSTS AND BENEFITS

13.1 HOW WE HAVE IDENTIFIED COSTS

The option costs for DWMP have been developed using our in-house cost estimation tool iMOD. The iMOD tool comprises a suite of engineering models and a cost database that provides detailed CAPEX, OPEX and whole life costs. The cost database feeding these estimates is built up using historical cost data which has been subject to competitive tendering processes and effects of efficiency incentives to effectively design, tender and deliver projects – this helps ensure that the estimates are based on efficient costs from the outset.

Some novel interventions, such as a Smart Network (see Part A), were not available in iMOD as Northumbrian Water has not delivered these projects historically. In these cases, costs have been provided separately using external consultant databases. These external sources are similar to our cost database but include cost information from other companies that have delivered these interventions and have also been subject to competitive and efficiency incentive pressures.

Following the production of the CAPEX and OPEX costs, NWL's costing principles have been applied in terms of risk, estimating uncertainty and project overheads to produce a Total expenditure cost (TOTEX cost). These principles follow best practice guidance from the Infrastructure and Projects Authority and the American Association of Cost Engineering to ensure that estimates reflect the degree of maturity in the scoping and design of projects. The Infrastructure and Projects Authority document can be found at IPA_Cost_Estimating_Guidance.pdf (publishing.service.gov.uk)

Cost benchmarking

We are carrying out 2 different forms of benchmarking to further check the robustness of our cost estimates that have informed our DWMP.

First, we have undertaken an exercise to benchmark the detailed cost estimates using framework contractors Mott MacDonald Bentley (MMB) and Esh-Stantec. Redcar & Marske and Berwick were selected for the comparison exercise due to the large costs associated with these catchments.

The total scope costs are shown below for the two areas:

Drainage Area	Esh-Stantec	MMB	DWMP
Berwick	£174,408,906	£200,819,625	£164,822,575
Redcar & Marske	£295,380,025	£358,265,320	£330,260,242

The table shows that the DWMP costs are within the region of the contractors' cost estimates. There was a discrepancy between the costs for the commercial source control (managing rainwater in industrial and retail properties). The DWMP costs used the same rate for commercial and residential properties whereas the contractor costs estimates applied a more realistic rate for commercial properties. The proportion of commercial source control in the DWMP is a small percentage of the overall cost and therefore it was deemed acceptable to remain with the DWMP cost estimates. The outcome of the exercise has shown that the contractor and DWMP costs estimates are in line with independent contractor estimates which gives further confidence in the DWMP costing methodology and that it is producing efficient costs in line with expected market outcomes.

Second, we are also using independent cost advisors, Mott MacDonald, to benchmark samples of our WINEP and DWMP investments against the cost curves of six other WaSCs on an anonymous basis. This is considering whether the direct and indirect costs associated with a sample of interventions are in line with the estimates produced by other companies' approaches. This work is focussing on the higher value items in the plan to ensure that the results provide the most value.

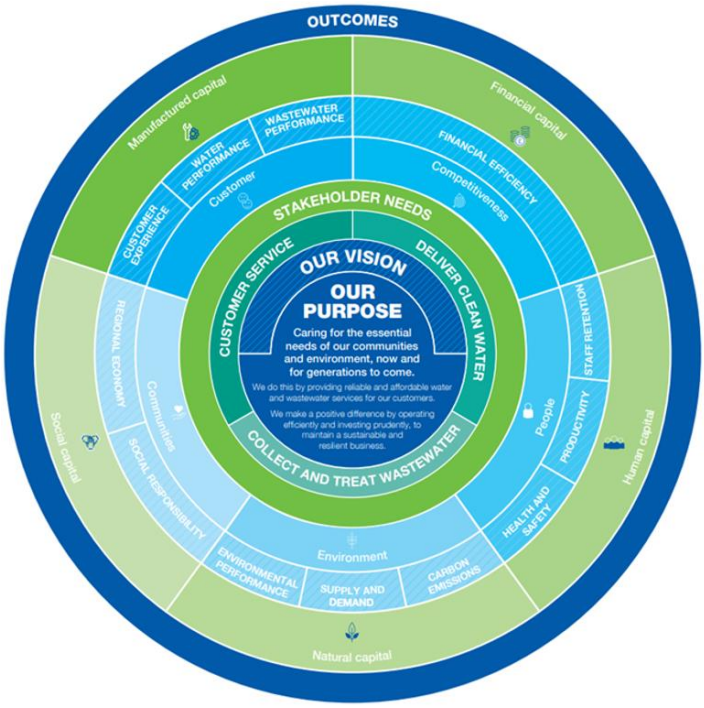
This information is not available at the time of this document but we expect it to be available alongside our business plan in October 2023. If this benchmark shows a divergence between our cost estimates and the benchmarks then we will consider what the appropriate response is in each case ahead of submitting our business plan.

13.2 HOW WE HAVE IDENTIFIED AND VALUED BENEFITS

NWL's Service Planning Framework (ref: Figure 21) improves our decision making through integrated planning that considers optimal interventions balanced across our whole asset base to deliver the outcomes for customers and the environment across our business.

Our Value Framework forms a core part of our technical approach to assessing the pros and cons of alternative options in a structured and consistent way. The Value Framework, as shown in Figure 21, enables us to apply our five capitals approach to the assessment of options within our Copperleaf decision support tool. The Value Framework contains 71 Value Models, 34 of which quantify societal and private benefits, with the remainder partially quantifying benefits (19) or being qualitative (18).

Figure 21: NWL Service Planning Framework



The impact of options under the quantified Value Models are estimated using the appropriate tool or estimation approach, eg Defra's Biodiversity Metric V3.1. Impacts are then monetised using common valuations, derived from customer research, internal estimates, and publicly available estimation as appropriate. Options are assessed using these valuations. We have engaged the external experts Frontier Economics to review our Value Model design and valuations, giving us confidence that we have developed a tool that reflects an industry best practice approach.

In line with the expectations of the DWMP process we have complimented our service planning framework approach with valuations from the CIRIA B£ST tool values as well as using the Mott MacDonald business planning tool to assess carbon to ensure we maximise societal and environmental benefits.

13.3 OPTION APPRAISAL FOR DWMP PLANNING OBJECTIVES

Hydraulic drainage models produced from our modelling approach produced for BRAVA allows an assessment of the following:

- Spill volumes for storage
- Demand requirement for surface water separation
- Drainage community where surface water removal is possible
- Opportunities to utilise existing in-sewer capacity (smart network)

An Options Screening Tool (OST) was developed to determine the feasible options available to deliver the improvements required to achieve the SODRP spill frequency reduction targets.

In addition, an assessment has been undertaken to determine the buildability of opportunities and the likely impact on the wastewater treatment works serving the drainage area.

Following a number of workshops, six option combinations were developed which look to achieve the spill frequency reduction at storm overflows through the provision of various option elements from the option hierarchy screening list.

Option 1 – DWMP Option Hierarchy

This option follows the Option Hierarchy approach of maximising the provision of sustainable infrastructure and minimising the provision of below-ground network storage. Option elements are to be selected from the option hierarchy in the following order of preference:

- Residential source control (rainwater harvesting of roof runoff).
- Commercial property source control (rainwater harvesting of roof runoff).
- Smart networks to intelligently operate the sewer network to utilise existing capacity within the network.
- Surface water removal by disconnection of existing separately drained catchments from the combined sewer network.
- Separation of highway runoff from the combined sewer network through the provision of new surface water networks.
- Provision of below-ground storage.
- ‘Difficult to achieve’ separation of highway runoff from the combined sewer network through the provision of new surface water networks.
- In drainage areas where surface water removal and/or separation is scoped, there may also be a requirement for the provision of blue-green infrastructure to enable to disposal of surface water into an appropriate receptor. This is not always required, for example, if the separation area is located within close proximity to a receptor.

Option 2 – Below-ground storage only

This option includes only the provision of below-ground network storage, where this has been deemed to be technically feasible.

Option 3 – Option Hierarchy, No 'Difficult to Achieve' Separation, plus Storage

This option follows Option 1; however, in catchments where there is deemed to be a requirement for 'difficult to achieve' surface water separation, this option element is removed from the scope and replaced with below-ground storage.

Option 4 – Smart Networks plus Storage

This option maximises the number of smart network installations and meets any remaining demand through the provision of below-ground storage.

