UUW35

Environmental strategy

October 2023

Chapter 6 supplementary document

The document sets out the key challenges faced by the North West's environment and how our AMP8 plans propose to address these, building on case studies of past delivery and details of some of the unique features of UUW's Environmental Strategy, including our approach to natural capital accounting, catchment systems thinking, environmental markets and partnership working across catchments.

United Utilities

Water for the North West

Contents

1. Environmental Strategy

1.1 Key messages

Through our environmental strategy we will:

- **Work with a range of stakeholders through Place Based Planning** developing bespoke solutions for water management in partnership.
- **Work systemically at a catchment scale** through our Catchment Systems Thinking (CaST) approach.
- **Drive more effective management of surface water across catchments**, utilising nature-based solutions where appropriate to reduce the pressure on sewerage networks, reducing spills and delivering resilience to climate change.
- **Deliver resilient, sustainable raw water sources** by effective upland management to improve water quality and quantity as well as supporting increased biodiversity and reduced greenhouse gas emissions.
- **Continually monitor, assess and account for our natural capital assets**, using this data to evaluate delivery and support long term planning.
- **Work with partners to innovate in monitoring and collaborative planning** to tackle challenging environmental issues across the region such as through the Love Windermere partnership.
- **Support the development of innovative environmental markets** to engage a broader range of stakeholders in collaborative delivery.

1.2 Structure

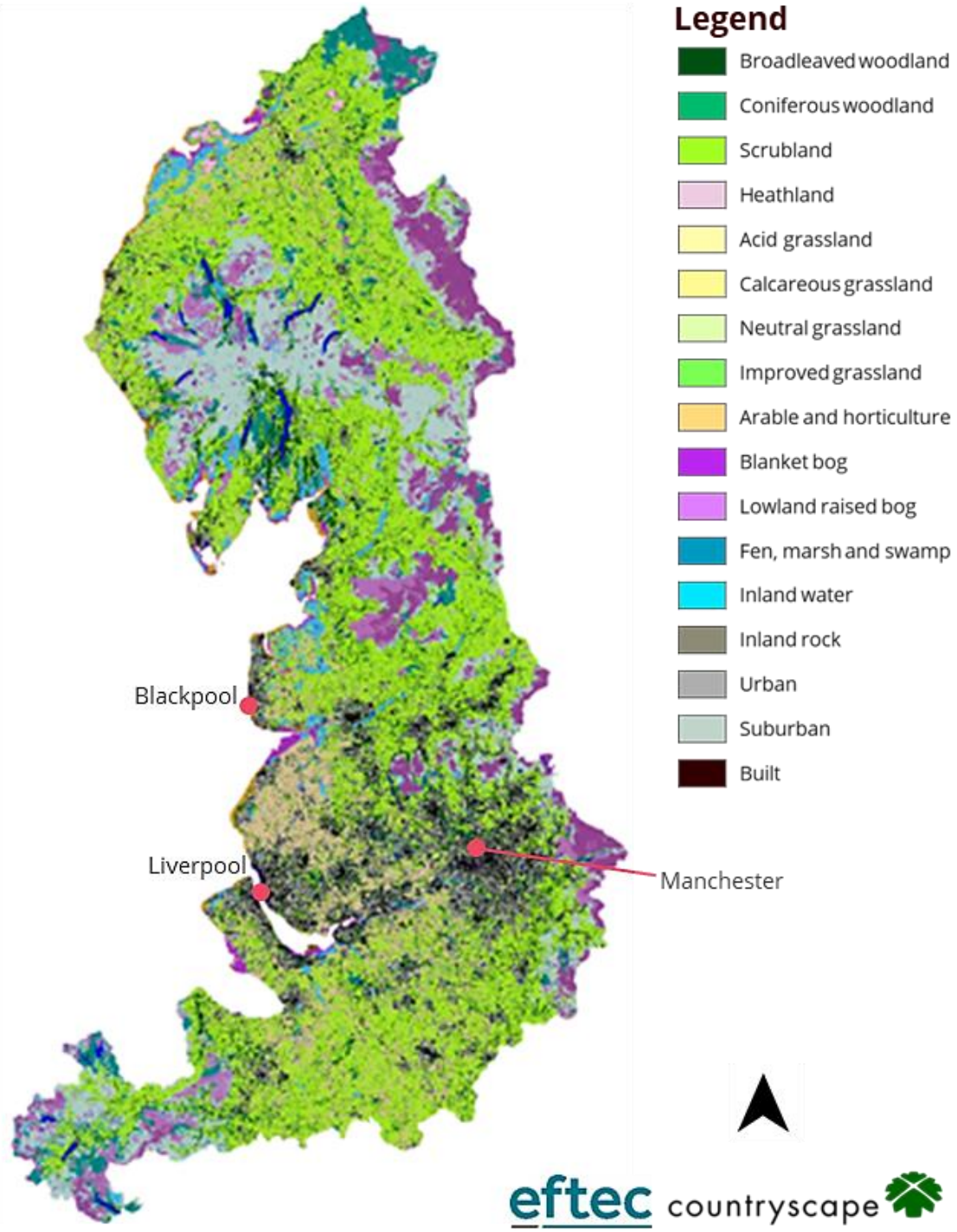
1.2.1 This document sets out details of some of the unique features of UUW's Environmental Strategy, including our approach to natural capital accounting, catchment systems thinking, environmental markets and partnership working across catchments. It is structured as follows:

- **Section 1** outlines the North West environment and some of the challenges faced.
- **Section 2** Includes case studies to support how we use our Catchment Systems Thinking, partnerships and environmental markets approaches. This further outlines how we use these approaches to meet the challenges identified in section 1 and drive improvement in the environment of the North West.
- **Section 3** outlines the specific challenges we will be tackling in our AMP8 plans, how we will deliver against these and demonstrates why this approach will be successful based on past delivery.

1.3 Overview

1.3.1 The natural environment in the North West Region is contrasting and unique. 66 per cent is protected by a landscape designation such as National Park or Area of Outstanding Natural Beauty and over 12 per cent of the land has an important European designation related to the habitat. This highlights the importance of the land for the provision of ecosystem services, and the intrinsic link between people and the environment. The protected ecosystems include habitats such as blanket bog, upland heath, acid grassland, reservoirs, rivers, streams, woodland and grassland. The most significant in terms of area (around 50 per cent) and its potential to store carbon is blanket bog which is a critical asset for UUW due to the water that is stored and the impact this habitat can have on the quality of water if it is in good condition. These habitats provide a home for many species of plant, animal and insects. Of particular significance are red deer, red squirrel, red grouse, hen harrier, curlew, golden plover, dunlin, short eared owl, mountain hare and water vole.

Figure 1: North West habitat map taken from the North West baseline NC Account



Source: Eftec report for UUW

1.3.2 Resilient ecosystems that have the capability to respond to the stresses and shocks that they encounter are key to being able to continue delivering our service. As a water company we are dependent on the ecosystems that we operate in to provide a reliable supply of high quality water for abstraction, reduce the risk of flooding and to receive treated wastewater so we can return this to the environment. The resilience of ecosystems is therefore critical to sustaining a high quality service in the long term.

1.3.3 As shown in Figure 1 there are a wide variety of habitats in the North West and North Wales, all providing a range of ecosystems services to customers. This assessment has been conducted to include North Wales as we recognise the key impact this area has on our service provision based on the water that is abstracted from these catchments. As a result it is important that we consider the impacts of natural capital across the full area which affects our service provision.

1.3.4 United Utilities interacts with this landscape in multiple ways to protect and enhance its resilience:

- Of the circa 56,000 Ha of land owned by United Utilities - much of which is catchment land which directly feeds our water abstractions - 66 per cent falls within a designated landscape;
- 43 sites are designated as SSSI, comprising 331 units (specific divisions within SSSIs based on habitat type and management). These measure a total of 22,435 hectares which represents 41 per cent of our entire land holding;
- There are 11 RAMSAR (wetlands of international importance) sites in the North West. These are not in our ownership but they are within our area of operation and therefore we play an important role in protecting these sites and the benefits that they can deliver;
- 6,816 hectares (around 12 per cent) of the UU land holding is woodland, of which 4,336 hectares is managed commercially for timber. To ensure this land is effectively managed to protect the benefits it delivers, our commercial forestry operations have been Forest Stewardship Council® (FSC®) certified since 2003. The FSC-UK forest management standard endorses the UK Woodland Assurance Standard (UKWAS) and this certification guarantees the timber planning, growing and felling operations to a high standard; and,
- Through our Sustainable Catchment Management Plan (SCaMP), which was focused on delivering catchment improvements for the benefit of raw water quality and biodiversity, we created new woodland areas to improve biodiversity. This effort amounted to 800,000 trees planted between 2005 and 2015. We have pledged to plant a further 1 million trees (550 hectares) by 2030 as part of the carbon net zero commitment.

1.3.5 As shown in Table 1, 91per cent of the area of SSSI currently meets “favourable” or “unfavourable recovering” condition as a result of decades of investment by United Utilities on improving land and aquatic habitats. This figure has increased from as low as 14 per cent in the Peak District area in 2004, prior to delivering SCaMP.

Table 1: Improvements in United Utilities land conditions since the start of the SCaMP Programme

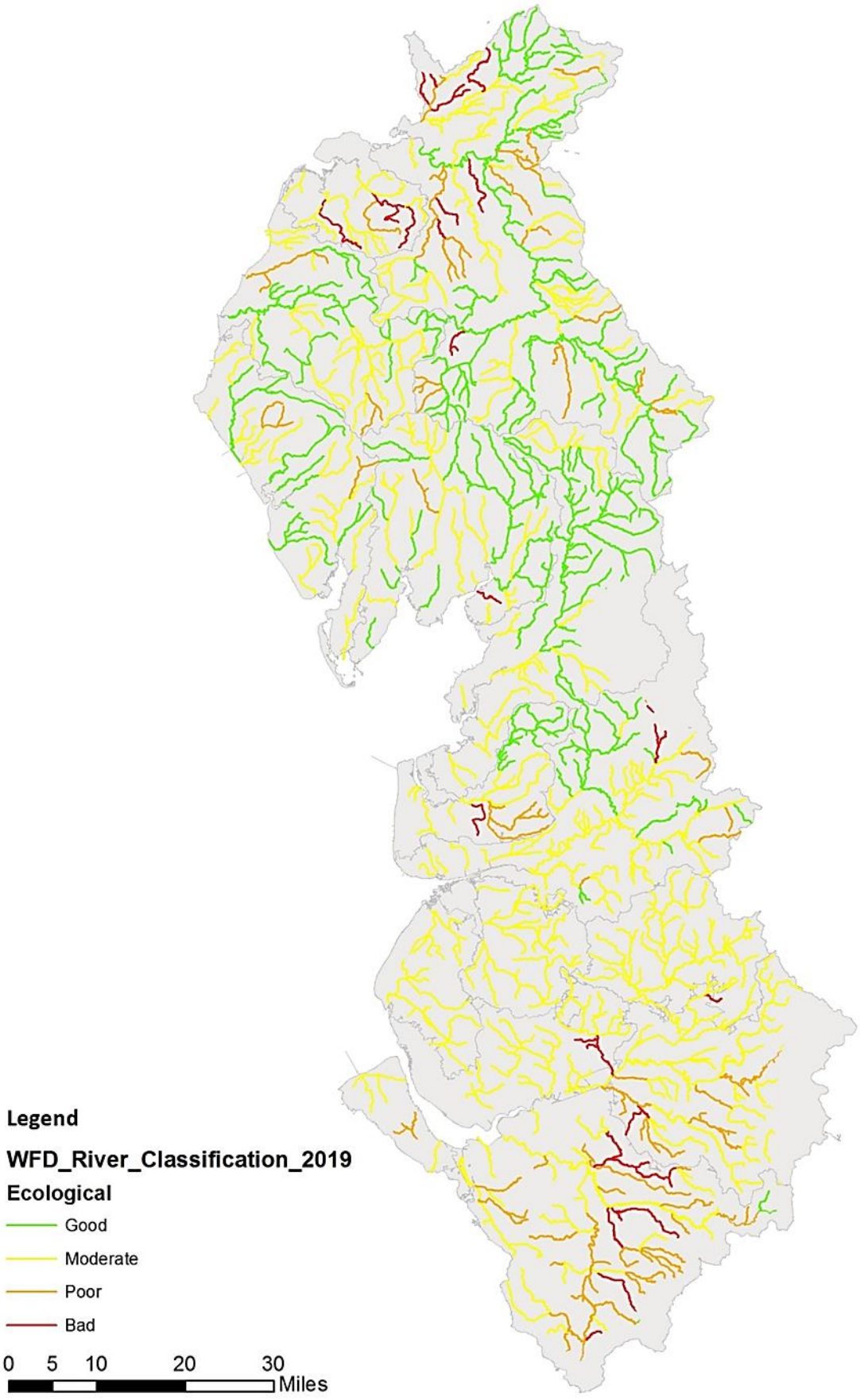
Year	% meeting area of favourable or unfavourable recovering	Favourable	Unfavourable - Recovering	Unfavourable - No change	Unfavourable - Declining	Destroyed
2023	91%	8%	83%	6%	3%	0%
2015	100%	9%	91%	1%	0%	0%
2004 (pre SCaMP)	48%	12%	36%	29%	23%	0%

Source: Natural England's designated sites portal

1.3.6 The contrasting landscape of the North West gives rise to a varied and ecologically important network work of rivers with 4,025km of rivers designated as Special Areas of Conservation (SAC) across the region. The rivers of the North West however face significant challenges with only 25 per cent of North West rivers achieving good or high ecological status under the Water Framework Directive (WFD) as shown in Figure 2. The reasons behind this are complex with a legacy of significant modification and rapidly growing populations that, over generations have utilising these rivers to serve their own needs such as agriculture and industry. This has contributed to 3,235 Reasons for Not Achieving Good (RNAGs).

1.3.7 UUW is committed to protecting and enhancing this valuable natural resource and the investment delivered over previous AMPs means that now only 18 per cent of the RNAGs in the North West are attributed to the water industry as shown in Table 2. There is still however considerably more to do. Table 2 shows the range of sectors that contribute to the status of the North West’s rivers and demonstrates the significant activity that is needed across multiple sectors to drive a healthy river network across the North West and realise the benefits that this can deliver for customers.

Figure 2: Map showing the WFD status of North West Rivers



Source: EA WFD classification from catchment data explorer

Table 2: North West RNAGs for the ecological status of rivers by sector

Sector	Ecological Reasons for Not Achieving Good Total	Ecological Reasons for Not Achieving Good percentage allocation
Agriculture and rural land management	1429	44.2%
Domestic General Public	137	4.2%
Industry	90	2.8%
Local and Central Government	83	2.6%
Mining and quarrying	27	0.8%
Navigation	10	0.3%
No sector responsible	188	5.8%
Other	37	1.1%
Recreation	8	0.2%
Sector under investigation	241	7.4%
Urban and transport	402	12.4%
Waste treatment and disposal	1	0.0%
Water Industry	582	18.0%
Grand Total	**3235**	**100%**

Source: UUW analysis from EA Catchment Data Explorer

1.3.8 The impact of historic land use and decisions taken to drain areas of land and channel water rapidly from uplands, combined with increasing urbanisation resulting in rapid surface water flows to water courses causes significant challenges in water quantity. This is evidenced by the flooding witnessed in the North West which has a significant impact on people's lives. In winter 2015/16 storms Desmond, Eva and Frank caused significant flooding across Cumbria, Lancashire, Greater Manchester and North West Yorkshire with thousands[1] [2] of homes and businesses flooding. This resulted in an estimated cost of damage of £1.3 billion according to the Association of British Insurers[3].

1.3.9 Managing this water differently, seeking to store as much as possible in the upland landscape and restoring natural drainage features is a key element of UUWs AMP8 plan and working with the landscape across catchments will be key to meeting these objectives.

1.3.10 As the landscape across our region is all interconnected and the services that this provides are dependent on the resilience of the full system we are committed to working with other stakeholders and land owners in the region. As part of our approach to doing this effectively we have led activity to develop a regional natural capital account. This has been developed collaboratively with a range of stakeholders and will be used to support a system approach to protecting and enhancing the North West's natural capital and drive partnership activity across the region.

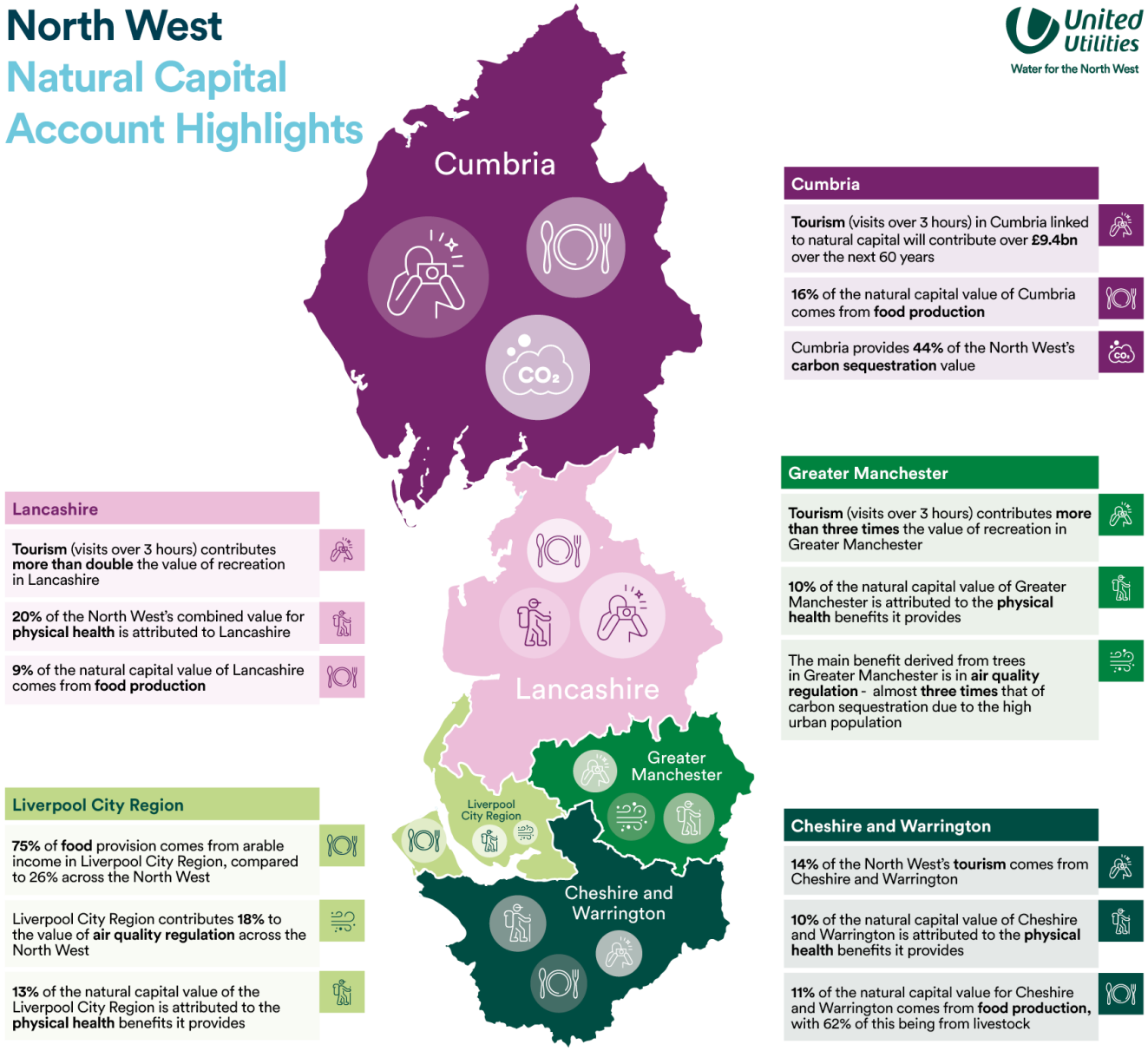
1.3.11 Our work on the natural capital account demonstrates both the physical and economic value that resilient well performing ecosystems provide for the region. It has shown that the natural capital of the North West has an estimated net present value of £137 billion over the next 60 years. This comprises of £51 billion of value to society and £85 billion of value to businesses.

[1] lancashire.gov.uk/media/900010/section-19-flood-investigation-report-december-2015-floods.pdf

[2] cumbria.gov.uk/elibrary/Content/Internet/536/671/4674/17217/17225/43312152830.PDF

[3] insurancetimes.co.uk/abi-uk-floods-to-cost-insurers-13bn/1416942.article

Figure 3: Learning from the UU Led North West natural capital baseline



Source: UUW North West Natural Capital baseline

1.3.12 As can be seen in Figure 3, the measurement completed in the natural capital account demonstrates the significant value the natural environment provides to the people of the North West. This shows the need to protect these assets and the services that flow from them. The fact that 75 per cent of local authorities[4] have declared a climate emergency with a growing number now declaring nature emergences, demonstrates that there is growing awareness that these ecosystems are under increasing pressure and a growing appetite to collaborate to tackle this challenge. Climate change is increasing the shocks and stresses that ecosystems are exposed to with more frequent instances of extreme weather, drier warmer summers and wetter winters. This is affecting all infrastructure and having an increasing impact on customers lives, as a result, there is now a greater interest from local government with elected mayors in particular taking active steps on water management. For example, Andy Burnham (Mayor of Greater Manchester Combined Authority) hosted two round tables on water management in the last year. This increased interest creates opportunities to work collaboratively and has resulted in the development of an Integrated Water Management Plan (IWMP) for Greater Manchester. Building on

[4] climateemergency.uk/blog/list-of-councils/

this foundation, we are currently working with the Liverpool City Region to develop a place based plan for water in this region.

1.3.13 Additional insights from the development of a North West natural capital baseline include[5]:

- Natural Capital provides over £385 million pa of benefits to the North West farming sector. Our insights will enable us to work together to support farmers, maintaining these benefits and seeking opportunities to drive greater value, such as by managing land to maintain output whilst increasing carbon and water storage.
- We estimate that woodland across the North West delivered £173 million of benefit in the improvement of air quality, which helps us understand the impact future activity could have.
- 1,537,838 tonnes of CO_2 are sequestered across woodland, saltmarsh and improved grassland; this is a vital benchmark in tackling climate change and can be monited annually.
- Rivers and lakes offer a welfare benefit of £146.8 million per year and to protect and enhance this value we need to prevent deterioration and drive increases in their water quality. This information on the welfare value of water supports the development of commitments such as our Better Rivers Better North West commitment for 95 per cent of customer to have access to a bathing water within 30 miles
- Active recreation across the North West delivers a value of £469 million per year in avoided medical treatment. This emphasises the need to work with partners focused on improving physical and mental health to support maximising this value from the regions natural assets
- The regions natural capital drives a value of £893 million per year for adult recreation as well as an estimated 68 million recreational visits by children. Understanding how natural assets are used by customers supports decisions that improve this provision

1.3.14 The nature of the challenges faced are significant and impact across landscapes meaning that these are not issues we can manage in isolation. To tackle these will require engagement and action across multiple stakeholders in the landscape. One of the key motivations behind the delivery of our North West natural capital account was to provide a consistent view of the assets in the North West and the benefits that they provide so that we could consistently work with other partners to align activity to protect and enhance these ecosystems.

1.3.15 This document describes how we are approaching our operations and investments to protect and enhance the environment of the North West and establish long term resilience. United Utilities has a long history of investing in catchments and since 2005 we have used our SCaMP programme to drive sustainable improvements in catchments for the benefit of water quality and biodiversity. Some examples of our leading approach to delivering for the North West Environment are included in Table 3.

Table 3: Key examples of United Utilities leading approach to delivering resilient ecosystems

Project	Location
First use of catchment nutrient balancing in Britain	Calthwaite Beck (Petteril)
First company to adopt catchment management to protect and enhance raw water	Regional wide through SCaMP
First integrated constructed wetland for storm spill treatment delivered in Britain	Southwaite WwTW
Second company to use a catchment permit	Manchester Ship canal strategy
First water company to develop a full regional natural capital account	North West Region
First CSO treatment wetland in England	Syd Brook, Chorley
First strategic partnership between the Rivers Trust and a water company	North West Region

[5] collab-uu.co.uk/wp-content/uploads/2021/12/United-Utilities-NWR-NCA-final-report-Nov21.pdf

1.3.16 As summarised in Table 3 we have been leading practitioners in how to manage and use catchments effectively for many years and the evolution of our approach from focusing largely on owned water catchment land though SCaMP into a focus on the full catchment system through CaST (Catchment Systems Thinking) demonstrates how our experience and learning is supporting us in developing and delivering our future strategies. This evolution will enable us to work effectively across the full catchment system to drive resilient ecosystems and protect and enhance the benefits that these ecosystems provide customers.

2. United Utilities Environmental Strategy

2.1 A Catchment Systems Thinking Approach

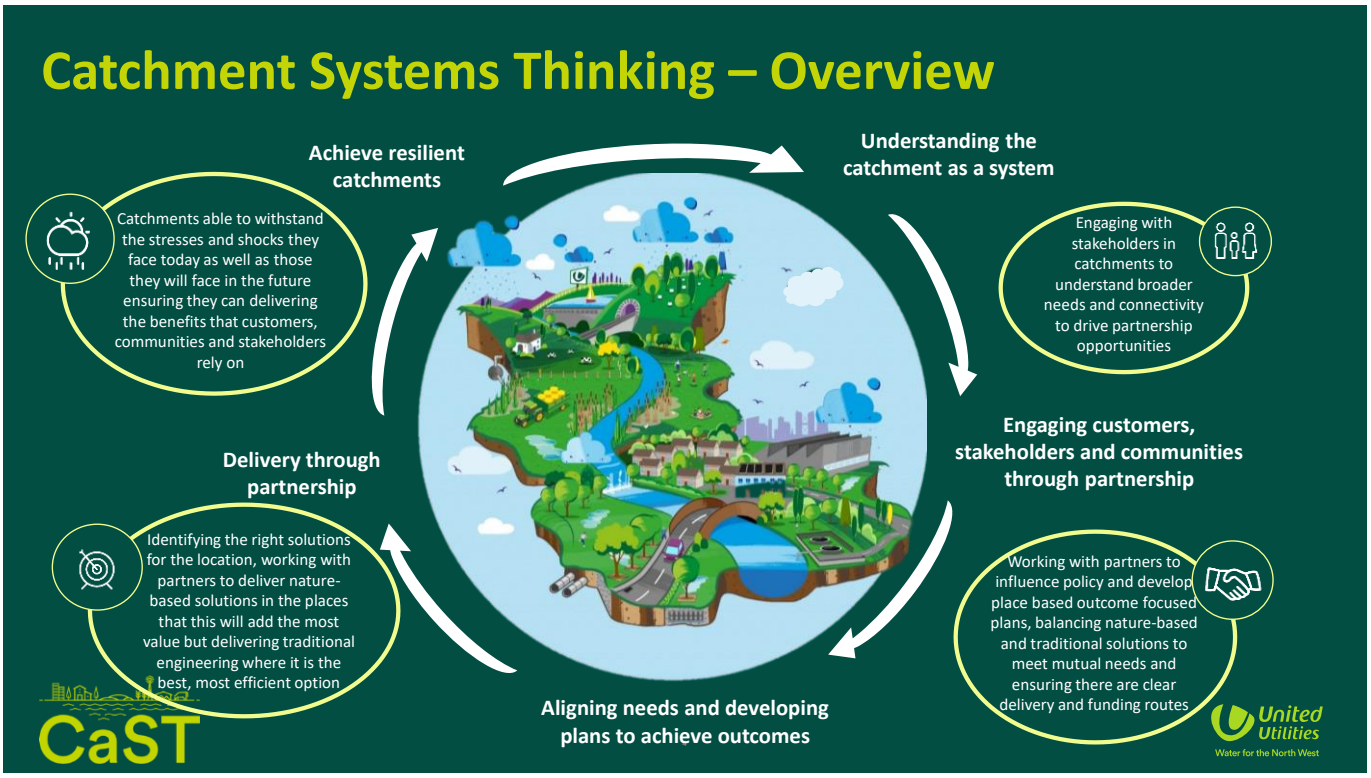
2.1.1 At United Utilities our strategy is to manage and understand the water environment at a catchment level. We call our integrated approach to water management Catchment Systems Thinking (CaST). This approach has been developed in recognition that we cannot de-couple our performance from the resilience of ecosystems and solely focus on our built systems to deliver service. As a result we understand the catchments in which we operate which allows us to determine the most effective and valuable way in which to intervene. We work effectively with other partners in the catchment to unlock the power of nature to support our delivery.

2.1.2 Our journey to Catchment Systems Thinking has developed over a long period during which we have grown and developed our understanding and approach. We first started our Sustainable Catchment Management Plan (SCaMP) in 2005 to manage raw water quality risk in upland catchments. Since then we've recognised this approach isn't just vital to protect water resources but important to address flood risk and manage the delicate balance between provision of essential services to customers and the health of ecosystems. To fully unlock this approach we have identified several key pillars to support the delivery of our environmental strategy as shown in Figure 4:

Figure 4: Key pillars of our environmental strategy

2.1.3 Delivering solutions that protect and enhance the natural environment are a key part of water companies' function and working with nature-based solutions can support delivering these enhancements in a way that maximises value for customers. However, nature-based solutions will not always be capable of delivering requirements in the most efficient way, so as shown in Figure 5 below CaST is not solely about investments in natural solutions. Fundamentally it is about understanding the full catchment system, the challenges that are currently faced and the most effective interventions to resolve these. This results in delivering the right intervention, in the right place, with the right partners, whether these are catchment measures delivered through partnership or traditional asset investment delivered by United Utilities. The guiding principle is that we must understand the functioning of the full catchment system to identify and deliver the best solution to the specific challenges faced and achieve the best overall value for the catchment and customers.

Figure 5: Catchment Systems Thinking overview



2.1.4 A key element to this approach aligns with our Dynamic Network/Treatment/Catchment Management approaches (DNM/DTM/DCM) which are discussed further in section 3.2. These programmes focus on improving our data and understanding of the operation of our network and treatment assets allowing us to utilise these in a more efficient and flexible way. This supports our identification of problems before they impact on service and allows us to optimise our asset base to resolve these issues effectively. The integration of catchment management into these programmes supports the long term use of catchment assets to support this overall delivery. These programmes are aligned to our CaST strategy and rely on understanding both the natural and the manufactured systems and how they interact to deliver the greatest benefits to customers and maximise the value that can be delivered.

2.2 Accounting for Natural Capital

2.2.1 Underpinning our CaST approach is our relationship with the natural capital of the North West and the services that it provides. Over recent years we have developed our understanding of natural capital and undertaken activity to grow our natural capital data across the region in three key ways. We have developed a corporate natural capital account which values the land owned by UUW, we have worked with stakeholders to complete a North West scale natural capital assessment which values the natural capital across the whole North West regardless of land ownership (some of the outputs from this can be seen in Section 1.3, Figure 1 and Figure 3), and we have delivered our Enhancing Natural Capital for Customers performance commitment which has developed project specific natural capital assessments. This data plays a key role in our long term planning, engagement with stakeholders and understanding the needs and opportunities to drive value across catchments. At the start of AMP7 we undertook an assessment of our natural capital capability and projected where we needed to be in 2050 in order to achieve our ambitions. The outcome of this assessment is shown in Table 4below which has been updated to reflect progress to summer 2023. As we have progressed through the AMP we remain on target to meet the goals established in this assessment.

Table 4: Natural capital maturity matrix

		VISION AND VISIBILITY		DEMONSTRATING ACTION				
		Vision, Values and Strategy	**Natural Capital Valuation**	**Natural Capital Influence and Engagement**	**Sustainable Management of Natural Resources for a Circular Economy**	**Ecosystem Resilience**	**Natural Capital Markets**	**"UUW target 2050 position"**
Natural Capital Embedded and Optimised	**5**	North West Catchment System Operation	Natural capital is valued for all of the North West	Natural capital decision making across the North West. Greater societal benefit is considered in decision making consistently across the industry	All resources are valued and used sustainably	North West ecosystems are regenerated so they are resilient to environmental stresses and shocks	Green solutions are funded through natural capital markets with access green finance	**UUW target 2025 position**
Natural Capital Balanced Decision Making	**4**	Full collaboration of partners within some catchments	Natural capital is valued within some catchments	Natural capital decision making within some catchments. Greater societal benefit is considered in decision making	All resources are valued and used sustainably within some catchments	Some catchment ecosystems are regenerated and resilient to environmental stresses and shocks	Collaborative financing of mutually beneficial work across some catchments using public and private funding	**UUW position Summer 2023**
Natural Capital Targeted Integration	**3**	Natural Capital embedded in internal decision making and integrated with partners at a project level	Natural capital is valued on specific projects	Decisions impacting our land are made to maintain or enhance natural capital	"CaST: green solutions delivered across water and wastewater projects. Valuing resources on owned and some	Natural Capital embedded in internal decision making and integrated with partners at a project level	Natural capital is valued on specific projects	**UUW position Spring 2020**
Natural Capital Strategic Awareness	**2**	Natural Capital awareness where there is a direct impact on UUW service	Natural capital is valued on UUW owned land	Natural capital valuations are built in to DWMP and WRMP long term plans and used in specific project decision making	SCaMP: Sustainable catchment management and valuing resources within UUW owned land.	Ecosystem risks are identified and projects build resilience to environmental stresses and shocks	No use of natural capital markets to finance activities. Traditional financing operating across programmes within UUW	
Natural Capital Corporate lateral activity	**1**	Natural Capital Strategy is at the corporate level only	Pockets of natural capital valuation at the corporate level only	Natural capital elements are included in project paperwork but doesn't change decisions	Unsustainable use of natural resources	Ecosystem resilience risks are understood at a corporate level only	No use of natural capital markets to finance activities. Some cross activity working at a corporate level	
Natural Capital Absence	**0**	No Natural Capital Strategy	Natural capital isn't understood or valued	No decisions are made based on natural capital	Unaware if use of natural resources is sustainable	Ignorance to the impact of ecosystem resilience on our business	Natural capital markets do not exist. Traditional financing operates in silos.	

Source: UUW Natural capacity strategy

Corporate natural capital account – Understanding the natural capital value of UUWs land holding

2.2.2 As part of the development of our natural capital capability – and in line with this maturity matrix - we have developed our corporate natural capital account which focus on understanding the value of the UUW land holding. The initial version of this was completed in 2017 but has now been refreshed for 2022 to bring it in line with the new British Standard (BS 8632)[6], as well as support the tracking of changes to our natural capital over this period. This data will support our ongoing planning as well as providing a measure of how resilient our natural assets are and a way to assess the impact of our investments on them.

2.2.3 To develop this account we worked with Eftec, a leading natural capital consultant, on both the first iteration and the recent refresh. Through this recent work we are developing our internal capability so that this process can be completed in house in the future which will allow us to refresh this data more regularly and use this to track delivery in the long term. This will continue the embedment of natural capital across the company to support the delivery of wider environmental outcomes.

2.2.4 Revising our account to understand changes and the impact of our decisions is already starting to show value. The updated account completed in 2022 showed that we have increased the net natural capital value of our land from £1,592 million to £4,528 million with only a modest increase in land ownership. This is supporting us in capturing the true value of our asset base and the services it can provide for customers and helping to inform decisions on how to most effectively manage this value. We are developing our capability to manage this more effectively and propose to continue repeating this account regularly to track improvements in our natural assets.

North West natural capital baseline – Understanding the natural capital value of the full North West

2.2.5 Whilst our corporate account helps to establish natural capital as a core principle in our thought process our impact on natural capital goes far beyond our own assets. In order to truly understand this impact and to support in the joint delivery of resilience across ecosystems it was necessary to develop a North West natural capital baseline.

2.2.6 Natural capital is not just the responsibility of water companies. It provides a common metric to measure benefits across multiple stakeholders and all society. This means that the development of a North West baseline was not something we could complete alone as it would need to be a key tool recognised and used across many organisations. As a result of this we formed a stakeholder group with representatives from local government, land owners, regulators and NGOs to support the development of this baseline. This group provided steer and feedback on the account and have supported in its dissemination. The reports and resources are now freely available to wider audiences through our CaST collaboration portal[7], meaning all stakeholders in the North West can benefit from this work.

2.2.7 This stakeholder relationship was key to achieving the results we needed out of this project as there are already a variety of local natural capital accounts across our region and we wanted to create something that added to and linked these on a regional scale to provide greater consistency across the North West. Maintaining effective relationships with regional stakeholders ensured this work was built on the existing natural capital accounting in the region and maintaining this will be key to delivering our long term aims of enhancing natural capital though the Natural Capital North West group which we have established.

2.2.8 Work is already underway to use the data with wider stakeholder groups, including several groups across Cumbria for example The Westmorland group have requested the data and are using this in developing projects along the M6 corridor in Cumbria

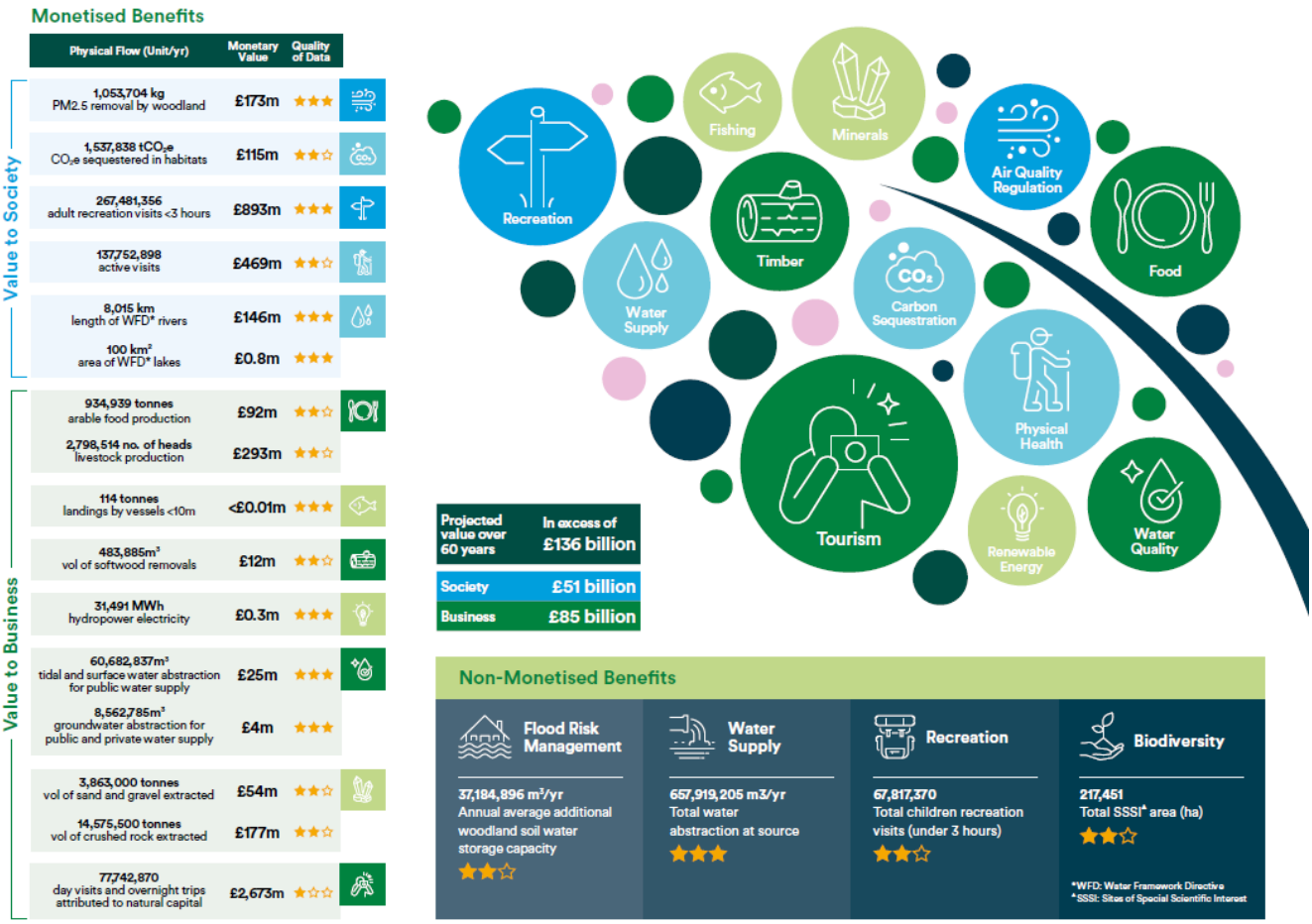
2.2.9 The analysis completed has proved useful to UU and has led to some key insights into the value of natural capital in the North West. It has already helped to show where across our region different

[6] bsigroup.com/en-GB/standards/bs-86322021/

[7] collab-uu.co.uk/cast/

natural capital is having the greatest benefit to customers. Figure 6 is produced from the analysis in the report[8] to help share and disseminate the key data and engage stakeholders with this work.