Option 5 – Surface Water Separation plus Storage

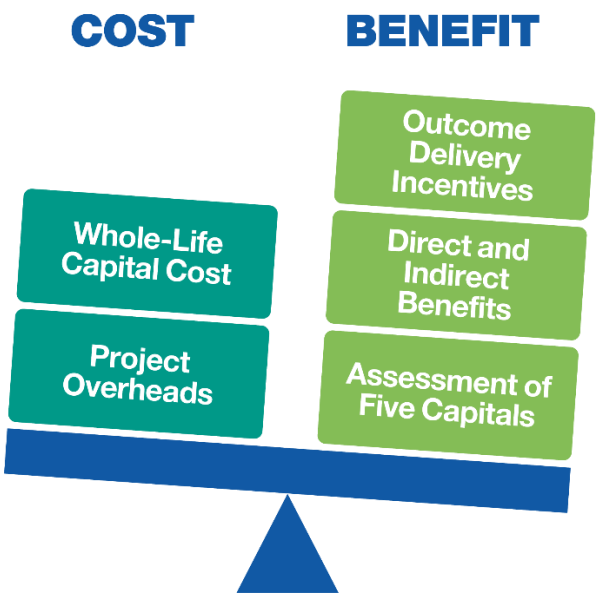
This option maximises the surface water removal and separation within a catchment, then any remaining demand is provided through below-ground storage.

Option 6 – Smart Networks plus Surface Water Separation

This option maximises the number of smart network installations and meets any remaining demand through the provision of surface water removal and separation

After costing each of these options, we have identified benefits as previously discussed for each option. This has allowed to produce a Least Cost and Best Value option for each drainage area. The following figure illustrates our approach.

Figure 22: Cost and benefit approach



13.4 OPTIMISATION

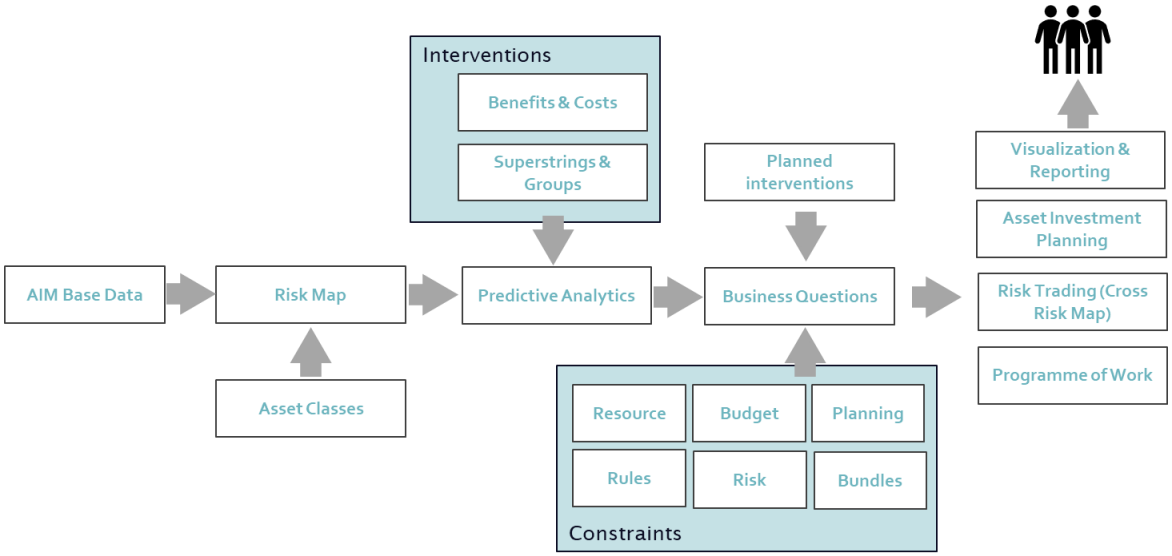
The DWMP has generated thousands of options and many scenarios. These options have been optimised using Asset Investment Manager with our partners ICS Consulting.

Asset Investment Manager solves large-scale infrastructure optimisation problems at any level of granularity and uses mathematical optimisation to optimise investment and risk in a fast, transparent and repeatable manner.

Asset Investment Manager is a bottom-up (asset level) investment planning tool, which allows the user to aggregate proactive investment needs, reactive costs, risks and investment benefits up to any level, including asset, system, organizational, cohort and spatial/geographical area.

Asset Investment Manager is fully configurable by the end user and requires no hard coding. There is no practical limitation on the number of assets or risk models within AIM. A summary of the work steps needed to build an Asset Investment Planning model is shown below.

Figure 23: Building an Asset Investment planning model



We used a flexible approach to accommodate many different scenarios using a decision tree to produce best options for those interventions and decisions.

For instance, we have reviewed a number of scenario-based options including delaying some high cost SODRP drainage areas to post 2030.

However, our statutory obligations under SODRP and WFD have constrained our final DWMP investment opportunities and choices.

PART C:
OUR DWMP

As previously identified, our preferred plan meets Ofwat's requirement to provide robust evidence for our business plan submission in October 2023. It also identifies how we intend to maintain and improve our performance to meet business objectives covered in the DWMP.

Below we set out how we plan to deliver against a series of objectives for our wastewater operations. We have structured our plan into five sections:

1. Storm Overflows
2. Wastewater Treatment
3. Wastewater Networks
4. Resilience
5. Further Investigation works

14.0 STORM OVERFLOWS - DWMP PLANNING OBJECTIVE 4 - BATHING WATER QUALITY & PLANNING OBJECTIVE 5 – RIVER WATER QUALITY

Our preferred plan meets the objectives outlined in the SODRP, details of which are outlined in Part A.

In line with regulatory requirements, we have identified a Least Cost and Best Value Plan. In addition, we have identified where a marginal increase in expenditure results in a reduction in grey concrete storage solutions and replaces it with green infrastructure and the removal of surface water from the combined sewer network. This approach reduces storage requirements by 15,200m3 in the period 2025-2035. This equates to a reduction equivalent to six Olympic sized swimming pools.

This promotion of green infrastructure aligns to a goal in our LTDS and we have included this in our preferred plan to meet the SODRP. We will test customers' views on this green enhancement proposal.

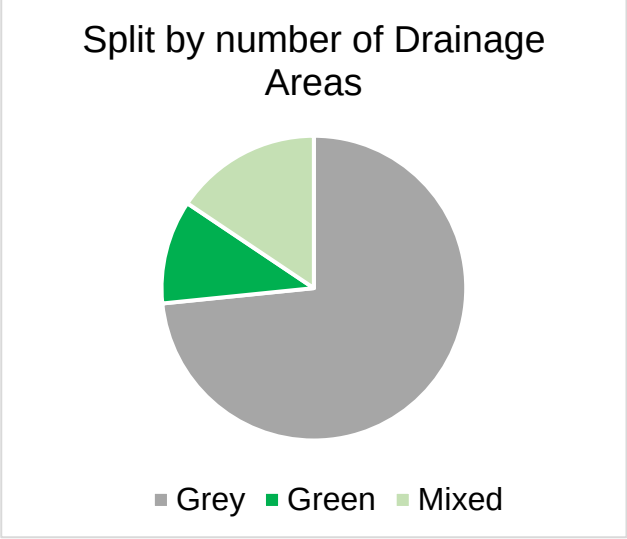
Our preferred plan meets the target in the Storm Overflow Discharge Reduction Plan. The table below shows the actual number of SO's improved against the SODRP targets (in brackets).