Figure 6: Infographic showing key natural capital values from the North West Baseline



Source: Northwest baseline report

2.2.10 Our aspiration is to maintain the engagement of key stakeholders and to grow the usage of the account across the North West, to help align planning and delivery to maximise the value of the region's natural capital. This account will continue to be evolved through feedback and regularly updated to track the condition of the region's natural capital and the resilience of our ecosystems.

Natural capital North West

2.2.11 In order to realise the full benefits of the North West natural capital baseline and provide an ongoing steer for the development and maintenance as well as sharing in the cost of these activities. We have formed a North West governance group to own the account and hold responsibility for driving the continual enhancement and maintenance of the regions natural capital.

2.2.12 Following on from the successful engagement during the development of the North West natural capital baseline, we invited a range of regional stakeholders - from regulators and local combined authorities to key private businesses with an interest in environmental resilience - to form a governance group. The purpose of this group is to drive collaboration with a focus on environmental and natural capital improvement, supporting the goals to deliver at landscape scale and working across catchments as a system to maintain and enhance the regions natural capital.

2.2.13 The focus on improving our natural capital across stakeholders facilitates increased partnership working and drives resilient ecosystems into the long term. Improving the condition of the region's natural

[8] collab-uu.co.uk/wp-content/uploads/2021/12/United-Utilities-NWR-NCA-final-report-Nov21.pdf

capital assets will ultimately improve the condition and quality of the services that it provides. Increasing environmental resilience and protecting and enhancing the value of ecosystem services helps to protect our services into the future and doing so in conjunction with other key stakeholders protects the wider services that customer's value.

2.3 Embedding natural capital in decision making

2.3.1 The growth in our understanding of natural capital and our ability to effectively value the additional benefits that this can provide has been important in developing our AMP8 plans. Our natural capital approach supported us in the development of a value tool, in line with the WINEP methodology to assess delivery options across all of our AMP8 plans, assessing both financial and wider environmental outcomes.

2.3.2 The aim of the PR24 value tool is to quantify both the risk reduction benefits that a scheme will deliver and the added value of implementing the solution. This was developed using our internal MyRisk assessment tool as the foundation and then extending the range of measures used based on customer willingness to pay (WTP) and EA suggested valuations across financial, health and safety, service driven, reputational, and natural capital measures.

2.3.3 Incorporating the wider environmental outcomes into our decision making is a natural continuation of the work we have already undertaken in our natural capital assessment. Capturing this value in our assessment of investments and our operations is a key step in ensuring we deliver best value for customers. We do, however, want to take this further and build a full picture of the value we deliver using a "Six Capitals" approach.

2.3.4 In the past, financial and manufactured capital were consistently embedded within business as usual activities. Through AMP7 we have considered natural capital in our decision making. Our future ambition as a company is to continue to develop our natural capital approach and further develop this into the 6 capitals through incorporating human capital (which is the value of the workforce), intellectual capital (industry knowledge and processes), and social capital (relationships and customers trust) within our business models. Our approach to natural capital and the experience of using this in decision making will be a key link to establish this broader value assessment and utilising this where it will materially impact our decision making for AMP8. Further information can be found in supplementary document *UUW45 - our approach to deliver best value totex*.

Natural capital performance commitment

2.3.5 The ability to utilise natural capital assessments in our decision making process has been demonstrated during AMP7 as a result of our natural capital performance commitment (PC). This was initiated to help facilitate the further development of our understanding and application of a natural capital approach in decision making and realise enhanced benefits for customers and the environment. These skills have been very valuable in developing our AMP8 plans. The PC encouraged a new way of thinking in order to deliver added natural capital value in the interventions we implement, in line with the ecosystems services that customers have expressed a willingness to pay for: Water Quality, Health, Amenity and Recreation, Flooding, Biodiversity and Climate Resilience.

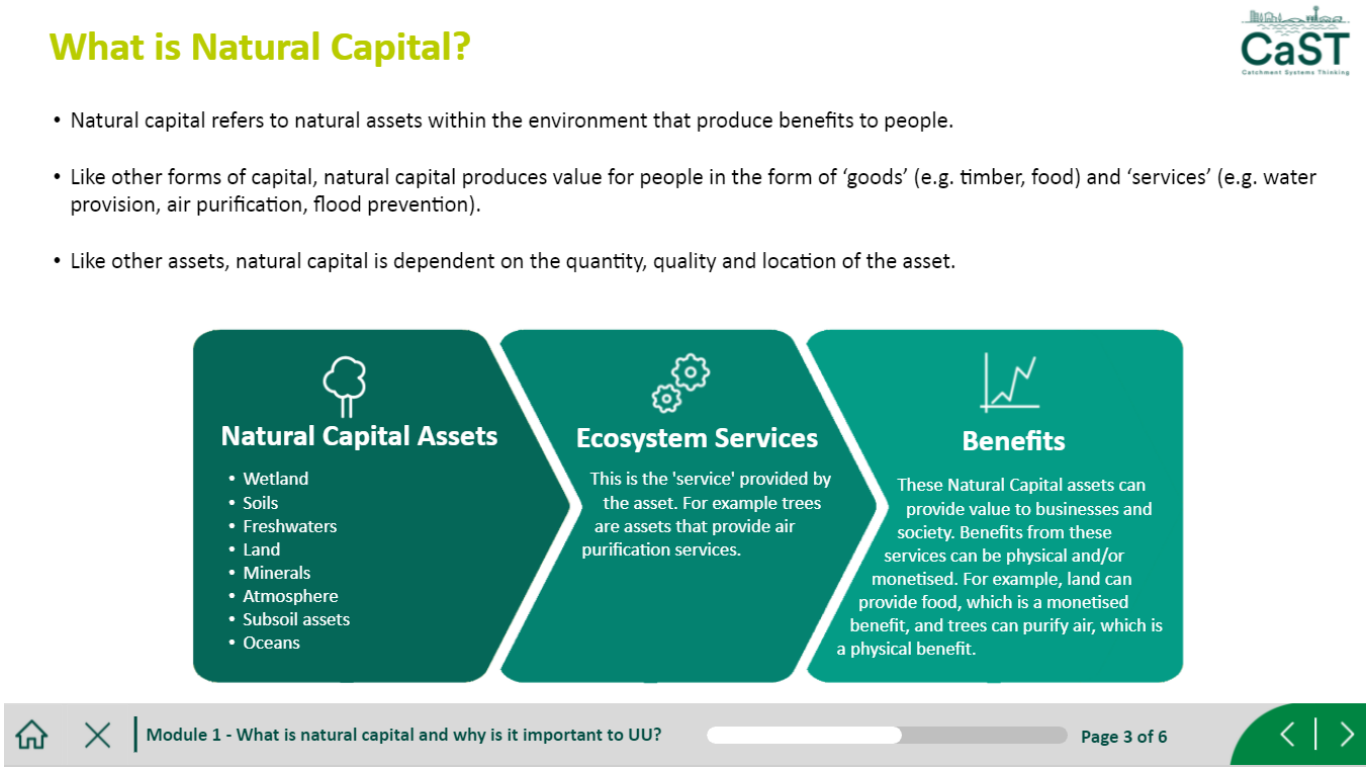
2.3.6 Development of the AMP7 PC further embedded an understanding of natural capital throughout the business decision making processes and embedded the concept of natural capital assessment when developing solutions.

2.3.7 Working with external assurers we developed an assessment methodology based on CIRIA's B£ST[9] tool to consistently asses solutions and identify the added natural capital value that can be realised. To drive better engagement in this assessment across the business we have developed an internal natural capital calculator to simplify the assessment process. A comprehensive eLearning toolkit has been developed to upskill people and embed a natural capital approach into decision making across the business. This

[9] ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=W047AF&Category=FREEPUBS

eLearning package ranges from a high level introduction to natural capital, to the detail of completing a project level assessment. An example of this is included in Figure 7.

Figure 7: Natural capital e-Learning module



Source: UUW Natural Capital E-learning

2.3.8 We are currently outperforming against our performance commitment and expecting to maintain this out performance through AMP7. As our performance is linked to delivery of added natural capital value through incorporating nature-based solutions into WINEP delivery, and relatively low numbers of WINEP solutions were targeted in year three of the AMP (with non being targeted for delivery in line with this performance commitment) our year three delivery was £0 added natural capital value against a target of £0.

2.3.9 In year two however, two schemes were successfully delivered, Southwaite WwTW and High Sparrowmire. The AMP7 performance commitment has encouraged the consideration of natural capital in decision making helping to promote natural solutions over conventional ones where appropriate. The successful delivery of a new Wetland at Southwaite is a demonstration of how natural capital assessment impacts decision making, leading to multiple benefits for the company and customers (shown in Figure 8). Table 5 and Table 6 show the outperformance delivered in year two has resulted in and added natural capital value to the North West of c£1.5 million over the value already delivered in the performance commitment of £1.75 million.

Figure 8: Solutions delivered providing added natural capital value at Southwaite WwTW and High Sparrowmire SuDS

Southwaite WwTW

High Sparrowmire SuDS

Table 5: Ecosystem services valued

Project Name	Southwaite WwTW		High Sparrowmire	
Option Name	**Baseline**	**Wetland solution**	**Baseline**	**SuDS solution**
Water Quality	£751,945	£751,945	£0	£0
Climate Regulation	£0	£525	£0	£0
Biodiversity & Ecology	£0	£566	£0	£0
Recreation & Amenity	£0	£970,329	£96,226	£1,043,962
Health	£0	£778,717	£99,329	£635,706
Total present value (£)	£751,945	£2,502,081	£195,555	£1,679,668
Natural capital added compared to baseline	**£0**	**£1,750,137**	**£0**	**£1,484,113**

Source: UUW Natural capital assessment of solutions delivered

Table 6: ODI calculations for year 2 delivery

	Southwaite WwTW Wetland	High Sparrowmire SuDS	
AMP7 Totex cost	£7.044m	£0.535m	
Conventional Solution Baseline NC Value	£0.752m	£0.196m	
Non-conventional Solution Total Natural Capital Value (£m)	£2.502m	£1.680m	
Scheme Level Uncapped Natural Capital Value	£1.750m	£1.484m	
Scheme Level Capped & Apportioned Outperformance	£0.704m	£0.054m	**Total Yr2 reward**
Penalty/Reward	£0.352m	£0.027m	**£0.379m**

Source: Assessment for enhancing natural capital for customers performance commitment

2.3.10 The examples demonstrate how we have used natural capital assessment as part of our decision making process in AMP7. We have built on this approach and incorporated it into our AMP8 planning through the wider environmental assessments completed as well as using the direct assessment methods used in the AMP7 performance commitment to value our proposed Advanced WINEP programme.

2.3.11 In order to ensure we are using the most suitable natural capital valuation tool available moving forward, we have carried out a detailed assessment of current modelling tools on the market. We found that although many tools offer in depth analysis of the ecosystem services, we experienced that there were a number of issues preventing us from using the tools on a large scale throughout the company.

2.3.12 The result of this assessment is that the B£ST tool remains one of the most suited to our needs. We are making use of EA's Natural Capital Register and Account Tool (NCRAT). NCRAT is a free resource, user-friendly with a comprehensive user guide, it contains catchment information built into the model. It can be modified to suit the user's needs, and models significantly more detail than many tools on the market.

2.3.13 Natural capital assessment is a continually evolving area so we will continue to explore different options on the market to see what is most suited to our company needs. We will continue to evaluate both B£ST and NCRAT as they evolve and develop as well as any other tools available on the market to ensure we are utilising the most effective assessment for our decision making, that can engage the most people across the business.

2.4 Partnership Working

2.4.1 A key benefit to the natural capital work that we have undertaken and one of the reasons for the development of the North West baseline is that this provides a common language amongst stakeholders to review and assess multiple benefits. This is a key factor in expressing shared benefits to others and developing long lasting sustainable partnerships. The challenge facing our environment is significant and the action required to sustain resilient ecosystems into the future is significant. As a result we acknowledge that we cannot address this challenge in isolation but need sustainable long term partnerships across catchments to deliver the improvements needed. We are adept at working in partnership having done so for many years and we continue to seek out opportunities to work in partnership across our region.

2.4.2 We recognise that we need to work closely with others who share our ambitions if we are going to be successful in delivering improved ecosystem resilience. As a result we have formed some strategic partnerships to help unlock the changes we see as necessary.

Rivers Trust

2.4.3 We have partnered with the Rivers Trust through our collaboration on Natural Course for approaching 10 years and have delivered significant numbers of interventions through partnership with local trusts on the ground.

2.4.4 We have now formed a strategic partnership with the Rivers Trust to work together to drive forwards the changes that are necessary to truly unlock Catchment Systems Thinking. This partnership will benefit not just customers in the North West of England but through sharing of our learning, there will be broader benefits across the country.

2.4.5 We have seconded a senior manager to jointly work on driving policy and strategy within the Rivers Trust. We have received secondments from technical experts who are embedded in the catchments we are working in to drive catchment planning activity and embed local knowledge into UUW teams. The partnership aims to drive:

- A joined up approach to building confidence in and unlocking nature based solutions;
- Development of more market led approaches to leverage the blending of public and private finance;

- Piloting of place based planning approaches to enable more integrated management of ecosystem services;
- Demonstration of more cost effective ways of replacing some of the catchment monitoring that has been lost in recent years as well as identification of how best to make use of new technology; and,
- Alignment of communications activity to help influence customer behaviour through a trusted intermediary.

2.4.6 Whilst this partnership is still relatively new it is already delivering significant benefit. It supported the co-development of our paper on unlocking nature based solutions[10] and following on from this it has driven the development of two of the most integrated projects across the industry to be successful in the Ofwat innovation fund in CaSTCo and Mainstreaming nature-based solutions.

2.4.7 It has led to a coordinated advocacy strategy to identify areas of agreement and utilise the collective influencing power of both organisations to promote approaches that result in better outcomes for customers and the environment. This has included working together to understand environmental issues associated with government policy and support a joint approach and consistent messaging to engaging with this where appropriate. This has focussed on developing how these policies can be used to deliver the greatest benefit in the most efficient way which aligns to the objectives of both organisations.

Catchment restoration in partnership with the Royal Society for the Protection of Birds (RSPB)

2.4.8 We have a long history of partnership with the RSPB delivering sustainable land management on our sites for the benefit of water quality, biodiversity and proving customers with free land access. COVID-19 pandemic has caused significant challenges in terms of increased visitor numbers[11] putting a strain on the landscape but this partnership has supported the ongoing maintenance of this land and continued to seek out ways to drive further improvement.

2.4.9 As evidenced in the impacts of Storm Desmond restored natural systems are important to ensure resilient landscapes to environmental shocks. Storm Desmond delivered a prolonged period of very intense rainfall and resulted in torrent flows at multiple locations across the Thirlmere catchment – resulting in very significant catchment damage, mobilisation of a large volume of debris and a rapid increase in raw water turbidity. In comparison, Ennerdale, which has been undergoing restoration activities for over 10 years and was recently designated as a National Nature Reserve[12], received the same volume and intensity of rainfall but showed no signs of damage or raw water quality deterioration. This is due to the benefits of increased resilience to storm events created through the rewilding initiative at Ennerdale, which has been running for over a decade. In contrast, the land at Thirlmere has been intensively grazed and lacked the resilience to absorb the impact of the storm. This is why since 2020 we have been working to restore natural features at Thirlemere to increase this resilience, this is work we will be continuing in AMP8 and more information on this is included in section 3.7.

2.4.10 One of the other key projects we are working on to increase resilience of catchments is our partnership activity with the RSPB, which has been delivering for over 10 years to restore the habitats around Haweswater. This is one of the first projects to be recognised and accredited by the IUCN as a high quality nature based solution and we continue to look for further opportunities including partnering with other local landowners to support projects for landscape recovery work. In 2022 RSPB secured £5

[10] https://www.unitedutilities.com/globalassets/documents/pdf/pr24---unlocking-nature-based-solutions-to-deliver-greater-value.pdf

[11] https://www.manchestereveningnews.co.uk/news/greater-manchester-news/double-yellows-made-permanent-dovestone-20573789

[12] https://www.gov.uk/government/news/3000-hectares-of-spectacular-lake-district-landscape-becomes-a-new-national-nature-reserve

million of private funding through the Endangered Landscapes Programme to support the Cumbria Landscape Partnership project[13]. United Utilities is a key partner in this project.

2.4.11 The Cumbrian Landscape Partnership seeks to inspire a co-developed vision of a restored 33,000 ha of English upland landscape through a partnership united by mutual interest in the landscape's future. The project aims to restore natural processes on core sites owned by United Utilities and Lowther Estates through large scale planting and natural regeneration, peatland restoration and reestablishment of historic river systems. Additionally, the project will work outside of these core sites, seeking to support farmers and land managers through a period of change and foster a collaborative working model that seeks to bring together differing values and perspectives.

2.4.12 To achieve this, the project will:

- Restore and reconnect woodland, scrub, grassland, peatland and wetland habitats.
- Selectively reintroduce rare or lost species.
- Restore natural dynamic woodland and peatland/hydrological processes and increase the landscape's carbon sequestration and water holding capacity, to increase ecological and human climate change resilience.
- Contribute to economic security for land-based businesses by helping them to access the new UK agricultural payments for 'public money for public goods'.
- Collaborate with local communities to identify values and attributes that form a 'sense of place', to understand how these relate to perceptions of landscape change, and the relationship to historic and cultural values.

2.4.13 To continue this work we have recently signed a memorandum of understanding with the RSPB to take this partnership forward and look for additional opportunities to deliver together for mutual benefit[14].

2.4.14 For many more examples of UUW working in partnership, please refer to the supplementary document *UUW38 – Working in partnership*.