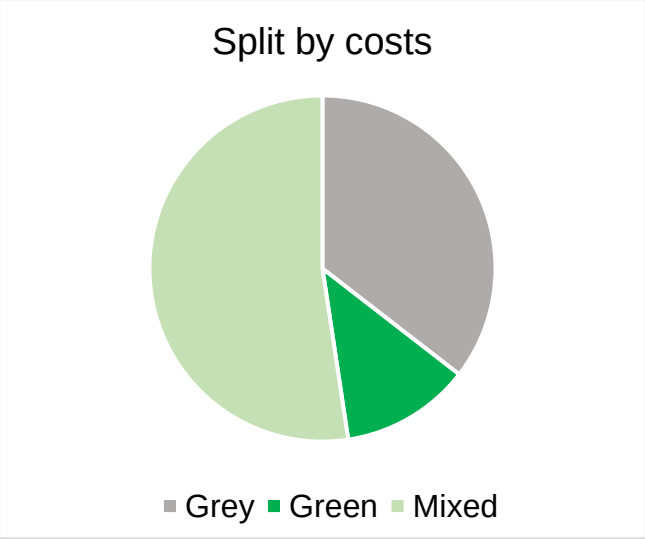
Year	2030	2035	2040	2045	2050
Total SOs improved	159 (143)	309 (286)	563 (530)	791 (775)	1017 (1017)

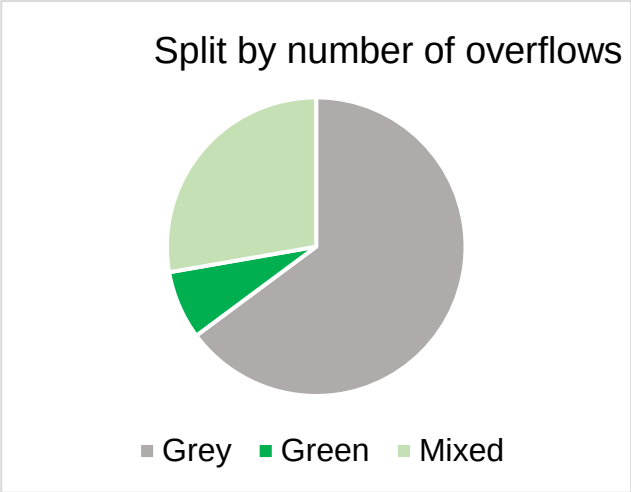
Interventions to meet the storm overflow discharge reduction plan targets form the majority of the costs and interventions identified in the DWMP. The table below gives the Whole Life Cost for each 5-year investment period.

Period	Least Cost	Best Value	Preferred Plan
2025-2030	£931m	£932m	£973m
2030-2035	£511m	£511m	£542m
2035-2040	£444m	£444m	£444m
2040-2045	£565m	£565m	£565m
2045-2050	£299m	£301m	£301m

An assessment has taken place on the preferred plan to determine the level of green and grey infrastructure being planned. By 'green' infrastructure we mean catchment and nature-based solutions, such as wetlands or swales. 'Grey' infrastructure includes investment in treatment works or building storm tanks. These are shown in the charts below:







Two of the larger areas for investment in the period 2025-2030 are Berwick and Redcar & Marske. Case studies on these two locations are below.

Screens

The SODRP also includes a requirement for water companies to ensure all overflows have screening controls and that these should be designed so that they achieve the solid separation and flow rates they were designed for. The SODRP states that this requirement should be delivered with the other targets outline in the plan. So, for example, any overflow improved by 2030 also need to meet the screening requirement.

We have identified that 849 SO's require new or replacement screens to ensure that this requirement is met. We have programmed these to take place with the other improvements as per the guidance.

Period	Screens
2025-2030	£33.m
2030-2035	£3.2m
2035-2040	£103.5m
2040-2045	£55.5m
2045-2050	£60.8m
Total	**£291m**

This gives the total capital expenditure to meet the targets set out in the SODRP is

Period	Preferred Plan	Screens	CAPEX cost
2025-2030	£970.50	£33	£1,003.50
2030-2035	£530.30	£38.20	£568.50
2035-2040	£427.60	£103.50	£531.10
2040-2045	£540	£55.50	£595.50
2045-2050	£316.30	£60.80	£377.10
Total	**£2,785**	**£291**	**£3,076**

The table for all SO's in the region is included in the L1 Region Summary report. This indicates the 5-year period when interventions are planned to occur. The L2 TPU plans breaks this down into work required in each area. Both the L1 and the L2 DWMP can be found on our website at www.nwl.co.uk/DWMP

The adaptive plan scenarios identified in Part B change our plan to following

1. Increase the speed of delivery of the SODRP requirements to be delivered by 2040. This pathway would increase affordability challenges in the short term and reduce the probability of being able to reduce costs and deliver better outcomes through innovative solutions as they are developed over time;

Period	Adaptive Plan 1
2025-2030	£1,171.50
2030-2035	£970.40
2035-2040	£934.10
2040-2045	£0
2045-2050	£0
Total	**£3,076**

2. Decrease the speed of delivery of SODRP requirements. This would reduce the short-term affordability impact (in 2025-30) and increase the potential for innovation to reduce costs and improve service. But it would be out of line with current government and societal expectations,

Period	Adaptive Plan 2
2025-2030	£712.50
2030-2035	£858.50
2035-2040	£532.40
2040-2045	£595.50
2045-2050	£377.10
Total	**£3,076**

Berwick Case Study

The Berwick catchment encompasses the towns of Berwick upon Tweed, Tweedmouth, Spittal and the smaller village of Scremerston to the south, with a combined population of just over 12,000.

The town centre of Berwick upon Tweed is characterised by its rich history, in particular its medieval town walls, Georgian Town Hall, Elizabethan ramparts and Britain's earliest barracks buildings. These aspects make construction within the town centre extremely difficult and, in many instances, not viable.

There are 36 storm overflows within the Berwick catchment, 30 of which need interventions to meet the targets outlined in the Storm Overflow Reduction Plan (SODRP). Of these 30, 13 SOs discharge to a designated bathing water and have a target to not spill more than twice per bathing season (15 May to 30 September). The remaining SOs have a target of spilling on average no greater than 10 times per annum. To achieve these targets different options have been considered.

Due to the architecture of Berwick town centre, building network storage in these areas is not technically viable due to limited space, and therefore green infrastructure has been promoted. These options contain multiple aspects to achieve an overall target including source control at residential and commercial properties, blue-green corridors and SuDS options.

The town centre of Berwick has been assessed as being able to support a blue green corridor. This option will include a large proportion of surface water removal from the existing sewer system via re-sewering (creating a blue green corridor) and discharging to the River Tweed and North Sea at viable locations.

Storage of network flows is also not technically viable for the majority of the Berwick catchment due to the treatment capacity at the Wastewater Treatment Works (WwTW). If large volumes of flow were retained within the network and released slowly it would take five days to fully empty these tanks and this would have a significant impact on the treatment process at the WwTW. There would also be the risk that further rainfall events would occur resulting in either additional SO discharges or sewer flooding.

The identified option does utilise storage, through the creation of new assets and maximising the existing sewer capacity by a Smart Network approach.

Although our plans for the area is between 2025 to 2045, we are looking at the whole drainage area to maximise the benefits achieved. This may result in accelerating the delivery of some interventions to shorten customer and environmental impacts.

Redcar & Marske Case Study

The Marske and Redcar catchment encompasses the towns of Marske, New Marske, Redcar, Saltburn, Skelton Brotton, Guisborough, Dunsdale and Mount Pleasant with a combined population of close to 100,000.

The Wastewater Treatment Works (WwTW) for this large catchment is located in the Marske area of the catchment.

There are 40 storm overflows within the Marske and Redcar catchment, 31 of these need interventions to meet the targets outlined in the which discharge in the Storm Overflow Reduction Plan (SODRP). Of these 31, 18 storm overflows discharge to a designated bathing water and have a target to not spill more than twice per bathing season (15th May to 30th September). The remaining 13 storm overflows have a target of spilling on average 10 times per annum. To achieve these targets different options have been considered.

The Marske and Redcar catchment has a ‘No deterioration’ driver for bathing water criteria, this means that the bathing water area cannot change classification due to any interventions by the DWMP or other programmes.

Storage of all overflow discharges is not technically viable for the majority of the Marske and Redcar catchment due to the treatment capacity at Marske Wastewater Treatment Works (WwTW). If large volumes of flow were retained within the network and released slowly it would take 10 days to fully empty these tanks and this would have a significant impact on the treatment process at the WwTW. The overflow at the WwTW discharges on average 90 times a year, with the additional storage discharge volume being received at this location it is possible that this number could increase. There would also be the risk that further rainfall events could occur resulting in either additional storm overflow discharges or sewer flooding.

However, the area of Marske has been identified as being suitable for a smart networks approach, this creates new assets and utilises existing network capacity to maximise the benefits achieved.

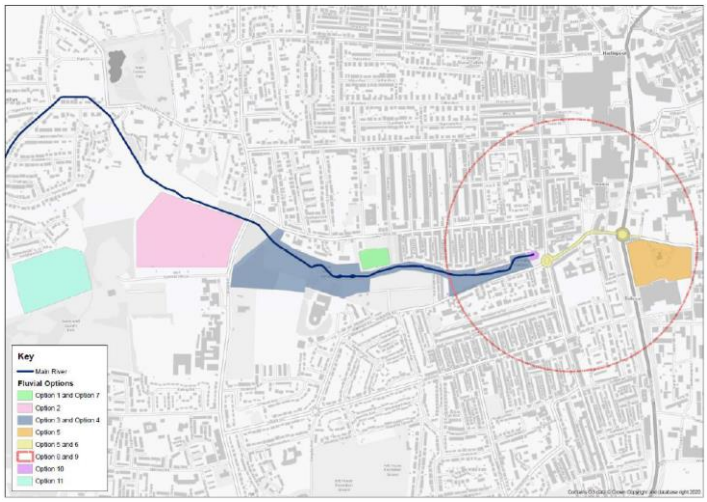
The remaining solution is to remove surface water from the existing network via re-sewering in the areas of Redcar and New Marske, with the surface water being discharged to the North Sea at a viable location. The estimated cost for this option is £270m.

Due to the large scale of the proposed options alternative have been considered but not fully explored at time of publication. These include the possible extension of the long sea outfall from the WwTW to greater than 1km from the bathing water area. The treatment of storm overflow discharges by ultraviolet disinfection will also be explored.

Collaborative Opportunities in the SODRP

Through engaging with partners as we developed our options to reduce spills from SOs, we have identified a number of exciting opportunities for collaboration. One such opportunity is on the Valley Burn in Hartlepool. The Valley Burn enters the drainage system close to Menceforth Terrace Pumping Station. This then pumps to Seaton Carew WwTW's for treatment. Excess flows that can't be pumped discharge to the North Sea.

Plan showing Valley Burn entering the drainage system



Plan showing Valley Burn entering the drainage system

During our stakeholder engagement session in February 2023, the Environment Agency (EA) and Hartlepool Borough Council (HBC) highlighted an existing flood risk in the area. Following this engagement, the EA has launched a project,

called Colwyn Road, with the first project board meeting being planned for June 2023. Northumbrian Water is committed to this project and look forward to collaborating to bring multiple cross organisation benefits building on the success of previous projects such as the collaborative flood alleviation projects we delivered in the Brunton Park area of Newcastle and Killingworth & Longbenton in North Tyneside. These can be found on our website at Rainwise (nwl.co.uk)

15.0 WASTEWATER TREATMENT

In this section we identify our plan for works required at wastewater treatment works (WwTW's) and to meet the requirements of the Water Industry National Environment Programme

15.1 HABITATS DIRECTIVE LEVELLING UP BILL AMENDMENTS - NUTRIENT NEUTRALITY

In 2022, Natural England issued advice that 31 habitat sites are in unfavourable condition due to excess nutrient pollution. Because of this, the advice says that development plans or projects in these areas can only go ahead if the additional wastewater produced by the development will not add to nutrient pollution – in other words they must be 'nutrient neutral'.

Following this advice from Natural England, the Environment Agency issued guidance in December 2022 to say that water companies should upgrade all WwTWs in these areas that serve a population equivalent of more than 2000 people. The objective of this would be to remove nitrogen from final effluent to meet the 'Technically Achievable Limit' (TAL), which is currently 10 milligrams of nitrogen per litre.

In our region, this only applies for Nitrogen limits for Teesmouth and Cleveland Coast Special Protection Area (SPA) and Lindisfarne SPA together with the river catchments that drain to these areas. As all wastewater treatment works discharging to Lindisfarne SPA have less than 2000 population, only the Teesmouth and Cleveland Coast Tees SPA is subject to TAL requirements and this would require us to upgrade 16 WwTWs in the Tees catchment. There is a significant cost of £380m to achieve TAL. The interventions also have a significant carbon impact both from the initial build and the ongoing operation. These upgrades do not provide sufficient nitrogen reduction to ensure these areas move to a favourable status. Therefore, there would be a requirement to maintain the nutrient neutrality obligation in perpetuity.

To address this, we propose an alternative plan that will restore the areas to a favourable status and remove any offsetting obligations for new developments connecting to our wastewater systems. Our plan consists of upgrades to Bran Sands WwTW (the second largest WwTW in the region and one of the largest contributors of nutrients to the protected area) and also a range of catchment and nature-based solutions. These will absorb the extra nitrogen within the SPA and improve the habitat quality. These plans generate more than four times the nitrogen removal than delivering TAL at each of the 16 WwTWs. This proposal restores the protected area to favourable status whilst removing the obligation for developers to offset their growth. This is our preferred plan in the DWMP.

Option
Native Oyster restoration
Shellfish farming
Seagrass restoration and mariculture facility
Seaweed cultivation
Seabed restoration
Intertidal edge restoration
Greatham saltmarsh restoration
Greatham integrated constructed wetland
Catchment measures
Estuary HQ - development and build for 2030 (20% contribution)
Bran Sands 50% reduction (Option 2)

We believe this represents far better value for money for customers, representing an investment of £42.6m including some excellent nature-based solutions in the period 2025-2030 compared to the £380m to deliver TAL at the 16 WwTWs.

15.2 WATER FRAMEWORK DIRECTIVE

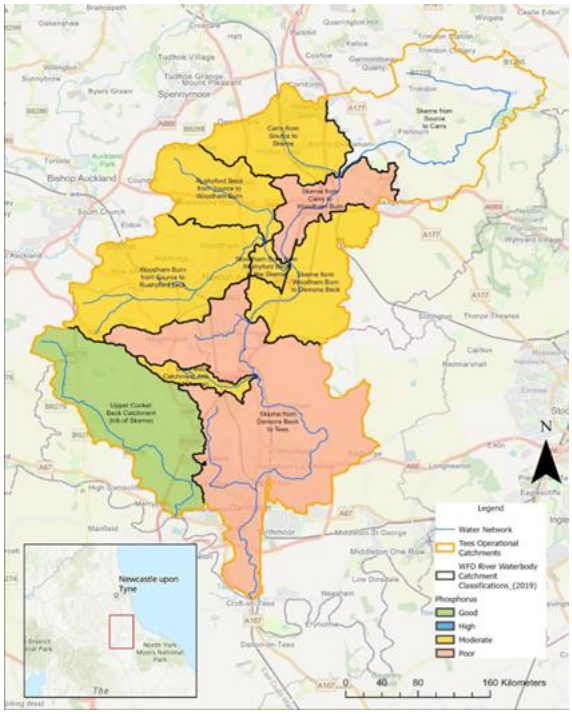
All Water Framework Directive (WFD) nutrient schemes have been developed collaboratively with support from the North East Catchments Hub (NECH), through assessment of catchment and waterbody needs and external information. We have followed the WINEP methodology. Assessments have taken place at catchment level (considering river catchments and individual waterbodies) to determine which of our WwTW's require investment or need further investigation to meet WFD requirements. For the catchments that were identified for improvement in the period 2025-2030, the opportunity for Catchment and Nature Based Solutions (C&NBS) was reviewed, using intelligence provided from partners through the NECH.

As outlined in Part A, the NECH brings resource, expertise and capacity into the region to support integrated catchment management. This provided support for the identification and development of C&NBS for our WINEP submission as part of business planning. The engagement activities undertaken included four workshops held at management catchment level with Catchment Partnerships and other stakeholders, engaging 145 partners and involving 20 follow up conversations to gather ideas and develop proposals for WINEP schemes. These resulted in 170 partner ideas that were mapped on the PR24 WINEP Planning Portal. Recommendations for the best opportunities were aligned to NWL investment needs and drivers. In addition to a number of general catchment schemes working upstream of our assets across multiple WINEP drivers, a number of C&NBS opportunities for WFD phosphorus improvements were reviewed.

This review led to the development of seven catchment solutions to achieve greater environmental benefits than end-of-pipe phosphorus removal alone. These schemes cover 30 waterbodies and include seven end-of-pipe schemes as part of the approach, which would drive wider environmental benefits beyond just phosphorus management, through a catchment nutrient balancing approach. Integrated catchment solutions can help ensure waterbodies move to overall Good ecological status through cross-sector, multiple-benefit approaches and will help achieve the Environmental Improvement Plan goal for clean and plentiful water.