2.5 Developing Environmental Markets

2.5.1 A key element of our environmental strategy is securing sustainable funding to enhance and maintain ecosystems. In order to do this it is important to understand the benefits that these ecosystems deliver and who the beneficiaries of these services would be. Water companies will be a key beneficiary of a lot of these services and it is right that we should fund some activity. However we will not be the only beneficiary so it is important to establish functioning markets that can engage buyers of ecosystem services and share the investment in catchments. We have pioneered several key mechanisms to develop markets and worked with partners such as The Rivers Trust to try and influence the regulatory and other changes needed to promote them. A key example of our delivery in this area is the Wyre NFM project which is the first project of its type in Britain and recently won the Edie award for nature and biodiversity project of the year[15].

The Wyre NFM model

2.5.2 United Utilities identified with partners a joint need to develop mechanisms that would enable greater applications of Natural Flood Management (NFM) interventions. A combination of factors including climate change and population growth over a number of years has led to greater intensity and severity of flooding events – increasing flood risk to UU assets and customer property. It was recognised that a conventional approach to this challenge was not sustainable – both from an economic and environmental perspective - and recognised that a nature based, collaborative solution had the

[13] endangeredlandscapes.org/project/cumbrian-landscape-partnership/

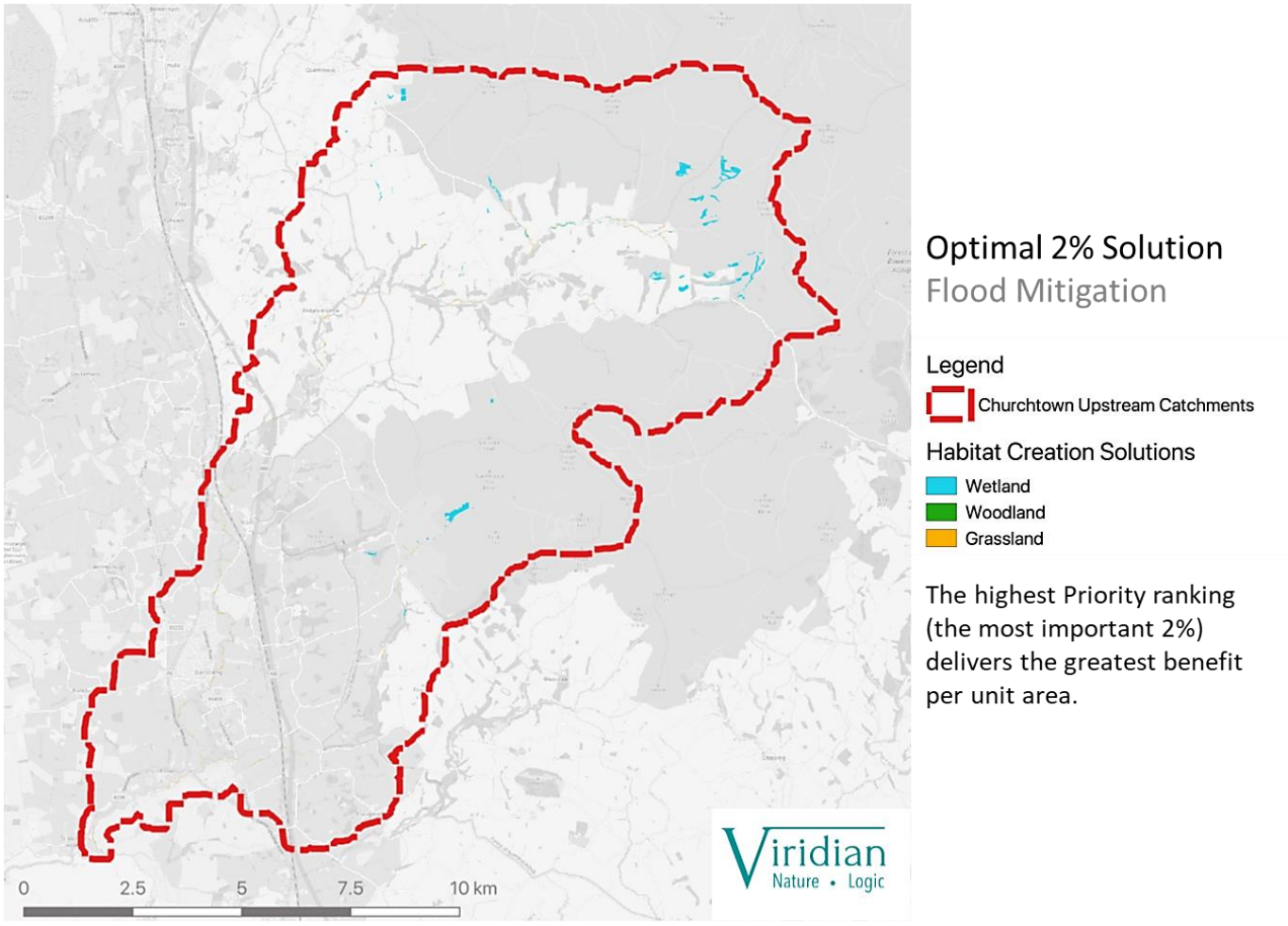
[14] unitedutilities.com/corporate/newsroom/latest-news/rspb-and-united-utilities-sign-up-to-shared-vision-in-the-north-west/

[15] Edie award winners 2023

potential to deliver the greatest efficiencies and opportunities to maximise additional ecosystem services. This could not, however, be delivered by any one organisation alone so needed to be delivered in partnership and an innovative solutions was required to facilitate this. This concept aligns with our Catchment Systems Thinking (CaST) approach, delivering multi-functional and multi-stakeholder solutions.

2.5.3 Through engagement with other partners it came to light that NFM opportunities were being considered by multiple organisations, however each organisation could not substantiate individual business cases and the greatest opportunity to enable NFM to be delivered was to develop an approach collaboratively. United Utilities encouraged the formation of a consortium that included Rivers Trust, Environment Agency as well as other key stakeholders and funded some innovative research to prioritise the NFM interventions and quantify the benefits they could deliver. An example of the outputs from this is included in Figure 9. Following on from this United Utilities the Environment Agency, FloodRE and the Rivers Trust jointly developed a project and secured external funding from the Esme Fairbairn foundation to progress the development of a market mechanism to deliver interventions collaboratively.

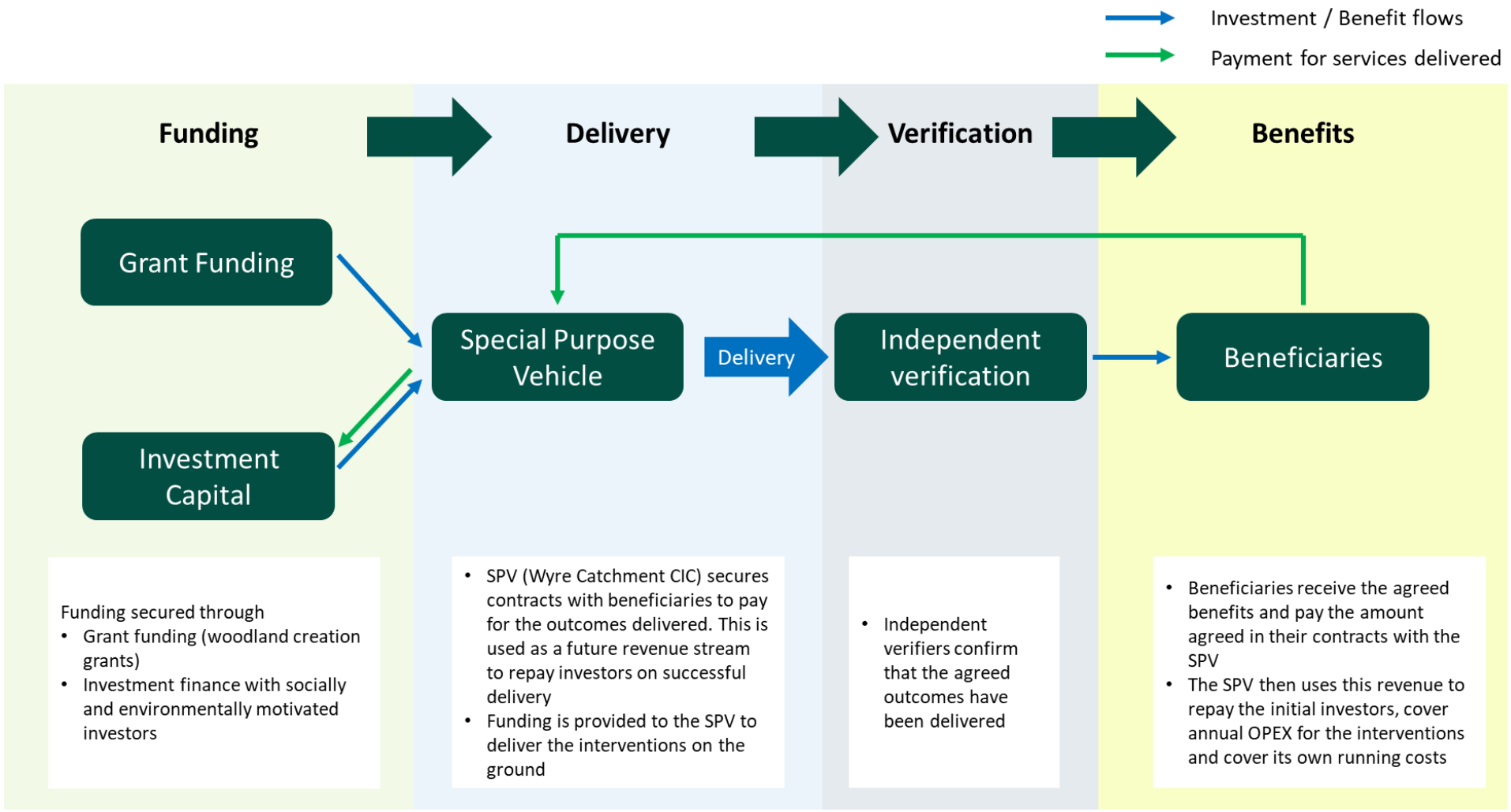
Figure 9: Map showing optimal locations for NFM in the Wyre Catchment



Source: Viridian NFM opportunities analysis

2.5.4 The funding received from the Esme Fairbairn foundation allowed the Rivers Trust to lead the development of the project as a whole and establish a project steering group, including United Utilities, Environment Agency and other key stakeholders such as Triodos Bank who led in developing a robust commercial mechanism that enabled organisations to fund interventions through a Special Purpose Vehicle. The details of the mechanism are outlined in Figure 10 below:

Figure 10: Wyre NFM finance mechanism



2.5.5 In order to ensure that UUW investment into the project was founded on genuine payment for the ecosystem service provided by the interventions, we undertook further innovative modelling to identify the flood risk reduction benefits that could be possible for our assets. From this modelling we identified circa 30 assets within the pilot area that could benefit from enhanced flood risk resilience. We calculated historic costs from flood damage sustained to these assets during severe storms and we then integrated multiple data sources, including both internal and external data sets, to determine a whole life present value to these assets from a reduction in peak flow of storm events.

2.5.6 The modelling quantified the whole life benefit (based on 120 years) of the NFM interventions, which enabled us to determine an appropriate contribution to the project, meaning we did not invest beyond the modelled benefit. As this model allows us to pay for the actual benefits received rather than providing upfront investment this value is calculated as an annual payment for flood risk reduction. This approach helps us to mitigate both the delivery risk of large scale catchment activity and the performance risk of the NFM interventions.

2.5.7 Once this quantified benefit value was identified it was important to negotiate the level of payment United Utilities would make based on the benefits received and this was done across all stakeholders. The result of this is that United Utilities has agreed to payments of £50 thousand per year for the next 9 years based on the NFM delivering the expected benefit. This spreads the cost of this intervention across many years for United Utilities and across multiple organisations as there are four other beneficiaries paying for flood outcomes based on the benefits to their organisations with payments ranging from £10 thousand to £80 thousand per year. This results in a circa £1.5 million project being delivered for a total cost to UUW of £450 thousand over 9 years.

2.5.8 In addition to this financial benefit there is a significant benefit in terms of risk management to this approach as there is a mechanism within the contract to monitor the performance of the NFM and after year six reduce payments based on any reduction in performance compared to the original expectations. This means the financial risk of delivery here is shared between beneficiaries such as UU and investors in the SPV which reduces the chance of customers funding something that does not deliver the benefits expected.

2.5.9 Beyond the nine year initial contract all beneficiaries have the option to extend contracts at a reduced rate to cover ongoing maintenance costs but reflect the fact that the capital expenditure would have been paid back by this point.

2.5.10 Currently this project has successfully formed the SPV in the form of a Community Interest Company (CIC), secured contracts with all beneficiaries for annual payments for the flood risk benefit, secured circa £575 thousand of grant and private funding for the sale of other ecosystem services such as carbon and water replenish value and secured circa £850 thousand of external investment from private investors to deliver interventions. The first year of delivery is well under way with the overall timeline to complete the installation of interventions to run over the next three years. United Utilities continues to be actively involved in this with a representative on the board of the CIC and UUW taking the role of representing all buyers' interests.

2.5.11 Going forward, we will focus on how we can learn from the project and scale the approach – including sharing appropriate learning with applicable projects. We want to improve our understanding of NFM and look to ways of linking the catchment measures into network performance to understand what this could deliver in terms of resilience for the sewer network.

2.5.12 This project was a forerunner of the Environment Agencies £10 million Natural Environment Investment Readiness Fund and continues to significantly influence many of the projects funded through this route, with several attempting to replicate this across the country. As such it is shaping the national approach to driving catchment markets and we have utilised our experience in developing this with a lot of the other catchment activity we are driving, taking learning and adapting and improving them to the specific needs of other geographies. This success has been recognised with the project winning an Edie award for nature and biodiversity project of the year.

2.6 Embedding CaST in the development of our AMP8 business plan

2.6.1 United Utilities fully supports the reform of the WINEP to deliver greater value which aligns very closely with our Catchment Systems Thinking approach. We have utilised the increased focus on wider environmental outcomes and working at catchment level that the new WINEP methodology has provided to develop more holistic approaches to delivery through our WINEP for AMP8.

A catchment approach to nutrient management

2.6.2 An example of this has been our use of Catchment Nutrient Balancing (CNB) which seeks to offset the required improvements at treatment works by supporting others in the catchment to reduce their impact over and above the requirements on them. This means that we can deliver the same or better environmental performance with a more relaxed permit which can be cheaper and avoid having to deliver carbon intensive on site treatment.

2.6.3 In AMP7 we are using this approach in the Eden catchment in Cumbria. Through this we have been able to identify nine sites where CNB can support our delivery in AMP8, reducing the required on site interventions, delivering wider benefit in the catchment and doing this at a reduced overall cost to customers. Assessing these solutions through a CaST approach has meant that where it is right for the catchment we have prioritised the use of CNB to maximise benefit and reduce the need for grey infrastructure. This has predominantly been on smaller sites where significant spend on grey infrastructure is disproportionate to the benefit delivered. Alternatively on larger sites where on site interventions deliver a greater benefit due to the higher phosphorus loads that pass through these works we have pursued on site interventions as the benefits delivered through on site activity in these locations are far higher. Further detail on this is included in section 3.3.

A catchment approach to delivering the Storm Overflow Discharge Reduction Plan

2.6.4 This approach has been utilised in our approach to meeting the requirements of the Storm Overflow Discharge Reduction Plan (SODRP). Using a CaST approach we have identified where there are opportunities to work with partners to deliver SuDS and rainwater management activities to reduce and sometimes eliminate the need for tanks, this has resulted in 177 schemes where these hybrid or blue green only solutions are more efficient. There are, however, occasions where traditional or grey solutions represent the best value. This is particularly the case where overflows are being delivered to meet a clear environmental issue such as a WFD driver. In these examples the impact of the first flush is the primary reason for the environmental impact and so SuDS and other solutions that reduce spills don't necessarily prevent this impact. In these locations there are clear benefits to tanks which can intercept the first flush and prevent this being released to the environment.

2.6.5 In addition to this in the development of our storm overflow programme we have taken advantage of its long term nature by taking a number of adaptive routes to the long term targets including:

- Focusing on addressing overflows with proven harm (either through integrated catchment modelling or ecological surveys) to maximise benefits for customers;
- Assessing hydraulic models and event duration monitoring confidence in prioritisation of overflows for AMP8 interventions (where we have low confidence in these models they will be a focus for improvements to inform future solution development for AMP9 and beyond);
- Prioritising inclusion of overflows where we have been able to identify low regrets solutions;
- Identifying areas of the North West with particular challenges meeting the long term targets which require strategic investigations to determine how management of water can be transformed both for the benefit of overflows and more broadly (such as overflows around the Mersey Estuary); and,
- Developing an Advanced WINEP proposal to accelerate storm overflow improvements by delivering the rainwater management element first so that we give the nature based solutions the best possible opportunity to deliver value for society before resorting to conventional solutions to close the gap to meeting the long term performance standards set out in Defra's Storm overflow discharge reduction plan.

2.6.6 Our CaST approach identifies these requirements in line with the principles of the right intervention in the right place with the right partners. Further information on this is included in section 3.2.

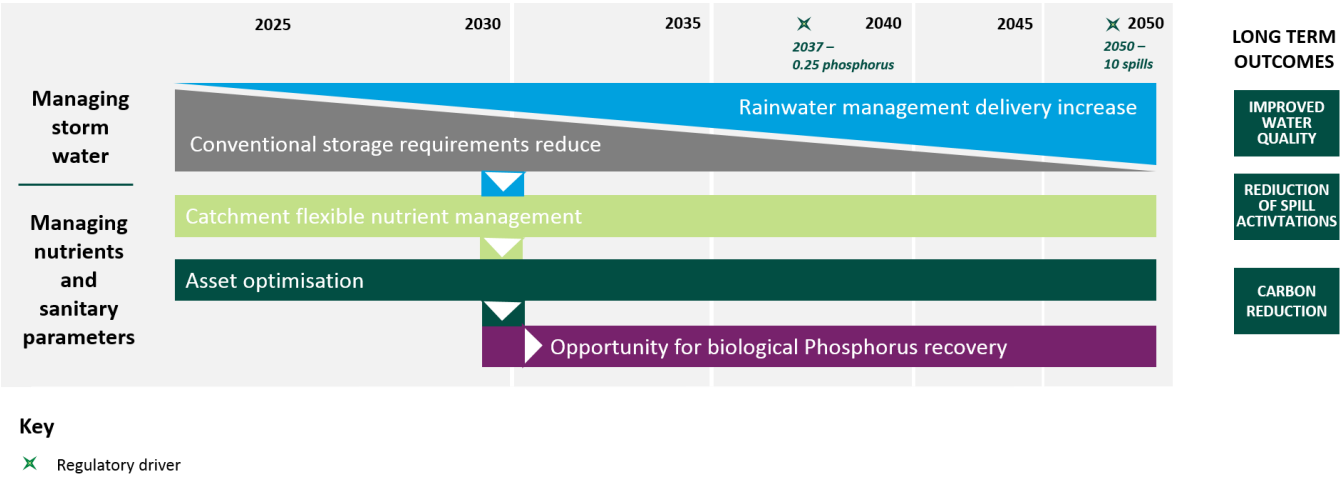
Utilising adaptive planning to drive greater long term value

2.6.7 Supported by our CaST approach we are making use of adaptive planning to get ahead of deterioration in catchments so that we can mitigate the risks and give nature based solutions a chance. The principles of adaptive planning are relevant to the WINEP, particularly where we have long term targets to meet or there is uncertainty around requirements or the level of solution required to deliver the outcomes. Where appropriate we have applied them to WINEP development to ensure we optimise the value we deliver for customers. In addition to the use of adaptive planning in the delivery of the Storm Overflow Discharge Reduction Plan discussed above we set out two further applications of adaptive planning: Manchester Ship Canal and chemical load standstill limits.