These solutions also provide the most cost-effective and affordable investment for customers; the schemes identified for 2025-2030 result in a £50m saving on investment and offer more benefits for customers and the environment.

Figure 24: Example of Catchment Approach – River Skerne



The remaining eight schemes are end-of-pipe schemes. These include chemical treatment and tertiary filters, the use of integrated constructed wetlands (ICWs) as nature-based solutions, or transfer of outfalls or closure of works.

Investment in WFD nutrient schemes for phosphorus and Biological Oxygen Demand for 2025-2030 will be £124m, of which £79m will be in phosphorus schemes, and £16m of that total will be used to enable collaborative catchment solutions. The adoption of catchment wide solutions results in a £50m saving on investment, and offering much bigger benefits for customers and the environment.

Design, delivery, and management of the C&NBS solutions will be led by the NECH, supported by The Rivers Trust, our own environmental experts, and catchment partners, with two years of enabling work planned for 2025-2030 to be initiated from 2023. The NECH is learning and developing from its first year of activity in 2022 and will upskill and upscale within the enabling stage to ensure it has the capacity and capability to manage these C&NBS solutions and other catchment projects for Northumbrian Water post 2025.

Figure 25: WFD Catchment & Nature Based Solutions

Catchment	No. Waterbodies Targeted to Good Status for P	Cost-Benefit Ratio
Pallins Burn	1	2.3
South Low	2	1.4
Embleton Burn	1	9.6
River Wear	16[2]	2.7
River Skerne	6	2.3
Clow Beck	5	5.2
River Leven	6	10.8
Total	**37**	**3.4**

These C&NBS schemes will enter into trials from 2030 to 2037, to align with the 25 Year Environment Plan and Environment Act targets. Their success will be monitored and measured by the NECH, Northumbrian Water and the Environment Agency, and further investment may be planned in future price reviews if required.

This collaborative approach is ambitious and requires the development and agreement of shared environmental ambitions and catchment improvement plans across stakeholders, and the support of co-funding and green finance contributions. We look forward to working with partners across the region as our catchment activity grows to improve the environment.

15.3 ENVIRONMENT ACT CONTINUOUS RIVER WATER MONITORING

The Technical Guidance for the delivery of the continuous river water monitoring obligation outlined in the Environment Act has not been finalised. Provisional Technical Guidance for the delivery of the continuous river water monitoring obligation outlined in the Environment Act was published by the EA in September 2022. Defra has launched a further consultation for this guidance which concluded on 23 May 2023. It is anticipated that the final Technical Guidance will be published in late June 2023.

This plan is based on the Provisional Technical Guidance issued by the EA in September 2022. We estimate more than 2000 monitors will need to be deployed across the region's water bodies including inland, estuarine and coastal locations.

Although monitoring the impact of our assets upon the environment is welcome, there remains considerable concern across the sector associated with the obligation's deliverability, affordability and accessibility to the required monitoring locations.

Proven technology is readily available for inland river deployments; however, uncertainty remains in the monitoring of both estuarine and coastal bodies which is illustrated in the inclusion of investigation drivers within the obligation's delivery.

Delivery of this obligation is over the period 2025 – 2035

Presently, all investigations need to be completed by 2027 with installation at our high priority sites commencing as early as 2025 to ensure the statutory high priority sites are delivered by 2030.

Below is the table showing the WINEP Driver codes against the planned date for delivery.

				Completion Dates	
Driver	Legal Obligation	Subject	Task	AMP8	AMP9
EnvAct_INV1	S	Estuarine	High Priority	Apr-27	
			Non Priority	Apr-27	
EnvAct_MON1	S	Estuarine	High Priority	Mar-30	
			All Others		Mar-35
EnvAct_INV2	NS	Inland Complex*	High Priority	Apr-27	
			Non Priority	Apr-27	
EnvAct_MON2	NS	Inland Complex*	High Priority		Mar-35
			Non Priority		Mar-35
EnvAct_INV3	NS	Coastal	High Priority	Apr-27	
			Non Priority	Apr-27	
EnvAct_MON3	NS	Coastal	High Priority		Mar-35
			Non Priority		Mar-35
EnvAct_MON4	S	Inland Water Courses	High Priority	Mar-30	
			All Others		Mar-35
EnvAct_MON5	S	Publish NRT Data		Mar-27	

The estimated overall capital expenditure based upon current guidance and available technology is in the region of £232m by 2035 with £130m being invested in the period 2025-2030. It is anticipated that the annual cost of maintaining these monitors upon completion will be c. £14m per annum.

15.4 25 YEAR ENVIRONMENT PLAN – NIDP – LINKED TO DWMP PLANNING OBJECTIVE 1 - INTERNAL SEWER FLOODING AND PLANNING OBJECTIVE 2 – EXTERNAL SEWER FLOODING

We have submitted the continuing contribution to the Northumbria Integrated Drainage Partnership in the WINEP 25 Year Environment Plan.

For more on the NIDP refer to Part A of this report.

The cost total programme cost for the NIDP is £140.1m with Northumbrian Water's contribution bring £65m.

The following table outlines the current programme for delivery by 2030.

Location	Drainage Area	Properties protected from all sources of flooding
Alnwick	01-D01	159
Corbridge	03-D05	69
Haydon Bridge	03-D28	7
Annfield Plain	04-D08	349
Whickham South	05-D11	102
Walker	05-D35	70
Wallsend	05-D37	164
Chirton	05-D38	322
South Stanley	07-D14	395
Ushaw Moor	07-D27	84
Easington	08-D03	189
Barnard Castle	09-D06	94
Great Ayton	11-D09	29
Redcar	11-D32	120
Sedgefield	11-D48	43
Stockton East	11-D52	343

This may be subject to change to meet the requirements of collaborating partners funding and governance processes.

15.5 25 YEAR ENVIRONMENT PLAN - BLUESPACES

Bluespaces are the environments covering or close to all surface water within our regions. This includes streams, rivers, ditches, lakes, reservoirs, ponds, wetlands, fens, bogs, marshes, reedbeds, canals, coasts and beaches.

NWL defines bluespaces as the area around water that is freely accessible to the public via road, footpath, bridleway or other public right of way, or accessible via a free point of access, including a country park, beach or other public area.

At least one of the following factors should apply to class public access close to water as accessible water environment:

- Immediate vicinity of water (within 100m)
- Visibility of water and water associated wildlife
- Sound of water and water associated wildlife
- Touch and interaction opportunities with water

Our Bluespaces programme is described in Part A. To take this further, we plan to improve access to an estimated 168km of bluespaces in 2025-30 where two out of the three core aspects of blue spaces improvements can be achieved. These are:

- Access, facilities & recreation,
- Wildlife & biodiversity
- Water Quality

The table below shows how these link with the 12 water environmental indicators we use to access the benefits of bluespace projects. These indicators are linke to those used in the Government's 25 year plan for the environment. This can be found at https://www.gov.uk/government/publications/25-year-environment-plan

Aspect of Improvement		Benefit Indicator
Access, Facilities & Recreation (A)	A1	Increases access to, engagement with and enjoyment of the water environment
	A2	Benefits health and wellbeing
	A3	Influences positive environmental behaviours
Wildlife & Biodiversity (B)	B1	Improves the quantity, quality and connectivity of habitats
	B2	Improves the conservation status and or abundance or distribution of species
	B3	Reduces risk or impact of invasive non-native species (INNS)
Water Quality (C)	C1	Reduces pollutants entering waters from point or diffuse sources
	C2	Contributes towards improved status or no deterioration of rivers or bathing waters or protecting drinking water
	C3	Improves state and function of water, including naturalisation, visual appearance, litter and odour
Additional Key Benefits (D)	D1	Provides resilience and adaptation to climate change and/or reduces the risk of flooding
	D2	Provides benefits to local communities, the local economy or NWG
	D3	Supports strategic project or investment into strategic partnership or landscape/regional activity

It is anticipated that the expenditure related to Bluespaces will exceed £4m in the period 2025-2030.

15.6 WWTW DRY WEATHER FLOW – DWMP PLANNING OBJECTIVE 8

We have assessed the impact of growth on WwTW Dry Weather Flow (DWF) permit compliance. This has been assessed against the existing per capita consumption (PCC) of water and our ambitious targets to reduce PCC to 110 litres per head per day by 2050. Out ambitious target is our preferred plan and the existing PCC is identified as an adaptive plan.