2.6.8 Where we have no choice but to embark on very significant WINEP investment proposals in the near term, but these may carry some uncertainty, we have specifically developed an adaptive plan to ensure our AMP8 actions are low regrets. For AMP8 this is particularly the case for investment relating to the Manchester Ship Canal. Greater Manchester drains through this canal which has complex water quality issues and is a focus of growth in the North West. Additionally, there is an interrelationship with our largest bioresources centre in this area.

2.6.9 Through developing these plans we have been able to identify the low regrets adaptive pathway for investment at key sites including Davyhulme, Salford, Eccles, Stockport and Sale WwTWs which puts us on course to deliver valuable benefits for customers whilst avoiding less certain or potentially wasteful expenditure until we have investigated or optimised solutions. An example of this is that we are proposing to phase the implementation of improvements at these sites to focus on addressing improvements to ammonia and biological oxygen demand performance along with prevention of deterioration drivers in AMP8 and then address the Environment Act phosphorus requirement in AMP9/10. This will allow us to see what performance gap we need to close before embarking on another phase of significant investment.

Figure 11: Simplified image of the Manchester Ship Canal adaptive plan



Source: UUW Long Term Adaptive Plan for Manchester Ship Canal

2.6.10 Within our AMP8 programme we have a significant number of chemical, no deterioration load standstill limits. These limits leave very little headroom in our permits and are often set using data that doesn't represent the current day situation; for example an AMP6 or AMP7 WINEP scheme may have improved the treatment standard or demand may have significantly changed. We are planning to take an adaptive approach to delivering solutions to these limits. Where we have recently implemented a solution that might bring benefits for the chemical in question we are proposing to monitor performance in AMP7 to determine if anything further is required. Where the plant doesn't have appropriate treatment technology we will embark on a programme of monitoring ahead of working with the Environment

Agency to determine whether the limit is appropriately set and whether additional treatment is required.

Scaling up Catchment Systems Thinking

2.6.11 A summary of the innovative and catchment focused interventions that have been unlocked through our CaST approach for AMP8 are included in Table 7 below.

Table 7: Catchment and Nature Based delivery included in the WINEP

Intervention Type	AMP8 Delivery
Catchment Nutrient Balancing	Delivery at **9 WwTW**
Peatland restoration	Delivery at **4 sites** totalling 4,764 Ha
Catchment management for raw water improvement	Delivery across **5 sites**
Catchment management to improve biodiversity	Delivery across **4 sites**
Blue green solutions to CSO Discharge	Delivery at **3 CSOs**
Hybrid solutions to CSO Discharge	Delivery at **174 CSOs**

Source: UUW WINEP submission

2.6.12 Whilst we have been able to utilise our CaST approach to deliver increased customer value across the schemes identified in Table 7 we believe there is scope to go further with this approach. As a result of this we published a discussion paper on how greater value could be delivered through the WINEP[16] which is published on Ofwat's Future Ideas Lab. This paper was presented to the group working on WINEP reform and subsequently we further shared our learning from our CaST approach by publishing a paper on unlocking nature based solutions[17]. This paper has proven useful in allowing UUW to lead the formation of a project with many partners from the water industry, consultancies, regulation and eNGO's. This project on Mainstreaming nature based solutions was successful in an Ofwat innovation fund bid and will now, under UUW's leadership deliver an ambitious programme of work to break down the barriers identified. We have shared our learning through site visits to partnership projects such as the peatland restoration at Dovestones and by hosting a webinar with the industry and stakeholders. Finally we recognise that there is further reform needed and so we have put forward an Advanced WINEP proposal which aims to create the flexibility to unlock a nature based solutions at scale.

2.6.13 Our extensive work across previous AMPs in pioneering approaches such as SCaMP or the use of catchment nutrient balancing, combined with our experience in delivering projects with others using innovative funding and financing arrangements such as through delivering the Wyre NFM project put us in a strong position to understand the barriers to nature-based solutions and what is need to remove these. The project on Mainstreaming nature based solutions led by UUW to remove these barriers will build on the positive momentum for utilising nature-based solutions that we have established in AMP7. It will identify barriers and assess solutions working with experts across multiple sectors and trial the proposed solutions in regional demonstrators across the country. The learnings from these

[16] How greater value could be delivered through the WINEP

[17] Unlocking nature based solutions

demonstrators will be combined and used to drive national changes to facilitate a far greater uptake of nature-based solutions across the water industry and other sectors.

2.6.14 UUW is in a strong position to benefit from this learning and embed these principles quickly as we have already embedded an understanding of natural capital more broadly across the company which has led to employees across a wide range of disciplines growing their confidence and expertise in this field to support increased delivery in AMP8.

3. Environmental benefits from our AMP8 plan

3.1 Overview

3.1.1 The expectations for our natural environment are higher than ever before and in order to meet these expectations we have developed AMP8 plans with a strong environmental focus. We expect to be delivering the biggest environmental programme to date and we will be doing this in new ways, seeking to promote more hybrid delivery combining natural solutions with conventional asset based improvements to achieve the best outcomes for the catchment that we operate in. This incorporates an uplift in our utilisation of tools such as catchment nutrient balancing and encouraging our biggest programme of surface water management and SuDS to help drive down spills and improve our regions rivers.

3.1.2 Our delivery for the environment is primarily driven through our WINEP programme and the nature and scale of UUWs AMP8 WINEP is fundamentally different to what has gone before. We have worked hard to optimise the programme and expect it to cost £5.695 billion in total expenditure, consisting of our core programme of £5.496 billion and an innovative Advanced WINEP programme of £199 million (which is expected to also bring in at least an additional £50 million of partnership funding). The estimated impact of the AMP8 WINEP programme on annual operating costs is a growth of £109 million. The programme of work set out is forecast to deliver £856 million of wider environmental outcomes.

3.1.3 The WINEP does not cover all of the effort in our plan to improve the environment and there will be considerable effort employed to continue to drive down leakage in line with our long term target of reducing this by 50 per cent by 2050. This will support reduced abstraction and reduce environmental strain during dry periods which will be more common as a result of climate change.

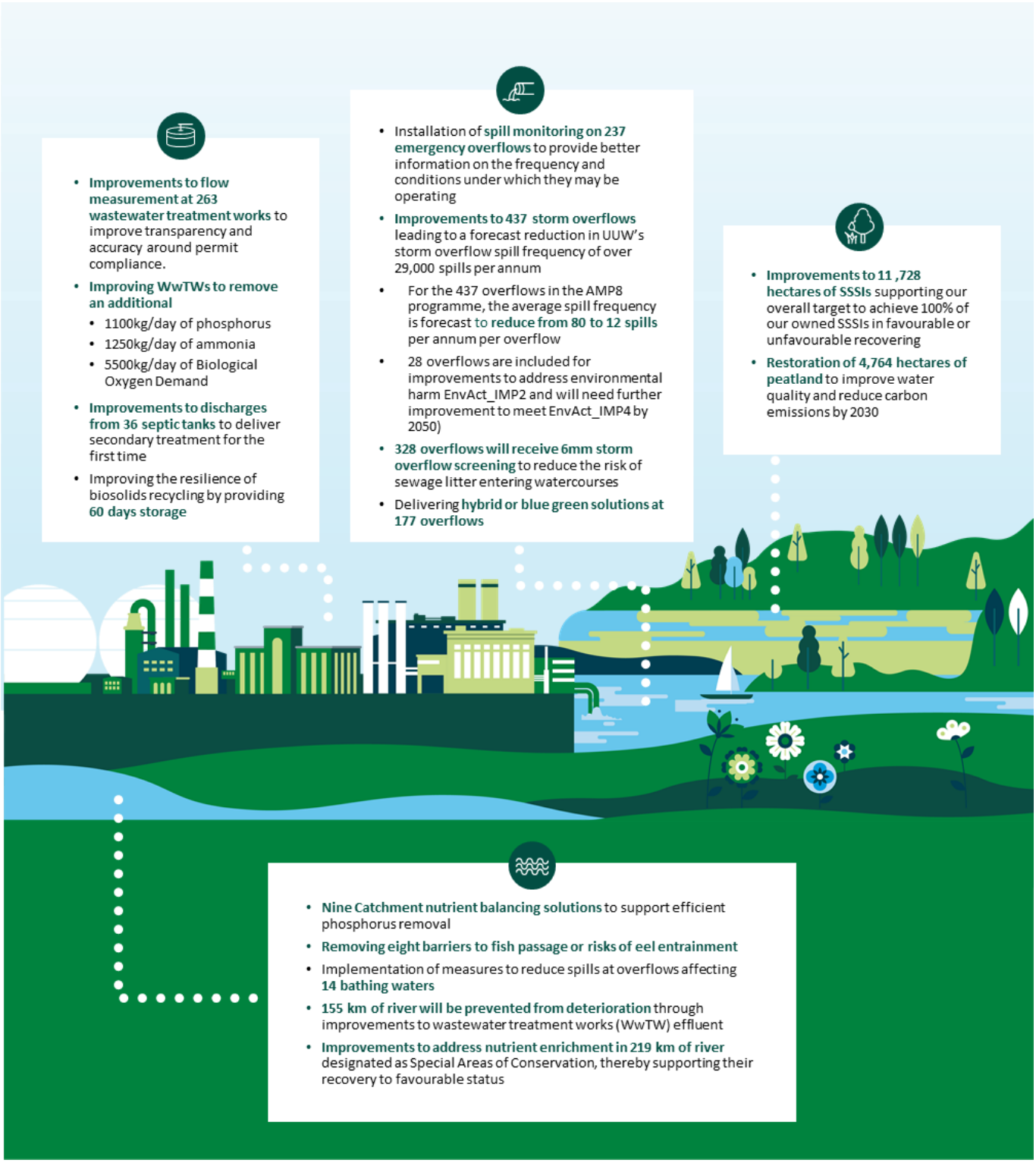
3.1.4 Water UK's 'A Leakage Route map to 2050'[18] sets out how water companies in England plan to significantly reduce leakage by 2050. Our demand options have been supplemented with other important measures of value specific to network leakage, for example Prevent, Aware, Locate and Mend (PALM), which are detailed in the route map. These elements of our leakage strategy have influenced our decisions on AMP8 activities alongside the use of best value optimisation. Our leakage strategy is a transformation from "find and fix" to Dynamic Network Management, predicting and preventing leaks to drive continual improvement in our leakage performance. Our best value leakage plan focusses on asset health improvements (mains renewal) and optimising the way in which we proactively manage the water network. Leakage and the wider demand programme will therefore contribute to future reductions in operational greenhouse gasses as overall water demand and associated abstraction, treatment and distribution requirements are reduced.

3.1.5 We will be investing in schemes to drive resilience into our asset base such as improved treatment at 5 Water Treatment Works to improve their resilience to substance such as Geosmin and 2MIB, which if untreated can cause taste and odour problems in water, ensuring they can continue to deliver output more reliably. We will be working with partners to deliver significant improvements such as the Crosby coastal resilience scheme which will be seeking to reduce coastal erosion protecting houses, infrastructure and our sewers.

3.1.6 Many of our environmental investments for AMP8 are reflected in enhancement investment cases. You can find these in documents *UUW60 – UUW67.*

[18] water.org.uk/sites/default/files/wp/2022/03/Water-UK-A-leakage-Routemap-to-2050.pdf

Figure 12: Some of the benefits that will be delivered in AMP8



Source: UUW Business plan

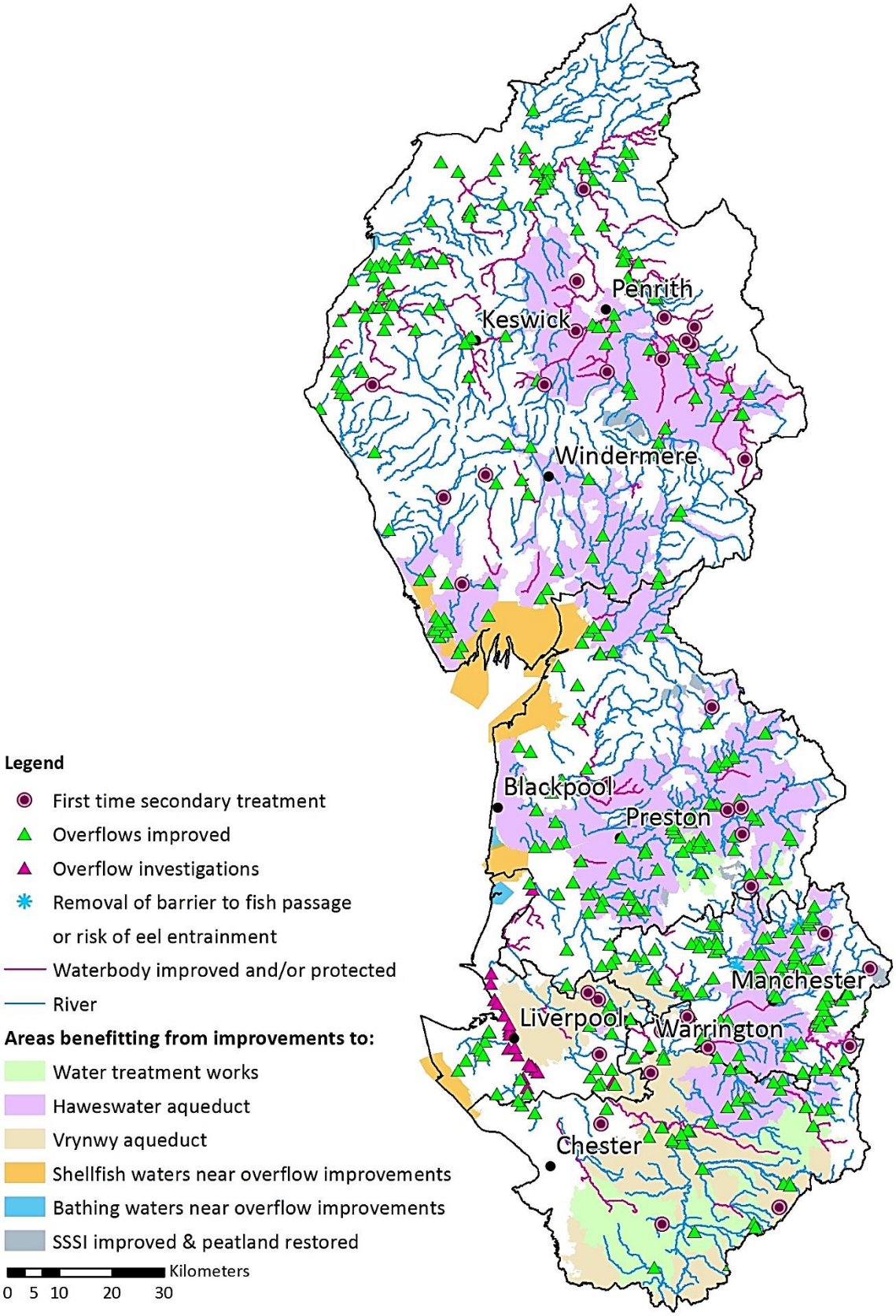
3.1.7 The major challenges and opportunities facing the North Wests environment, which we will be tackling through our AMP8 plan are:

- Tackling storm spills and flooding (see Section 3.2)
- Reducing nutrients and supporting nutrient neutrality (see Section 3.3)
- Catchment Systems Thinking in Greater Manchester (see Section 3.4)
- Delivering improvements for Windermere (see Section 3.5)

- Enhancing water resources (see Section 3.6)
- Maintaining resilient water catchments (see Section 3.7)

3.1.8 The locations that will benefit from these activities are shown in Figure 13.

Figure 13: Map showing the locations that will benefit from activities to deliver environmental improvements



Source: UUW Business plan

3.2 Tackling storm spills and flooding

AMP8 Plans

3.2.1 The analysis carried out by Stantec for Defra as part of its Storm Overflow Evidence Project identified that 35 per cent of the investment required to meet the standard of 10 spills per annum set out in the Storm Overflow Discharge Reduction Plan (SODRP) would be expected to occur in UUW's area. This broadly aligns with the scale of investment need we have identified following the WINEP guidance and means we have a sizeable programme of work to deliver in the next 25 years.

3.2.2 We have categorised all 2,249 of our permitted storm overflows in line with the criteria in the SODRP and reviewed this with the Environment Agency and Natural England. In doing this we have been able to rely on our extensive integrated catchment modelling capability along with our full coastal modelling capability. This means we already have a good understanding of the water quality impact of around 75 per cent of all our overflows.

3.2.3 In developing the proposed programme for AMP8 we have set out to develop a plan that achieves the following:

- Exceeds the trajectory set out in the SODRP by improving 44 per cent of high priority overflows;
- Addresses Reasons for Not Achieving Good (RNAGs) associated with storm overflows wherever we have been able to identify the best value solution (around 70 per cent of all RNAGs);
- Improves 29 per cent of all storm overflows, substantially outperforming against minimum SODRP requirements (see Table 8 below.) This aims to achieve a reduction in spill frequency across UUW resulting in modelled average spills of slightly less than 20 spills per annum by 2030;
- Proposes strategic investigations to identify the best overall plan for the more challenging parts of the North West: Mersey estuary, River Irwell catchment and Davyhulme WwTW drainage area. This will involve working with partners to understand opportunities for better integration of water management;
- proposes an Advanced WINEP that will enable us to work more flexibility to deliver the rainwater management solutions required as part of the long term adaptive plans required for our sewerage systems, as well as advancing the techniques, relationships and approaches to mainstream these solutions;
- includes adequately sized screens and chambers for all overflows in the programme that require one, irrespective of whether the solution is blue/green only (SuDS), hybrid or grey only

3.2.4 For UUW, this programme will require us to use every tool and option available to us as we transform our systems to meet this new ambitious standard. The scale of transition required is driven by a range of factors including: the extent of the existing combined sewer system in the North West, the high levels of rainfall in key urban areas such as Greater Manchester and East Lancashire, and the poor soil permeability in much of the region. UUW has a history of investing in storm overflow improvements where impacts had been identified and investment could be justified under the SOAF approach. However, these investments were focussed on reducing harm to the watercourse rather than targeting an absolute number of CSO spills. New legal requirements to work towards the delivery of a 10 spills per annum target on average at each overflow represents a very substantial additional change in performance standard.

3.2.5 As we move through the 25 year programme we will have to intervene with some very challenging trunk sewer overflows which will require multi AMP programmes to address them and the unit cost per spill reduction is going to increase as we tackle these overflows. We therefore envisage future AMPs will contain fewer overflows but still require similar levels of expenditure to AMP8. We will be using AMP8 to plan for some of this major investment. You can read a lot more detail on our approach to AMP8 investment in overflows (and the Advanced WINEP) in *Enhancement Case 13 – Overflows and Advanced WINEP* – in supplementary document *UUW64.*

Table 8: UUW proposed storm overflow programme compared with SODRP targets

Overflow category	No of overflows requiring upgrade by 2050	Minimum AMP8 target no of overflows	UUW WINEP no of overflows	Minimum AMP8%	UUW WINEP %
EnvAct_IMP2 high priority	448	159	198	38%	44%
EnvAct_IMP4 other	1400	196	407	14%	29%

Source: UUW breakdown of WINEP Overflows

3.2.6 In optimising our programme for AMP8 we have aimed to strike a balance between addressing as much of the proven harm as possible whilst reducing spill frequency significantly in line with expectations.