The assessment has highlighted a number of WwTWs that will require interventions by 2060. Our ambitious target to reduce PCC to 110 litres per head per day by 2050 is incorporated in our DWMP preferred plan. A scenario in which the existing PCC level is maintained is identified as an adaptive plan.

The preferred plan for DWF against the DWMP Planning Horizons is:

Location	2030 Planning Horizon	2045 Planning Horizon	2060 Planning Horizon
Allendale WwTW	Pass	Fail	Fail
Alnmouth WwTW	Pass	Pass	Fail
Bowburn WwTW	Fail	Fail	Fail
Brasside WwTW	Fail	Fail	Fail
Chilton Lane WwTW	Pass	Pass	Fail
Howdon WwTW	Fail	Fail	Fail
Longhorsley WwTW	Pass	Fail	Fail
Lynemouth WwTW	Pass	Pass	Fail
Morpeth WwTW	Fail	Fail	Fail
Snitter WwTW	Pass	Fail	Fail
Stressholme WwTW	Pass	Fail	Fail
Willington WwTW	Pass	Pass	Fail

In the period 2025-2030, investment will take place at:

Location	Intervention	Capital Expenditure Cost (£m)
Bowburn WwTW	Increased growth requiring an upgrade to the WwTW's to meet demand.	8.0
Brasside WwTW	Increased growth and transfer from Pity Me WwTW requiring an upgrade to the WwTW's to meet demand.	17.2
Howdon WwTW	Increase in growth requires interventions to treatment to increase capacity to 271,031m3/day. Purchase of adjacent site completed to enable expansion to occur.	90.0
Morpeth WwTW	Continued growth requires an upgrade to the existing works. Industrial effluent discharge to be removed from one facility reduces the extent of the required intervention	9.2

Snitter WwTW has been identified as having high infiltration of surface water and a study is planned before 2030 to investigate options to remove this from the combined sewer network.

15.7 WASTEWATER NETWORKS

In this section we identify our plan for works required at wastewater treatment works (WwTWs) and to meet the requirements of the Water Industry National Environment Programme

15.8 SEWER COLLAPSES – DWMP COMMON PLANNING OBJECTIVE

We continue to invest in the initiatives to reduce the risk of collapses in our sewer network. The key initiatives associated with this initiative, alongside the benefits we measure and report against are shown below.

Intervention	Description
Enhanced Flooding Other Causes	Increased length (km) of proactive CCTV and network rehabilitation on our network
Training/Awareness	This includes improving the data we collect on site to improve root cause assessment and allowing us to raise jobs more efficiently and effectively.
Solution hierarchy	This involves ensuring that the solutions we identify are right first time and avoid where possible the need to "dig down".

In addition to this we are increasing our investment by an additional £49.5m of capital and operational expenditure for the period 2025-2030 to help us reduce sewer collapses in line with our proposed performance commitment level. This will take our overall investment to help reduce sewer collapses to approximately £150m for the period 2025-2030.

This additional £49.5m investment will include:

- Investment in an enhanced strategy and inspections for wastewater networks. This will lead to the following benefits:
    - Effective information and data to help optimise our network performance.
    - Reducing the risk of future failures.
    - Optimised strategy for future investment.
    - Evidence based assessment of asset health.
- An enhanced sewer rehabilitation programme (above existing levels) – targeting reducing condition grades in high-risk locations.
- An enhanced proactive inspection and fix programme (above existing levels).
- A greater investment for rising main replacement – named schemes.

15.9 SEWER FLOODING – DWMP PLANNING OBJECTIVE 1 - INTERNAL SEWER FLOODING AND PLANNING OBJECTIVE 2 – EXTERNAL SEWER FLOODING

Sewer flooding is expected to increase in the future. The rate of increase is not linear and accelerates after 2030 as the impact of climate change models take effect.

The table below outlines the modelled number of properties at risk and the extent of the future increase

Planning Objective	2020 no properties at Risk	2025 no properties at Risk	2030 no properties at Risk	2045 no properties at Risk	2060 no properties at Risk
P01 - Internal flood risk	15,735	15,787	16,200	23,587	25,769
PO2 - External flood risk	232,945	234,395	236,343	304,571	320,355

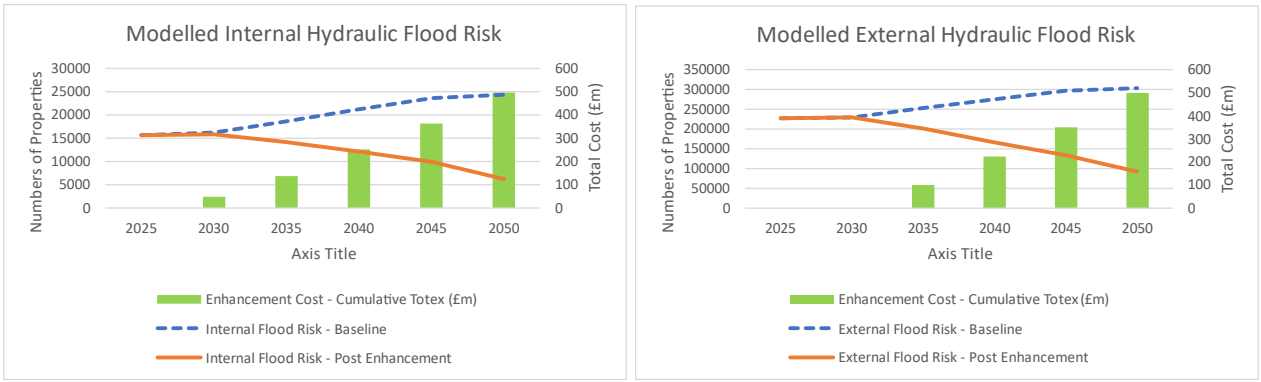
Our Long-Term Delivery Strategy identifies a target of reducing sewer flooding by 60% from our 2025 position. To achieve this, we will plan to reduce hydraulic flood risk by:

- 17,999 internal properties
- 216,074 external properties

in the period between 2030 and 2050. This approach deals with the impact of climate change, growth and urban creep.

This target is in line with the targets in the National Infrastructure Commission (NIC) report on surface water flooding. This report can be found on the NIC website at Surface water flooding - NIC.

Figure 26: Reduction in modelled internal and external flood risk 2030-2050



It is anticipated that we will achieve these targets through the following approaches:

- Working in partnership through the NIDP
- Working with customers and communities for the widescale disconnection of roof drainage from the combined sewer network
- Implementing source control via sustainable drainage measures (SuDS) including wetland creation
- Implementing Smart Networks throughout the region
- Disconnecting highway drainage and
- Working with others to implement permeable pathing and roadways schemes.

Examples of wetland creation installed as part of the Killingworth and Longbenton Surface Water Management Scheme

Wetland creation at Longbenton High School

Floating island for habitat and water quality improvement at Killingworth Lake

We have estimated that the cost of achieving our ambitious targets will be £1 billion between 2030 and 2050. We will seek customer support for investment to achieve these targets.

Planning Objective 1 - Internal Property at Flooding Risk proposal

L2 Area	2025 no properties at Risk	2030 no properties at Risk	2045 no properties at Risk	2060 no properties at Risk
Northumberland - Pre-intervention	1,700	1,712	2,635	3,119
Northumberland - Post-intervention	1,700	1,712	1,080	1,055
Rural Tyne - Pre-intervention	1,470	1,486	2,079	2,203
Rural Tyne - Post-intervention	1,470	1,486	734	439
Tyneside - Pre-intervention	2,997	3,260	4,821	5,272
Tyneside - Post-intervention	2,997	3,260	2,439	2,107
Wearside - Pre-intervention	1,182	1,194	1,935	2,135
Wearside - Post-intervention	1,182	1,194	931	801
Wear - Pre-intervention	2,691	2,756	4,065	4,380
Wear - Post-intervention	2,691	2,756	1,641	1,141
Teesdale - Pre-intervention	2,066	2,067	2,753	2,991
Teesdale - Post-intervention	2,066	2,067	929	578
Teesside - Pre-intervention	3,681	3,725	5,299	5,669
Teesside - Post-intervention	3,681	3,725	2,263	1,631

Planning Objective 2 - External Property Flooding Risk proposal

L2 Area	2025 no properties at Risk	2030 no properties at Risk	2045 no properties at Risk	2060 no properties at Risk
Northumberland - Pre-intervention	23,272	23,695	29,941	30,935
Northumberland - Post-intervention	23,272	23,695	10,881	7,456
Rural Tyne - Pre-intervention	15,070	15,170	18,523	19,279
Rural Tyne - Post-intervention	15,070	15,170	4,455	1,956
Tyneside - Pre-intervention	59,080	59,455	79,416	84,709
Tyneside - Post-intervention	59,080	59,455	45,713	44,028
Wearside - Pre-intervention	21,002	21,286	29,054	31,192
Wearside - Post-intervention	21,002	21,286	14,685	13,695
Wear - Pre-intervention	38,890	39,007	48,909	51,278
Wear - Post-intervention	38,890	39,007	17,255	12,147
Teesdale - Pre-intervention	21,468	21,652	26,184	27,293
Teesdale - Post-intervention	21,468	21,652	6,680	3,199
Teesside - Pre-intervention	55,613	56,078	72,544	75,669
Teesside - Post-intervention	55,613	56,078	33,436	27,760

The above tables include the reduction in flood risk from all wastewater programmes including SORDP and NIDP.

The adaptive plan scenario 4 identified in Part B changes our plan. As a reminder,

- Increase the role of surface water separation and sustainable drainage solutions to target delivering a reduction of internal and external sewer flooding alongside storm overflow discharge reductions for the RCP2.6 scenario.

We have estimated that the cost of achieving our ambitious targets will be reduced from £1 billion to £878m between 2030 and 2050. We will seek customer support for investment to achieve these targets.

15.10 RISK OF SEWER FLOODING IN A 1 IN 50-YEAR STORM – PLANNING OBJECTIVE 3.

In addition to the benefits that we have identified for PO 1 and PO2 above, we also expect to achieve secondary benefits for PO3 - Risk of sewer flooding in a 1 in 50-year storm.

The risk of sewer flooding in a 1 in 50-year storm is predicted to increase over time as shown in the table below due to climate change, urban creep and population growth. Also identified are the benefits achieved from the DWMP.

Planning Objective	2025 %age Risk	2030 %age Risk	2045%age Risk	2060 %age Risk
P03 - Risk of sewer flooding in a 1 in 50-year storm. Pre-intervention	15.48	15.59	20.11	21.18
P03 - Risk of sewer flooding in a 1 in 50-year storm. Pre-intervention	15.48	15.48	19.82	20.88

15.11 POLLUTION – DWMP PLANNING OBJECTIVE 6

As outlined in Part A, we have a very successful programme of operational interventions to the reduce impact of blockages in our wastewater network has on the water environment.

Our plan to reduce the risk of sewer flooding (outlined above) will achieve a reduction in the hydraulic risk of escapes from manholes close to watercourses. Therefore, our plan for pollution is identical to our plan for sewer flooding.

We anticipate that our number of pollution incidents per 10,000km of network will be:

Outcomes	2025 Risk	2030 Risk	2045 Risk	2060 Risk
Pollution incidents – no action	19.5	19.5	20.9	24.4
Pollution incidents – planned outcome	19.5	13.65	10.9	10.9

We have carried out analysis on the risk of an escape from the sewerage system impacting on a watercourse in a 1 in 5-year storm (20% chance of occurring per year). We have utilised hydraulic models of our assets to conclude that our pollution risk will be:

Modelled Flood Risk	2025 Risk	2030 Risk	2045 Risk	2060 Risk
Total manholes at risk – no action	2,069	2,096	2,074	2,710
Total manholes at risk – planned outcome	2,069	2,064	1,137	828

We will achieve both the above targets by 2050 and will maintain these in future years to ensure no deterioration occurs.

In addition, our Pollution Incident Reduction Plan (2022) outlines the actions we undertake to reduce pollution from manholes close to watercourses. These includes:

- Increased visibility of our wastewater system through the deployment of low cost telemetry at descriptive sewage works and level monitoring of high risk sewers near to watercourses.
- Full deployment of Stormharvester smart network management technology using advanced machine language learning, together with hyperlocal rainfall forecasting, to accurately predict the normal performance of our assets and provide alerts of issues occurring.
- Base maintenance capex programmes to target pollution risk reduction, vulnerable locations and increase resilience.
- Find and fix programme to address sewers near to watercourse risks.

The EA's Water Industry Strategic Environmental Requirements (WISER) contains the following obligations under regulatory compliance:

- at least a 30% reduction of all pollution incidents (cat 1 to 3) by 2030 on current 2025 targets (Statutory).
- there might be some variation depending upon WaSC performance during AMP7 to 2025.
- at least 90% self-reporting by 2030 with >95% for SPSs and WwTWs (Non-Statutory).

Post 2025, we will continue to invest in our business as usual activities and also invest more in key areas to help us to achieve the targets set out in our 2025-2030 business plan. These Include:

- Increased wet well cleansing.
- Proactive investigations and root cause assessments to evidence "no impact".
- Increase the number of burst sensors and early warning capability on rising mains.
- Increase the size of our misconnections team.

In order to achieve these statutory obligations, we need to invest £40m totex expenditure per 5-year investment period between 2025 and 2060.

We continue to put in place measures to increase our power resilience, such as improved arrangements for generators and engagement with our power Distribution Network Operator to address risks. We also actively share experiences and learn from others, such as through the industry Pollution Reduction Task Force and our innovation networks.

16.0 RESILIENCE

This section outlines our plans to make our assets more resilient to a changing climate.

We have carried out analysis to support our 2025-30 Business Plan to understand the impact of climate change on resilience and have identified a number of investments that we consider necessary in relation to resilience to power outages and flooding.

These are:

- Protection of 52 wastewater treatment works and 60 sewage pumping stations from a 1 in 100-year event from surface water or river flooding or a 1 in 200 event from tidal flooding.
- Protection of 27 high criticality wastewater treatment works and 57 high criticality pumping stations from power outage associated with severe storm or wind events or repeat failures from the power distribution network operator. We are protecting against a third-party power failure both in normal operating conditions and extreme weather.

The cost for protecting assets from flooding and power outages is circa £75m for the period 2025-2030.

For further information on our approach to resilience across the wider business in the period 2025-2030, refer to our Business Plan 2025-2030:

Business Plan 2025-30 (nwg.co.uk)

16.1 FURTHER INVESTIGATIONS

In the period 2025-2030, we intend to carry out investigation in a number of areas to assess the impact of our assets have on specific environments. We will use the information gained to develop future plans, if necessary.

Bathing water investigations

We reviewed the list of bathing waters with the Environment Agency (EA) to include in our business plan for 2025-2030. The EA has produced a process that provides an assessment of the current planning classification for each bathing water versus the baseline classification. The planning classification is a ‘warts and all’ assessment as all samples are included, such as discounted short term pollution samples. This highlights where a bathing water has deteriorated or is at risk. The following designated bathing waters were identified for investigation by April 2027:

- Beadnell
- Crimdon
- Newbiggin South
- Seaton Sluice
- South Shields

Investigations consist of desk top assessments, collection of monitoring data (e.g. bacterial sampling and analysis), field surveys and marine impact modelling. They provide a detailed catchment wide assessment to understand the reasons for deterioration, a source apportionment and an options appraisal of actions to improve bathing water quality.

We have also worked with the North East Catchments Hub to identify potential new inland bathing waters. Based on recent applications to Defra for designation, we have also submitted plans for investigations at three non-designated bathing waters, which requires evidence of customer support. These sites are:

- Wylam (Inland River)
- Fish Sands (Coastal)
- Fishermans Haven (Coastal)

These investigations will follow the same methods as the no deterioration studies.

The cost of these investigations is £1m for deterioration investigations and £645,000 designation investigations between 2025-2030.

Shellfish Water Investigations

We are undertaking a shellfish waters investigation at Holy Island shellfishery in Northumberland that will be completed by April 2027. This is to understand the reasons for a deterioration in the levels of bacteria in the mussel flesh and why the microbial standards are not being met consistently. The investigation will identify actions that are needed to improve the shellfish waters.

The study will comprise of a review of current information in a desk top review, the collection of monitoring data (e.g., bacterial sampling and analysis) and marine impact modelling. This will be reviewed to characterise the catchment and assess the sources of microbiological contamination. An option appraisal report will be prepared to identify the needs for further investment to protect the shellfishery.

The cost of this investigation is £210,000 between 2025-2030.