3.2.7 We are ambitious about significantly scaling up the use of rainwater management solutions across the North West through the WINEP submission and more broadly and have taken every opportunity to explore options to deliver source control of rainwater through our SuDS Methodology. As a result of this, an option including SuDS has been developed for 391 of the overflows in the programme with 177 of these being selected as the preferred option. The overflows that did not have a SuDS option identified were those that require improvement to meet Water Framework Directive standards.

3.2.8 In these cases, we have focused on meeting these standards and capturing the first flush of the sewer system after rainfall is a proven solution that addresses the harm caused by the overflow. This cohort of overflows tend to require substantial additional change to meet the 10 spills standard and we may implement rainwater management solutions in subsequent AMPs to meet this.

3.2.9 Where the opportunities to allow delivery of rainwater management exist we have attempted to optimise these to deliver through rainwater management solutions alone. In many cases however, a storage tank of reduced volume and/or an increase in flow to full treatment is required. These options therefore include both grey and blue/green elements and we refer to these as hybrid options. Following options selection the preferred option for over 40 per cent of the overflows in our proposed programme is a hybrid solution. The types of rainwater management solutions considered during our options development are shown in Figure 14.

Figure 14: Rainwater management options considered during options development

1. **Greenfield** – new development where the surface water discharges to the combined / "foul" sewer as a result of 'no alternative'
2. **Brownfield** – re-development where the surface water discharges to the combined / foul sewer as a result of 'no alternative'
3. **Residential retrofit** – where property measures are installed on a domestic customer property within their curtilage. Property may be owned or rented and be freehold / leasehold
4. **Street side retrofit** – retrofit of measures in the highway to intercept flows currently discharging through gullies (ultimately) to the combined or surface water sewer
5. **Urban realm retrofit** – retrofit of measures within an urban space (hard or soft landscaped) that may or may not directly discharge flows to the combined or surface water sewer
6. **Business retrofit** - where property measures are installed on a non-residential customer property within their curtilage. Property may be owned or rented and be freehold / leasehold
7. **Surface water disconnection** - where a surface water sewer or highway drain is connected to the combined sewer and it can be discharged to an alternative receptor
8. **Watercourse - disconnection** – where there is inflow from a watercourse that is connected to the combined sewer and it can be discharged to an alternative receptor

3.2.10 In addition to these proposals we will be delivering a separate Advanced WINEP. This aims to enable the implementation of the rainwater management element of hybrid solutions ahead of any conventional solutions thereby maximising uptake and efficiency. Key features of UUW's Advanced WINEP proposal include:

- A flexible £250 million AMP8 investment programme in rainwater management solutions with circa £50 million of this expected to be raised through partnership funding. This will start on delivering the rainwater management element of the adaptive plan for overflows that will need improvement in subsequent AMPs. This will enable rainwater management opportunities to be optimised before the scope of any conventional element is developed
- An objective of removing at least 200 hectares of impermeable area from the combined drainage system
- A focus on Greater Manchester which requires extensive transformation to the sewerage system to meet the requirements of the SODRP and has growing political and stakeholder support to help us drive the transformation

- Innovative approaches to co-funding building on UUWs involvement in pioneering markets-based approaches to co-funding investment with multiple beneficiaries

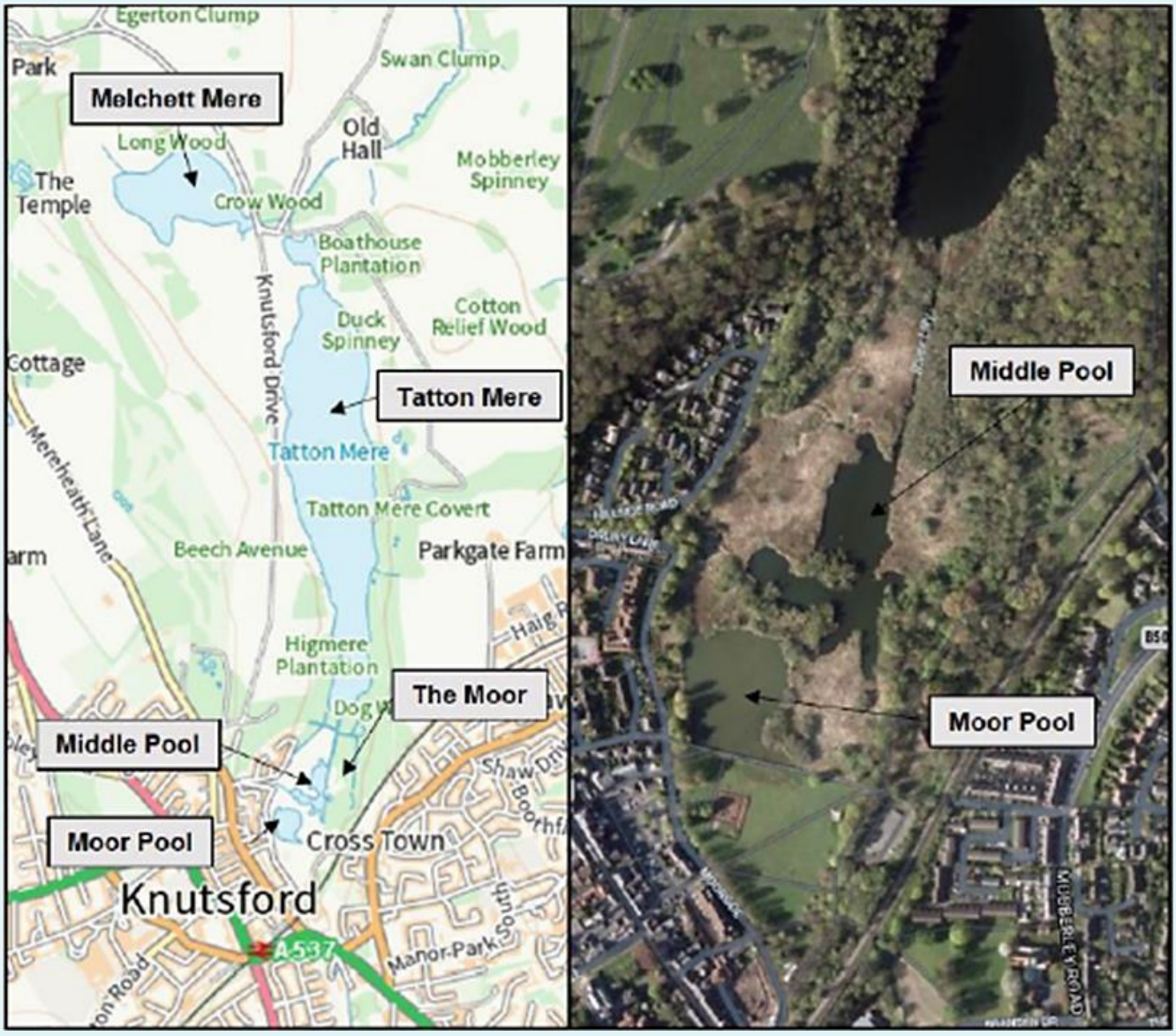
3.2.11 By creating more flexibility around this element of the WINEP, it will allow us to maximise uptake and attract more co-funding which, in turn, means we will be able to deliver wider benefits for society without customers necessarily needing to support the greater cost of delivering rainwater management solutions.

3.2.12 Whilst delivering the Advanced WINEP and a very substantial programme to improve performance of overflows will be challenging, we are confident that new and innovative approaches will be capable of facilitating these improvements through, for example, the growing use of technology to drive better operational performance. The case studies below describe examples of the types of techniques we might utilise.

Case study: Moor Pumping Station

Moor (Knutsford Main) Wastewater Pumping Station, upstream of Knutsford WwTW discharges in storm conditions to Moor Pool which is hydraulically connected to Tatton Mere SSSI.

Figure 15: Aerial view of Moor Pool and the connectivity to Tatton Mere



An AMP7 a water quality driver, under the Habitats Directive, was identified for Moor PS to reduce phosphorus load discharged into the Tatton Mere system to meet conservation objectives and move towards WFD Good status. The AMP7 water quality driver for Moor PS requires cessation of storm discharges up to a 1-in-30 year storm return period.

A notional asset based solution to meet the AMP7 cessation of spills requirement has been identified for Moor PS which would require provision of circa 17,300m^3 of additional storm storage. Due to the nature of this location the only viable option for a tank of this size is in a public park and the size of tank required would result in closing the majority of this space during construction, resulting in significant disruption to the local community as well as adversely impacting local environmental features with further significant carbon impact. We have identified that due to the historic pollution of this pool there is a significant sediment build up which is contributing to the phosphorus load in the pool so the cessation of spills from Moor PS on its own, without further mitigation in the wider catchment would not achieve the environmental outcomes targeted.

Using a catchment Systems Thinking approach UUW have considered a range of alternative options that could deliver better environmental outcomes that are more sustainable and environmentally resilient as well as minimising additional storage requirements and reducing the impact on the local community and environment.

The previously produced (AMP6) *'Tatton Mere Management Plan'* recommends a number of options across the wider Tatton Mere catchment to improve water quality in the Tatton system. UUW engineering teams have used recommendations from this report, in addition to more recent thinking in respect of rainwater management and SuDS to develop alternative options using a CaST approach.

Rather than provision of a storm storage solution alone to meet the cessation of spills requirement a preferred alternative option has been identified and has recently been accepted by the Environment Agency and Natural England. The alternative *hybrid* solution considers a combination of:

- **Storage –** a target spill reduction from a storage volume that will significantly reduce spills but not meet the full cessation requirement. We have proposed a 7,000m^3 tank rather than the 17,300m^3 tank in the original requirement, reducing storm storage volumes to be constructed in Knutsford Park by 10,000m^3 meaning less impact on the community during construction but still reducing spills to a 1-in-5yr storm return period.
- Offsetting the residual modelled spill to Moor Pool with **additional Moor Pool management/mitigation** including sediment removal to target the internal phosphorus load which doesn't currently form part of any funded catchment action plan.
- **SuDS retrofit/optimised storage –** optimising storage and realistic SuDS retrofit to further reduce the spills entering the pool, these have been identified using modelling/Atkin SuDS studio tool. The output of this are shown in Figure 16 below, which is the outcome of the spatial assessment showing potential opportunities to deliver SuDS. These six sub catchments with high potential for SuDS, are marked in green.

Figure 16: Potential SuDS opportunities in the Moor PS catchment

Visual observations of satellite imagery was used in tandem with SuDS Studio analysis to determine six delineated subcatchment areas with the highest likelihood for high impact SuDS opportunity implementations.

Source: SuDS Studio assessment for Moor PS catchment

It is proposed that the alternative hybrid approach will be developed as part of a long term adaptive phosphorus management plan for Tatton Mere which will see additional monitoring for deterioration carried out by United Utilities and additional partnership opportunities identified to manage and mitigate environmental and water quality issues outside of UUW's impact.

The Environment Agency and Natural England have recently accepted United Utilities WINEP alteration form to formalise this alternative hybrid approach to improving water quality in Moor Pool as the preferred option. Detailed design and planning will continue, but it is currently expected that the hybrid approach may provide capex savings of circa. £25 million when compared to delivery of a solution to achieve cessation of spills achieving greater environmental benefit and resilience at reduced cost and disruption for the local community.

Case study: Dynamic Network Management

Our approach to Dynamic Network Management (DNM) has been developed as part an enhanced systems thinking approach which enables us to become more proactive in the way that we are able to manage our sewer network.

To achieve this we are using Artificial Intelligence and installing the latest technology in the form of 20,000 sensors across a large number of 'hot spot' areas in the North West – these hot spots include locations where incidents such as blockages, flooding and pollution are at an elevated risk. These sensors are being installed at key points across sewer pipes and in pumping stations to monitor and provide up to the moment information back to our teams via a cloud based platform.

Through conventional wastewater network operations many of the incidents aren't detected until they are experienced first-hand by customers, which can be distressing and something we want to avoid as much as we can. The work that we are carrying out through our DNM programme helps us discover potential issues before they become a problem for customers and the environment.

The more granular data not only provides earlier identification of issues but it provides the data to allow us to learn signature trends. This means we can understand what "normal" looks like for that part of the network, be alerted when the readings vary from the normal range and then act to respond or investigate.

Development and delivery of the DNM project will continue into AMP8 to ensure that we are proactively sending our teams to the right places at the right time. This will not only help us avoid the disruption and inconvenience

that sewer blockages can cause to homes and businesses but will be integral in our operational approach to reducing the frequency of combined sewer overflow discharges to the environment and with learning and data returned from our monitors we will be able to help prioritise future CSO improvement programmes.

In addition to Dynamic Network Management and in line with our Catchment Systems Thinking Approach, Dynamic Catchment Monitoring (DCM) is our innovative and exciting new strategy which will allow United Utilities and all stakeholders involved in the management of a water catchment to understand the part they play in maintaining and improving the health of our natural water resources and environments. As part of DCM we will be enhancing our monitoring and control capability deploying new monitoring systems as well as taking in lots of external data currently available from other stakeholders and partners in order to be able to improve the natural environment.

Through delivery of this approach we will become a system convener where anyone involved in the management of water quality can access the information they need to understand what impact they are having and what they need to do in order to reduce that impact. This will mean that, alongside United Utilities proactively targeting maintenance of its network to reduce the impact of storm overflows or to optimise the wastewater treatment process to minimise the nutrient load, we would be looking to other stakeholders to carry out interventions such as ensuring septic tank discharges are compliant with requirements and that run off from agricultural or surface water is managed in a controlled and beneficial way.

We have chosen to pilot our DCM approach within the Windermere catchment, recognising the importance that it plays in providing ecological, environmental and economic benefits to the local community and beyond. With a complex range of challenges such as water quality impacts from third parties, private septic tanks, as well as impacts from land management, alongside opportunities to drive improvements through the Love Windermere partnership, Windermere is well suited to pilot the DCM approach. We will be carrying out a 6 month trial to identify what is possible and will collaborate with our partners in order to begin monitoring, analysing and improving the health of Windermere. In addition we are proposing a bespoke performance commitment that is aligned to our DCM approach for Windermere and will enable us to facilitate delivering the improvements that are identified through our enhanced monitoring and analysis of holistic catchment data from 2025. This will support reducing nutrients and delivering nutrient neutrality.

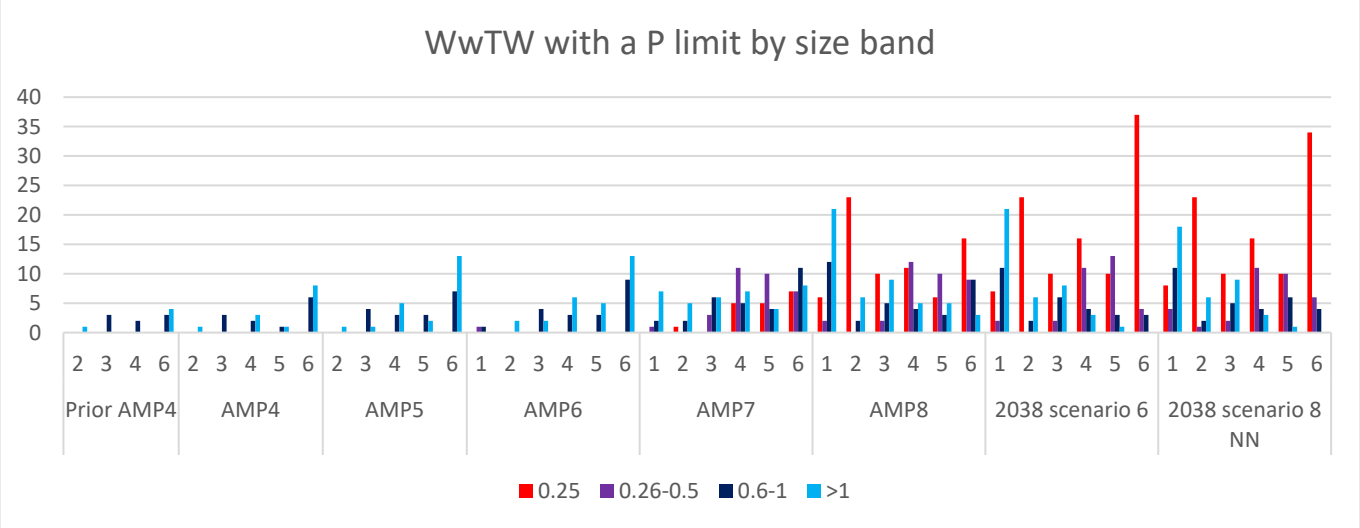
3.3 Reducing nutrients and supporting nutrient neutrality

AMP8 Plan

3.3.1 The introduction of the Environment Act long term phosphorus target means that UUW needs to remove another 1,000 tonnes per year of phosphorus to achieve its share of the industry's target by 2038. While much of this target includes achievement of Water Framework Directive standards, it will require us to implement schemes previously deemed to be disproportionately costly. This is a significant change that puts added focus on the sustainability and resilience of the chemical supply chain as well as the logistics of frequent chemical delivery to sustain wastewater treatment and the ever increasing quantity of phosphorus rich sludge that needs to be recycled to a land-bank under pressure.

3.3.2 Figure 17 shows the number of wastewater treatment works with phosphorus permit limits grouped by the permit requirement. The columns group our treatment works based on the phosphorus permit limit they are required to achieve, the Y axis shows the number of treatment works and the X axis shows the different size bands of treatment works split into each of the AMP periods. This shows the increase in phosphorus permits over time but the step change between AMP6 and AMP7 where the technically achievable limit of 0.25mg/l phosphorus was introduced and as can be seen the red columns start to increase. There is then a further step change between AMP7 and AMP8 with the introduction of the Environment Act requirement of 80 per cent reduction in phosphorus from WwTW by 2038 against a 2020 baseline. This shows the increasingly high number of phosphorus consents we will be operating with in AMP8 and beyond and the increasing number that will be requiring treatment down to very low levels.

Figure 17: Cumulative number of WwTW permits with phosphorus limits by AMP



Source: UUW data

3.3.3 To deliver the step up in phosphorus removal by 2038; we will need to deploy a multifaceted approach to achieving catchment phosphorus targets through:

- Chemical phosphorus removal;
- Catchment interventions;
- Balancing of catchment permits;
- Biological phosphorus removal; and,
- Phosphorus recovery.

3.3.4 Each of these approaches has both advantages and disadvantages and so a range of solutions will need to be deployed. These are summarised in Table 9 below.

Table 9: Summary of phosphorus removal approaches

Phosphorus management approach	Advantages	Disadvantages
Chemical phosphorus removal	Low capex, relatively short delivery timeframe, tried and tested	Relies on resilience of chemical supply chain with limited UK production facilities, increases HGV movements, creates more phosphorus rich sludge's for disposal (North West soils are phosphorus rich so adding to land bank pressure)
Catchment interventions	Delivers wider environmental outcomes	Legislative barriers to use on Environment Act phosphorus removal schemes or for nutrient neutrality. Monitoring costs can be high thereby limiting applicability. Requires time to understand the opportunity and identified the partners and exact locations for intervention
Catchment permits	Allows optimisation across a suite of assets to meet the standard in the most efficient way.	Only applicable where there are multiple wastewater treatment works
Biological phosphorus removal	Enables phosphorus recovery, reduces reliance on chemical supply chain, reduces HGV movements, may need supplementing with fermenter or chemicals if sewage too weak	High capex cost, particularly if the existing plant is a trickling filter plant Phosphorus re-releases readily therefore removal or locking in with chemicals is required

Phosphorus management approach	Advantages	Disadvantages
Phosphorus recovery	Removes phosphorus permanently from the treatment cycle thereby reducing the phosphorus load in sludge and avoiding re-release	High capex cost.