Marine Conservation Zones

Under our WINEP planning, we will undertake investigations at Marine Conservation Zones (MCZs) to determine any impacts from our assets and operations on protected features. The overall aim is to maintain the conditions of the sites in favourable conditions. The MCZs for investigation by April 2027 are as follows:

- Aln Estuary MCZ
- Berwick to St Mary's MCZ
- Coquet to St Mary's MCZ

An options appraisal report will identify the needs for further investment to maintain or improve to favourable condition along with technical feasibility of meeting the targets for the MCZs.

The cost of these investigations is £111,000 between 2025-2030.

17.0 SUMMARY OF PROGRAMMES IN THE DWMP

Our DWMP outlines the investment that is required over future decades to ensure that drainage and wastewater systems are able to cope with the coming pressures associated with climate change, population growth and increased impermeable hard standing in urban areas (known as urban creep). Our plan outlines the level of investment that is required to achieve a number of planning objectives associated with flooding, and the environmental impact of storm overflow discharges and wastewater treatment.

We have developed a preferred plan that incorporates all of the significant investments to meet new statutory requirements and additional investments to improve performance where required. The five sections above form our DWMP and a summary of the cost for the period 2025 – 2050 are shown below.

DWMP section	Preferred Plan
Storm Overflows	£3,076m
Wastewater Treatment	£295m*
River Water monitoring	£232m
Wastewater Network	£1,064m
Resilience	£50m*
Further Investigations	£1m*
Total	**£4718m**

*denotes 2025-2030 costs only

This plan does not include all activities undertaken in our base plan (base maintenance and routine maintenance activities to manage performance and risk). Our plan also does not include the management of sludge, which will form a separate part of our PR24 business plan submission to Ofwat in October 2023.

We have assessed the likely impact on customer bills that would result from our preferred plan. By 2060 we expect this investment from DWMP would mean that customers' annual wastewater bills will increase by £166 from the current bill of £187. Bills will start to increase in 2025 with a year on year increase over and above the normal inflationary increases. Our long-term delivery strategy, due to be consulted on during June, will look at long-term bills in more detail and across all parts of water and wastewater.

We are gathering our customers' views on this plan during our business planning process in the coming weeks. There are a number of aspects of our plan that remain under review by our regulators, the Environment Agency and Defra. These aspects are therefore subject to change in the coming months. It is likely that we will republish our DWMP along-side our draft business plan in October 2023.

A summary of all our interventions together with costs can be found in our L1 and L2 plans. These are found on our DWMP website at www.nwl.co.uk/DWMP

18.0 STRATEGIC ENVIRONMENTAL ASSESSMENT

Although not a regulatory requirement for this cycle of DWMPs, we have completed a Strategic Environmental Assessment (SEA) on the Least Cost, Best Value and Best Value Marginal Green Options.

Our SEA provides an opportunity to consider ways by which the plan can contribute to improvements in environmental conditions; as well as a means of identifying and mitigating any potential adverse environmental effects that the plan might otherwise have. It has informed the decision-making process through the identification and assessment of significant and cumulative effects our plan may have on the environment. By doing so, it has helped ensure that the proposals in the plan are the most appropriate given the reasonable alternatives. The SEA process is conducted at a strategic level and enables consultation on the potential effects of a plan with a wide range of stakeholders.

A final stage of the SEA process is to assess any monitoring required at implementation of the plan with the purpose of identifying unforeseen adverse effects at an early stage and being able to undertake appropriate remedial action. In line with the SEA Regulations, monitoring is only required for significant environmental effects and may comprise or include monitoring undertaken for other purposes – monitoring of all topic areas is not required. Monitoring proposals within the DWMP were reviewed and found to cover all the potential significant adverse effects (and benefits), as such no additional monitoring is proposed through the SEA.

A Habitats Regulations Appraisal (HRA) Stage 1 Screening and Stage 2 Appropriate Assessment has also been undertaken at plan level to check if proposals within the plan are likely to have a significant effect on the conservation objectives of sites within the national site network (previously known as 'European Sites'), i.e., Special Protection Areas and Special Areas of Conservation. The screening has identified the relevant sites within and adjacent to (within 5km) of the study area, their qualifying features, and the potential negative and positive impacts on the sites. The plan level appropriate assessment carried out on the remaining 95 L3 catchments shows that with appropriate mitigation, no likely impact is expected on any protected sites.

The Strategic Environmental Assessment Report and HRA Assessment can be found on the DWMP web page www.nwl.co.uk/dwmp

Our SEA has driven the development of our plan. It has identified that the Best Value Marginal Green preferred plan for Storm Overflows provides additional environmental benefits and moves the plan to an overall positive position.

19.0 WHY WE CONSIDER THIS TO BE A GOOD DWMP

Throughout the development of our Drainage and Wastewater Plan, we have endeavoured to ensure that the plan:

- Meets all the requirements of the DWMP Framework other than when they have been superseded by legislation and regulator guidance. Drainage and Wastewater Management Plans | Water UK
- Complies with Defra's Guiding principles for drainage and wastewater management plans a principles for drainage and wastewater management plans - GOV.UK (www.gov.uk)
- Includes regulator and customer feedback from our draft DWMP. See our statement of response at www.nwl.co.uk/DWMP.
- Has been developed collaboratively, including through our Strategic Planning Group
- Meets the requirements of the Government's Storm Overflow Discharge Reduction Plan. This required us to created new hydraulic models to ensure all storm overflows that do not meet the SODRP targets are covered in the DWMP.
- Identifies collaborative opportunities – by L1, L2 and Drainage Area.
- Has been adapted to include the latest and best possible information including, but not limited to, climate change models, Time Series Rainfall generating software, and assessing the benefits of green infrastructure
- Has a Strategic Environmental Assessment that has driven the choices in the preferred plan
- Has been extended to cover close to 100% of the North East region

We therefore consider our DWMP to be a high quality plan.

As previously identified, our preferred plan meets the Ofwat's requirement to provide robust evidence for our business plan submission in October 2023. It also identifies how we intend to maintain and improve our performance to meet business objectives over the planning horizons covered in the DWMP.

20.0 ACKNOWLEDGEMENTS

We would like to take this opportunity to thank all those who participated and contributed to our DWMP. These include the following organisations:

Arup
Avant Homes
Banks Group
Barratt Homes
Barton Willmore
Bellway Homes
Blue Green City Declaration
Blueprint for Water
Broomford Farm
Canal & River Trust
Capability North East
CC Water
Coal Authority
Coast Care
Conservaqua
Darlington Council
Developing Consensus
Durham County Council
Durham County Council (Heritage Coast)
Durham Wildlife Trust
English Heritage
Environment Agency
Everflow Water
Forestry Commission
Forestry England
Future Water Association
Gateshead Council
Gentoo
Gleeson Developments
Groundwork North East
Groundwork South and North Tyneside
Hartlepool Council
Hellens Group
Historic England
JBA Consulting
Keepmoat Homes
Lichfields
Marine Management
Middlesbrough Council
Miller Homes
National Farmers Union
National Infrastructure Commission
National Trust

Natural England
Newcastle City Council
Newcastle University
North East Coastal Group
North East England Chamber of Commerce
North East England Nature Partnership
North East LEP
North East of England Chamber of Commerce
North of Tyne CA
North Pennines AONB
North Tyneside Council
North Yorkshire County Council
Northern Upland Chain Local Nature Partnership
Northumberland AONB
Northumberland Councy Council
Northumberland Estates
Northumberland Inshore Fisheries & Conservation
Northumberland National Park Authority
Northumberland Rivers Catchment Partnership
Northumberland Wildlife Trust
Northumberland Zoo
Northumbria Regional Flood and Coastal Committee
Northumbria University
Ouseburn Trust
Port of Blyth
Redcar & Cleveland Council
Rivers Trust
RSPB
RTPI
Skill Mill
South Tyneside Council
Stockton Coucil
Story Homes
Sunderland Council
Sustainable Water Industry Group
Taylor Wimpey
Tees Catchment Partnership
Tees Valley Combined Authority
Tees Valley Nature Partnership
Tees Valley Wildlife Trust
Teesside University
Tweed Forum
Tyne & Wear Museums
Tyne Catchment Partnership
Warkworth Harbour
Washington and Wetlands Trust
Water Forum
Wear Catchment Partnership

Wear Rivers Trust