3.3.5 Using adaptive planning we have assessed the delivery needs in line with the Environment Act targets to reduce phosphorus load from treated wastewater by 80 per cent by 2038 in conjunction with the other drivers around nutrient reduction. We have prioritised delivery of sites where there is significant need to deliver early such as in rivers with certain eutrophication problems, rivers with identified improvement options to meet good WFD status or with a need to be protected from deterioration. On these sites we have prioritised delivery and ensured we will be meeting the long term requirements of the Environment Act. This will result in interventions that will remove over 1100kg of phosphorus per day. Sites without the urgent environmental need to be delivered in AMP8 have been planned for delivery in the AMP9 and early AMP10 period in order to meet the requirements of the Environment Act.

3.3.6 An example of this adaptive planning is in our approach to Davyhulme WwTW, our largest treatment works, which includes the construction of a phosphorus recovery plant for the sludge liquor stream in AMP8 with further delivery coming in subsequent years. This first step will satisfy the requirement to prevent deterioration in phosphorus concentrations in the Manchester Ship Canal by reducing the phosphorus loading on the treatment plant. Following this we have identified biological phosphorus removal with a chemical trim as the best approach to meet the Environment Act phosphorus target.

3.3.7 There is a global shortage of rock phosphorus with a heavy reliance on Morocco for resources and biological phosphorus removal presents an opportunity in the longer term to build a circular economy to put phosphorus back into the supply chain through phosphorus recovery. At the same time the North West has a surplus of phosphorus that contributes to the growing pressure we see around recycling biosolids to land thereby making the ability to move phosphorus out of the North West attractive.

3.3.8 Biological phosphorus removal and recovery is most cost effective at scale and in particular when the sewage strength is strong enough to sustain the bacteria. We have therefore evaluated our largest wastewater treatment works with phosphorus removal requirements and developed an option for biological phosphorus removal for those that are best suited. This has resulted in the preferred option for Davyhulme and Eccles being biological phosphorus removal. We will continue to drive innovation through AMP8 and beyond to see whether more of the Environment Act target can be met through biological phosphorus removal.

3.3.9 At the other end of the spectrum, finding sustainable solutions for smaller wastewater treatment works has been challenging. We are therefore pleased to see the recent direction that we should now assume that the Levelling up Bill will require phosphorus removal to the technically achievable limit of 0.25mg/l for WwTW serving over 2,000 population equivalent rather than 250 population equivalent. This brings back the possibility of catchment nutrient balancing for areas of the Derwent and Eden catchments where treatment works serve fewer than 2,000 people. As a result of this we have been able to identify 9 sites where catchment nutrient balancing offers an alternative to solely treatment works investment and we will be delivering these solutions to drive overall catchment load reduction.

3.3.10 The Environment Act targets along with other drivers targeting phosphorus removal significantly increase the delivery required to meet these environmental objectives as show in Figure 17. Our history of delivering innovation in this area through schemes such as the Petteril and developing solutions such as Nerada however puts us in a good position to meet these challenges efficiently and effectively.

Case study: Petteril Catchment

The River Petteril is a tributary of the River Eden, located in Cumbria. United Utilities has a number of small wastewater treatment works across the catchment. The Petteril is impacted from nutrient inputs which affect the ecology of the water course and cause a failure to meet good ecological status in line with the Water Framework Directive (WFD). There are a range of phosphorus inputs into the river including wastewater discharges but a significant amount of agricultural load.

In order to achieve good ecological status under WFD, action was required to reduce the amount of phosphorus entering the water course. In AMP6 and AMP7, four of UUW's WwTWs had WFD regulatory drivers identified to help address this issue however it was clear that this activity alone would not resolve the problem and that the costs associated with these interventions would be disproportionate compared to the relatively low influence that wastewater discharges were having. In order to address this we looked at how catchment measures could be used to mitigate the impact of treatment works discharges and reduce the scale of investment required at some very small treatment works. This had the benefit of helping to address the catchment load by working with farmers in the area.

Using our Catchment Systems Thinking approach we have been able to deliver enhanced ecosystem resilience through our investments. Key elements of this approach are:

- Establishment of catchment steering group and piloting natural capital methodology;
- Building a data driven evidence base to characterise the catchment;
- Developing sustainable solutions for small treatment works;
- Initiating the first trial of flexible permitting using Catchment Nutrient Balancing (CNB);
- Piloting a nutrient trading approach; and,
- Working in partnership to deliver agricultural interventions across the catchment.

The first CNB flexible permit trial was delivered at Calthwaite WwTW in AMP6. This was targeting removing a total of 150kg of Phosphorus load though integrated solutions with 13kg of these coming though farm interventions. This trial has recently concluded and demonstrated how successful these measures can be which the actual catchment load reductions far outstripping the targeted ones. During the three years of this trial we have monitored the impact of the interventions in the catchment and the treatment works and the results can be seen in Table 10 below.

Table 10: Catchment load reductions achieved at Calthwaite Beck

Year	Targeted ortho-phosphate catchment load (kg/year)	Measured ortho-phosphate load achieved (kg/year)
Baseline	1683	N/A
2019	1670	1626
2020	1533	521
2021	1533	-
2022	1533	621

Source: UUW data from monitoring from Calthwaite Beck

The success of the project is clear to see with phosphorus reductions far outperforming the catchment targets. This was recognised with the project being awarded a Water Industry Forum Environmental Innovation award, recognising the environmental impact and cost savings delivered by the project.

In AMP7, we have expanded the CNB flexible permitting trial into a further three WwTW in the Petteril catchment (Greystoke WwTW, Motherby WwTW and Southwaite WwTW) targeting reducing the phosphorus load by a total of 566kg/yr by September 2024 with 98kg of this reduction being achieved through catchment measures. We are aiming to deliver the associated farm interventions by September 2023 across nine farms in the catchment.

This project is expected to deliver a CAPEX saving of c£6.5 million across AMP6 and AMP7 compared to the estimated cost of delivering the initial required permits through on site conventional interventions. In addition to the primary phosphorus reductions benefit required by regulation these interventions are estimated to deliver significant additional ecological benefits as shown in Table 11

Table 11: Additional modelled benefits through the Petteril catchment scheme

Determinant	Reduction
Nitrate	1,057kg/year
Sediments	13,835kg/year
Nitrous Oxide	194kg/year
Faecal Indicator Organisms	23,325 x109cfu

Source: UUW modelling of Petteril catchment improvements

As well as the quantified benefits included in Table 11 these catchment interventions are predicted to deliver wider biodiversity benefit and overall soil quality enhancement. We will continue to monitor the key benefits to determine the overall effectiveness of this approach which can then feed into our future plans. We are currently looking to expand the flexible permitting approach across the Eden catchment though the AMP7 Green Recovery programme to further improve overall ecosystem resilience in the catchment.

3.3.11 We published a case study titled "Transforming the River Petteril"[19] on the UUW web site to share our Petteril story with the wider industry. To support the wider water sector in learning from our experience in the Petteril and facilitate greater uptake of catchment and nature based solutions nationally we published a CNB guidance document[20]. These documents provides information that will enable other water companies to better understand CNB schemes and how to implement them and support greater uptake across the industry.

Case study: Biological P Treatment and Pioneering NERADA

Our history of being first to trial and then roll out of the Nereda® technology at a number of our wastewater treatment works has continued to reap benefits for customers over the course of AMP7. Nereda is a biological phosphorus removal process utilising the innovation of aerobic granules, which we applied at five sites during AMP6. Three of those sites; Kendal, Blackburn and Failsworth have needed to meet even more stringent permits in AMP7 as a result of drivers in the WINEP.

Our experience of working closely with the Nereda supplier and history of testing and trialling gave us confidence that we could optimise Nereda in order to meet these AMP7 needs. Table 12 shows the tightened permits for AMP7 and how Nereda supported meeting these.

Table 12: Tightening permit limits at AMP6 Nereda sites

	AMP6 Phosphorus permit	AMP7 Permit Change to	AMP7 solution outcome
Kendal	1mg/l Total P	0.25mg/l Total P	Optimisation
Blackburn	1mg/l Total P	0.25mg/l Total P	Optimisation
Failsworth	n/a	0.3mg/l Total P	Trim dose following trials

Source: UUW permit limit changes for AMP7 at Nereda sites

[19] unitedutilities.com/Transforming-the-River-Petteril/

[20] unitedutilities.com/globalassets/documents/corporate-documents/catchment-nutrient- balancing-approach.pdf

At two of our sites we were able to optimise the process in order to meet the new permit. In the case of Blackburn this has resulted in reducing the need to build a further eight of the largest available cloth filters and associated backwash returns system as well as all the associated chemical dosing system, coagulation and flocculation tanks to achieve the low phosphorus permit. A trial at Failsworth WwTW, using a novel approach of a trim ferric dose into the Nereda buffer tank, has provided another innovation as a means of further reducing phosphorus levels whilst still utilising mainly biological nutrient removal. This optimisation strategy has led to capital programme efficiencies, lessened our reliance on chemicals and lowered our carbon impact through a reduction in the need to build new assets.

We're taking this learning and developing further enhanced biological phosphorus removal (EBPR) sites in AMP7 by adopting another innovative technology at Macclesfield WwTW. Mobile Organic Biofilm or MOB™, is an innovation which features the use of a plant-based media, called Kenaf, which creates organically ballasted granular biofilms (with similar properties and benefits to that experienced with Nereda). UU are the first to adopt the technology in the UK and we have since put further EBPR sites into our AMP8 plan as a result of all of this learning, some of which we hope to adopt MOB within. Implementing further biological phosphorus removal at our sites has meant we are able to meet the needs of reducing phosphorus levels but in a more efficient and sustainable way. We will carefully monitor the success of this technology which has implications for our AMP9 WINEP where significant amounts of additional phosphorus removal will be required.

Figure 18: Europe's largest new build Nereda® solution at Blackburn WwTW

3.4 Catchment Systems Thinking in Greater Manchester

AMP8 Plans

3.4.1 In AMP8 in Greater Manchester alone we will be delivering interventions at 105 storm overflows with 22 of these being delivered through hybrid or blue green solutions. We will be improving 82km of river and protecting a further 12km from deterioration, and we will be improving over 1,000 Ha of SSSI land.

3.4.2 In Greater Manchester we have a major opportunity to tackle emerging and historical water and wider infrastructure and societal challenges in an integrated way. Through water and wider infrastructure investment (including, for example, housing and transportation) we believe it is possible to achieve far greater integrated and connected delivery. This can be achieved in a co-ordinated way with our partners that introduces multiple benefits for Greater Manchester's citizens, improving place, the environment and reducing costs to deliver. Furthermore, many other stakeholders' ambitions align with our own. For example, in Greater Manchester Combined Authority's recent devolution trailblazer deal[21] with the

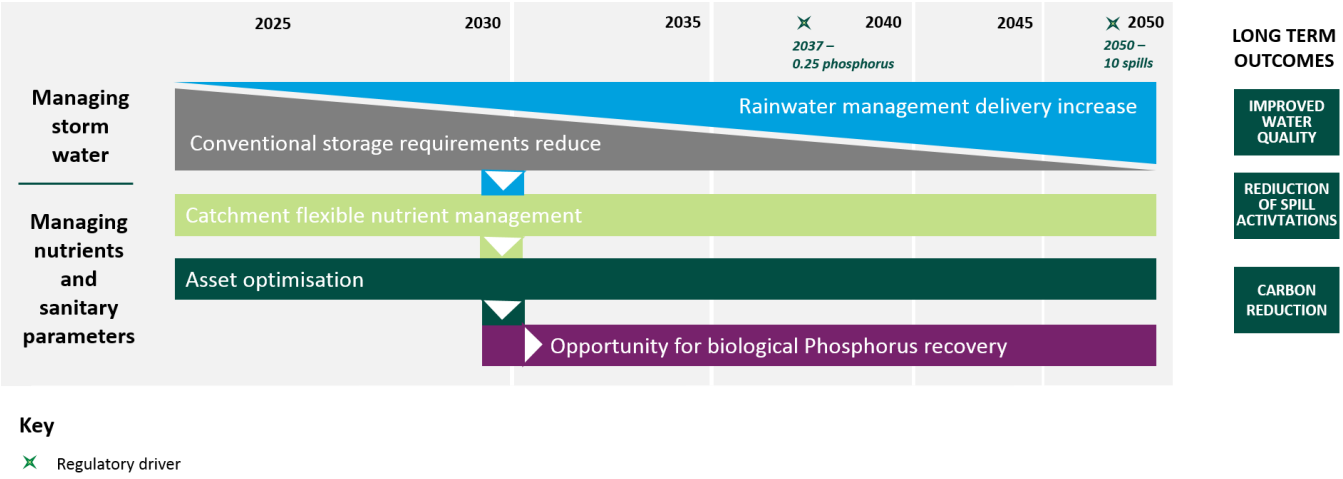
[21] Greater Manchester Combined Authority Trailblazer deeper devolution deal, March 2023

Government, it was agreed that the area should be a test bed to explore and develop options for how flood risk management can be accelerated. The devolution deal points to adoption of an ecosystem services approach, Integrated Water Management Planning and piloting revenue stacking, where multiple beneficiaries pay for the different outcomes that are delivered by a single solution which reduces the cost to individual benefices and makes these nature-based solutions more deliverable. All of these align strongly with our Catchment Systems Thinking approach. We have developed a strategy and adaptive delivery plans that bring these opportunities together in a managed way to provide flexibility of how and when we invest and maximise the value by working with others.

3.4.3 We have invested in Greater Manchester in previous AMPs as we look to keep pace with a fast-growing city region and environmental legislation. Our future requirements will require a substantial increase on previous AMPs investments utilising an adaptive planning approach to meet enhanced water quality objectives. Greater Manchester's watershed has over 51 per cent of our storm overflows and 75 wastewater treatment works, including Davyhulme which is our largest wastewater treatment works and serves a population of 1.2 million.

3.4.4 Figure 19 below is a simplified schematic of the general adaptive plan in Greater Manchester which shows the core pathway to enable delivery of long term outcomes for improved water quality, reduction of spills and carbon reduction. This includes the delivery of a biological phosphorus recovery plant at Davyhulme WwTW, to break the nutrient cycle between wastewater and bioresources, and drive the required improvements of dissolved oxygen in the Manchester Ship Canal. The biological phosphorus recovery performs optimally when the influent is less diluted, therefore managing rainwater out of the Davyhulme drainage area, and the drainage areas of sludge feeder sites in Greater Manchester is advantageous to achieving water quality standards in the canal.

Figure 19: Simplified schematic of the adaptive plan for Greater Manchester



Source: UUW Long Term Adaptive Plan for Manchester Ship Canal

3.4.5 Along with managing storm water to reduce spills and pollutant loads, we need to improve raw water quality and local water capacity. Taking an integrated approach to water management is key to aligning these objectives and ensuring that, where possible, interventions support better management of rainwater to reduce spills and improve the quality and quantity of raw water available in the region. These are significant challenges but we believe that working with partners and stakeholders creates the greatest opportunity to meet them.

Greater Manchester's Integrated Water Management Plan

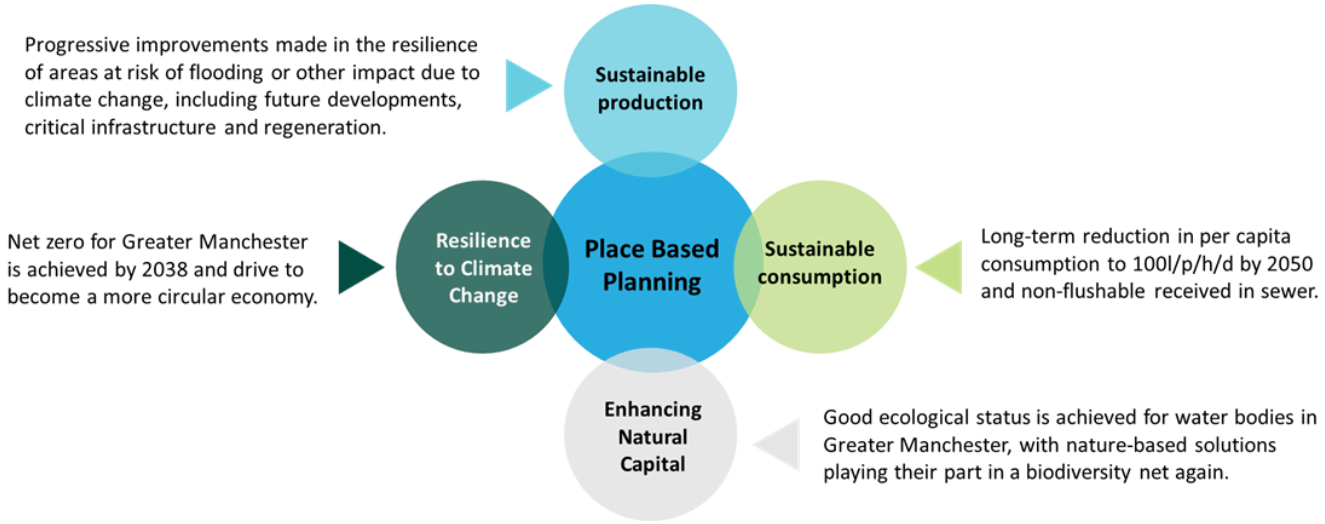
3.4.6 The Greater Manchester city region is home to a significant number of customers, and is therefore a significant opportunity and requirement to deliver efficient and sustainable water services into the future. In order to deliver the best value outcomes for the environment and customers we entered into a Memorandum of Understanding with the Greater Manchester Combined Authority (GMCA) and the

Environment Agency[22] in September 2021 to form a trilateral partnership. Both organisations have a strong track record of influencing local policy, delivering sustainable solutions and have long term targets that align to our own.

3.4.7 The trilateral partnership has an ambition to ensure progressive improvements in sustainable water management across the city region, enhancement of the natural environment and ensuring all future developments and critical infrastructure are resilient to flooding and the impact of climate change. The Memorandum of Understanding includes 11 long term outcomes which the three organisations have agreed to work in partnership to drive.

3.4.8 To support the delivery of these outcomes the trilateral partnership established five work streams as shown in Figure 20. Each has a working group of mixed representation from the three organisations and a work stream lead who sits in the Collaborative Team and reports progress to a Strategic Partnership Group, which provides steer and oversight.

Figure 20: Overview of the 5 work streams established by the trilateral partnership aligned to the 11 agreed outcomes



Source: Placebased planning 5 workstreams established in the Greater Manchester tripartite

3.4.9 The Place Based Planning work stream focussed on the Upper Mersey catchment with the aim of bringing together all core stakeholders which have an influence over planning, development and management of water within the catchment. The work stream helped to build relationships, provided an opportunity to listen and share the activities, initiatives, opportunities and challenges faced in managing the water environment; ultimately informing the co-creation of a place based plan. Further detail on United Utilities Place Based Planning activities can be found at our website[23].

3.4.10 The learning and understanding developed within the Place Based Planning work stream in the Upper Mersey catchment provided the catalyst for putting forward a recommendation at a water roundtable event hosted by the Mayor of Greater Manchester in September 2022 to develop an Integrated Water Management Plan (IWMP)[24] which provides the framework for 'what' will be delivered and 'how'.

[22] democracy.greatermanchester-ca.gov.uk/documents/s16654/MOU%20Partnership%20FRM%2024%20September.pdf

[23] unitedutilities.com/corporate/responsibility/stakeholders/catchment-systems-thinking/

[24] greatermanchester-ca.gov.uk/media/8082/integrated-water-management-planv14.pdf

Figure 21: Greater Manchester's Integrated Water Management Plan (June 2023)

3.4.11 The IWMP was co-developed by the GMCA, Environment Agency and UUW, with the support of independent industry advisors and consultation with key stakeholders. It will facilitate sustainable water management within Greater Manchester (GM) and influence activities upstream of the city region to enhance water quality, manage flood risk and increase biodiversity which benefits people, place and prosperity. The IWMP will bring together various strategic plans into an overall framework and seek to integrate opportunities which will maximise outcomes and move partners from a siloed delivery approach to a collaborative and complimentary one.

3.4.12 The scale of the opportunity to integrate in GM is significant as the three partner organisations have the jurisdiction over multiple programmes with a value over £1 billion and analysis highlights numerous locations where there are opportunities to integrate water management. Therefore an integrated team with a co-funded role to co-ordinate the integrated opportunity pipeline has been created to support the delivery of the integrated opportunities and report into the trilateral governance board.

3.4.13 The integrated opportunity pipeline and trilateral partnership framework are two components of the plan and there are another five elements which complement these. The key principles of this partnership link well to United Utilities Catchment Systems Thinking Approach and the Integrated Water Management Plan will enable United Utilities and partners to unlock issues, realise opportunities, work collaboratively, access markets and influence political thinking.

Case study: Manchester Catchment Permit

The Manchester Ship Canal downstream of our largest Wastewater Treatment Works (WwTW) at Davyhulme has been subject to a deterioration in phosphate status from the WFD baseline. An AMP7 Water Industry National Environment Programme (WINEP) Phosphorus limit was identified as being required at Davyhulme to address potential deterioration to 'Bad' chemical status in the Canal.

A conventional chemical dosing solution of the scale required to meet the proposed phosphorus driver at Davyhulme WwTW was not considered sustainable due to the significant quantities of chemicals required for treatment, but due to uncertainty on the sources of the increasing phosphorus load and the impacts of on- going population growth on the phosphorus load received at Davyhulme WwTW.

To address this United Utilities and the Environment Agency worked together to develop a set of alternative measures to the proposed end of pipe phosphorus limit at Davyhulme based on the principles of CaST. The alternative approach reverses the phosphorus deterioration to 'Bad' status in the Manchester Ship Canal by

delivering an equivalent phosphorus load reduction to the end of pipe limit at Davyhulme but delivering this across the catchment.

The required catchment phosphorus load reductions are delivered through a flexible catchment permitting approach which is set out in the Manchester Ship Canal Flexible Permitting for Phosphorus Operating Techniques Agreement (OTA). This has the aim of achieving outperformance and enhanced P removal at six WwTWs (Bolton, Bury, Rochdale, Failsworth Oldham and Rossendale) in four river catchments upstream of Davyhulme WwTW as shown in Figure 22.

Figure 22: Map of the treatment works included in the Manchester Ship Canal catchment permit

This will reverse the phosphorus deterioration in the Manchester Ship Canal and will deliver local WFD improvements in the upstream catchments. This catchment permit, formalised through the OTA, is only the second case of its type to be implemented by the Environment Agency. In addition to the flexible permit limits identified through the OTA, Eccles WwTW and Oldham WwTW will meet tighter backstop final effluent permit limits to fully deliver equivalent load reduction targets.

Normally tighter permit limits at treatment works drive investment at individual sites and we would typically deliver improvements that incorporate an element of headroom to ensure that the new permits are consistently met. By utilising a catchment permit we can optimise the existing assets and utilise the headroom that currently exists to meet the overall catchment reduction targets. This delivers twin benefits of improved environmental performance and delays the need for additional investment.

As part of the WFD no deterioration driver, and to compliment the phosphorus removal that will be delivered in AMP7, United Utilities has completed a catchment investigation to better understand the sources and potential for future increases in phosphorus load draining to Davyhulme WwTW. The investigation is directly informing the strategic thinking required to develop a long term adaptive phosphorus management strategy for Davyhulme WwTW and the Manchester Ship Canal Catchment which is detailed in the Manchester Ship Canal Adaptive Plan.

Over the first three years of this approach we have been able to deliver recognisable outperformance as shown in Table 13 below.

Table 13: Phosphorus reductions achieved through the Manchester Ship Canal catchment permit

	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Total (2020-2023)
Total P Reduction vs. Baseline	38,618kg	21,684kg	41,968kg	102,270kg
Performance beyond annual target	24,618kg	7,656kg	27,940kg	60,214kg

Source: UUW data from monitoring from Manchester Ship Canal catchment

Compliance and outperformance opposite the OTA is demonstrating CaST in action and the benefits that this can deliver. This is achieving improvements in four river catchments, moving them towards WFD compliance for phosphorus on top of what is being achieved in the Manchester Ship Canal.

On top of this the approach taken is delivering carbon, energy and chemical savings as well as a total capex saving in AMP7 of circa £115 million when compared to the expected cost of delivering a conventional phosphorus removal project to meet an end of pipe standard at Davyhulme WwTW. This approach was the first step on a low regrets adaptive pathway towards meeting the long terms needs, of this catchment. This adaptive pathway has been reassessed for AMP8 and the next stages will be delivered to support the continuation of this adaptive catchment approach.

The Manchester Ship Canal Flexible Permit for Phosphorus has been a key part in enabling, developing and delivering a long term adaptive plan for Davyhulme and the Manchester Ship Canal. This adaptive plan has been developed further to support PR24 plans.

3.5 Delivering for Windermere

AMP8 Plan

3.5.1 Windermere is an iconic water body at the heart of the Lake District which attracts significant numbers of visitors from around the world every year resulting in the lake having a significant natural capital value based on the benefits that it provides in terms of tourism and recreation. Currently classified as moderate under the Water Framework Directive it faces challenges from agriculture, treated wastewater discharges, private septic tanks and storm overflows. In order to address point sources from wastewater assets, United Utilities has, over a significant period, invested in catchment investigations and asset improvement.

3.5.2 Over more than 30 years significant investment, technological advances and innovation has meant that phosphate inputs into Windermere from wastewater assets have reduced from circa 2mg/l in 1990 to circa 0.25mg/l in 2022. Overall, over £40 million has been invested in wastewater assets around Windermere through AMP6 and into AMP7 in order to deliver the most advanced wastewater treatment possible, appropriate for a national park and world heritage location. These advances include innovative filters on the treatment works and allow us to treat to the lowest ever phosphorous levels entering Windermere.

3.5.3 Despite this there is still an ongoing challenge with nutrients in Windermere and campaigning on the issue has become more prominent with local and national media coverage. The most recent data suggests that 60 per cent of phosphorous inputs into Windermere come from other sources including diffuse catchment runoff from agriculture and private septic tanks. These inputs are a key contributor to ongoing challenges with algal blooms which pose a threat to the overall health of the ecosystem. To tackle these challenges it will be key to work effectively across stakeholders in the catchment and as part of this we are committed to continuing our long history of investment in the Windermere catchment.

3.5.4 Our most recent £45 million investment in AMP6 delivered significant upgrades as Windermere WwTW, Ambleside WwTW, Grasmere WwTW and Glebe Road pumping station, collectively these upgrades halved our phosphorous inputs into the lake, enabling us to meet our fair share reduction for Windermere to achieved ‘Good’ WFD status.

3.5.5 Looking ahead, we recognise the need to go further and strive for the continued improvements that customers and communities expect to see. In AMP8 we plan to deliver a further £36 million of investment to reduce spills from remaining assets within the catchment including from Ambleside WwTW, Near Sawrey WwTW, Elterwater Pumping Station and Hawkshead Pumping Station. £19 million of the total investment is being accelerated into AMP7 to enable the benefits of the project to be delivered as quickly as possible and achieve the greatest environmental benefits possible.

3.5.6 In addition to this we are putting forward a bespoke performance commitment for Wonderful Windermere to support activities in the wider catchment that tackle phosphorus sources beyond our

assets. This will allow a fully systemic approach to be taken to improving this lake and ensuring it can retain its status as the jewel in the crown of the Lake District. Further details of this bespoke performance commitment can be found in Chapter 5 of the plan.

3.5.7 To help with this delivery we have formed a partnership with other key stakeholders, Love Windermere. This partnership is committed to supporting the development of a long-term plan to reduce nutrient inputs to Windermere from multiple sources, including from catchment runoff and private discharges, such as septic tanks, to ensure a holistic approach to delivering improvements, leading to a healthier environment.

Case study: Love Windermere partnership

The partnership has been formed with organisations including the Environment Agency; Lake District National Park; South Cumbria Rivers Trust; Freshwater Biological Association; National Trust; NFU, Lake District Foundation; Local Enterprise Partnership and Westmorland and Furness Council. The purpose of the group is to work collaboratively and to take a holistic approach to improve the water quality of Windermere and the surrounding catchment. Through this partnership, the members are working to develop a plan that will identify opportunities to improve the overall health of the Windermere ecosystem.

The partnership is structured into several work streams centred around robust data and evidence. Work streams include communication and engagement, sustainable financing, long-term planning and several sub-groups dedicated to developing solutions for key challenges in the catchment, such as non-mains drainage and land management. Key activity is being delivered to build a robust foundation of the latest best evidence to inform appropriate, long-term solutions to reduce nutrient inputs. Engagement with communities is essential to the success of the partnership and a number of activities have taken place to understand community views on the challenge including a 'Citizens Panel'. Additionally, projects have been delivered to enable and empower residents to support the challenge including establishing a septic tank emptying co-operative and production of a household pack to advise and promote efficient septic tank maintenance.

In order to ensure that the overall plan is evidence led, the Freshwater Biological Association, in partnership with organisations, including Lancaster University and United Utilities, have developed a large scale citizen science project which commenced in summer 2022. The 'Big Windermere Survey' is anticipated to run four times per year, with over 100 volunteers sampling Windermere to collect water samples for Lancaster University and the Freshwater Biological Association to analyse. Determinants sampled include phosphorus, nitrate and ammonium. This activity has not only set a strong baseline for the partnership to utilise in the development of a plan, but has engaged the local community in development of the plan, enabling local views and input to be adopted at all possible stages. It has been aligned to our CaSTCo Ofwat innovation fund project so the learnings from implementing citizen science on this scale can be share nationally.

As the plan develops and matures, the Programme Board will develop a range of communications and engagements to ensure that the community is at the heart of delivery and will ensure that the plan is long-term in order to ensure the longevity of the water quality in Windermere, leaving a healthy environment for generations to come.

Initiatives like this are key to realising the full value of United Utilities investment as despite significant investment in assets on Windermere the outcomes that we seek can't be realised without addressing the issues across the catchment. Partnerships that can help mobilise other sectors to tackle their inputs are therefore key to realising best value from our own investment.

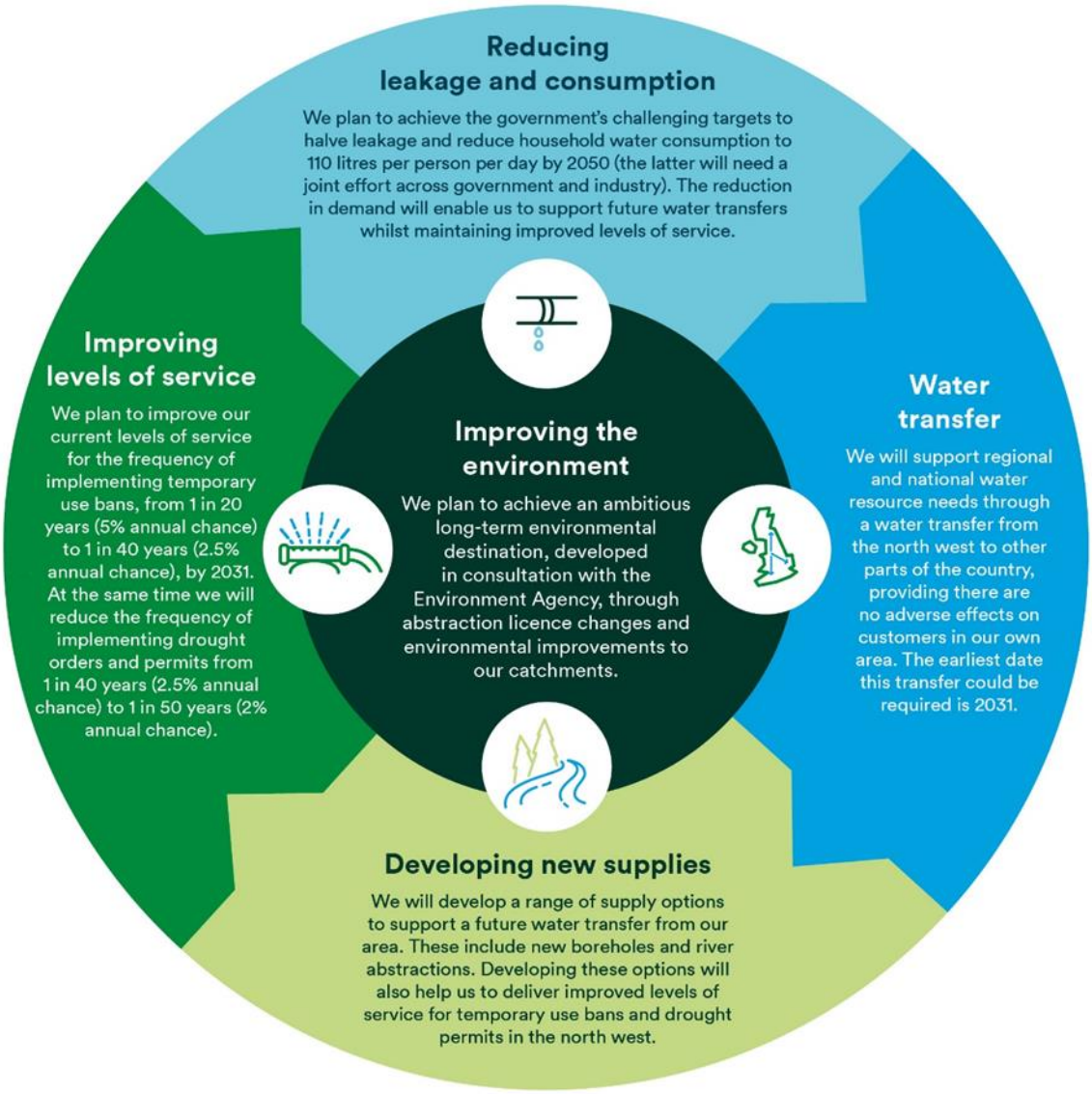
3.6 Protecting water resources

AMP8 Plans

3.6.1 We have developed our Water Resources Management Plan (WRMP) in line with guidance and by working collaboratively with regulators, stakeholders and customers, in particular through the regional

group, Water Resources West, of which we are a leading member. We have assessed our supply system through detailed modelling of different drought patterns, and produced forecasts of future demand taking into account predicted population changes and future patterns of water use. Our plan ensures a resilient supply into the future as well as delivering key customer and environmental priorities, meeting government targets and supporting regional and national water resource needs, as summarised in Figure 23 below.

Figure 23: Overview of the Water Resources Management Plan



Source: UUW Water Resources Management Plan

3.6.2 Our demand management strategy is a key part of our WRMP and includes a range of demand management options to reduce both leakage and per capita consumption (PCC). We plan to meet challenging targets set by the government to reduce leakage by 50 per cent by 2050 (from 2017/18 levels) and to reduce PCC to 110 litres per person per day by 2050; the latter commitment assumes government interventions including changes to building regulations and legislative support for water labelling. The resulting reductions in demand will enable us to reduce the amount of water taken from the environment and will contribute to our commitment to reduce carbon emissions.

3.6.3 Our leakage reduction strategy is aimed at the proactive 'Prevent' and 'Aware' aspects of the PALM framework (Prevent, Aware, Locate and Mend). With a strong focus on the need to **Prevent** leakage, we are promoting options which:

- Ensure that our networks are effectively optimised and managed via 'calm networks', live valve status and remote control;
- Apply intelligent maintenance to water network assets; and,
- Stop deterioration in water network asset health, ensuring that we have already applied appropriate operational mitigation and that any new network is leak-free.

3.6.4 This approach is reflected in our asset rehabilitation, replacement and Dynamic Network Management (DNM) options. DNM involves installing monitoring technology to enable us to proactively pinpoint and prevent leaks or reduce leak run times.

3.6.5 Our approach to ensuring that we are **Aware** of leaks so that we can efficiently repair them, is to:

- Prioritise targeted enhanced monitoring; and,
- Use the latest data analytics and prediction techniques to shift the balance from customer reported leaks to proactively found leaks.

3.6.6 To **locate** leaks, we will work with our suppliers to develop and implement automatic correlation for pinpointing leaks to reduce leak runtimes. Finally, our demand-side options will enable us to **Mend** leaks, by implementing a robust repair prioritisation, using customer impact and size of leak, and reducing disruption by continuing to seek out and implement 'no dig' and 'in pipe' repair techniques, as well as utilising temporary repairs for leak mitigation.

3.6.7 We are conducting trials of innovative technologies, which can help to reduce leakage, as part of our Innovation Lab programme. This has included a trial of an app that manages and monitors valve operations and reduces transient pressure waves on a potable water network.

3.6.8 **Our water efficiency options** were developed in collaboration with a range of stakeholders. This included work with the industry through Water UK and the Waterwise strategic communications programme. We engaged with customers and stakeholders, including non-household customers via retailers, and specifically targeted the education and tourism sectors where we believe significant water efficiency savings can be made. Many of our options utilise data-driven insights to target our activities, for example water efficiency audits. Options to reduce consumption focus on:

- Customer communications (community and direct messaging);
- Smart metering;
- Water efficiency home audits; and,
- Water efficiency audits for non-households (likely to focus on education and health).

3.6.9 An overview of our water efficiency programme is shown in Table 14

Table 14: Overview of our water efficiency programme

Customer insight and engagement	**Reconnecting customers with water as a vital resource is key to sustainable water resources. Therefore customer insight and engagement is a large element of the water efficiency strategy.**
Prioritisation	Reducing consumption is a pivotal outcome of the strategy; to achieve this we must understand the region's customer base, asset condition and opportunity for the company to ensure that investment is targeted in the correct way. Regional prioritisation helps with this.
Remote monitoring	Remote monitoring (meter penetration) allows us to identify high consumers and gradually increasing water use. It allows us to validate the effectiveness of our strategies and interventions.
Data led interventions	We will be able to select the correct combination of interventions by understanding the regional customer base, our assets and what customers say they need.

3.6.10 Our plan supports long term national resilience through the development of strategic supply options. As a company we have taken a leading role in ensuring the success of Water Resources West, including providing an employee on full time secondment. We have collaborated through the RAPID process to support regional and national water resource needs by enabling future potential transfers from UUW, subject of course to key principles such as there being no adverse effects on customers in our area. We have identified a range of supply options, including groundwater and river abstractions, which increase the resilience of the region during normal years and backfill for any traded water in dry years.

3.6.11 Our plan aims to deliver environmental improvements whilst meeting demand. In the National Framework for Water Resources, the Environment Agency set out its aspirations for long-term environmental improvements to be incorporated into each regional and company resources plan. The Environment Agency has undertaken a national catchment data exercise to identify waterbodies, which are at risk of not meeting their environmental flow objectives by 2050, taking into account the future impacts of climate change. In parallel with this work, we have identified priority catchments within our own region and we have been consulting with stakeholders in those areas to identify where nature-based solutions may offer a water resources (Ml/d) benefit. As part of the WINEP we will be undertaking four investigations in the Upper Wyre catchment to understand the potential water resources (Ml/d) benefit.

3.6.12 Our target is to achieve our long-term environmental destination by 2050 in line with the national framework, and this will require a number of short, medium and long-term actions including abstraction licence changes and environmental improvements to our catchments. There are a number of possible scenarios under consideration, relating to the degree of environmental protection provided and the assumptions relating to abstraction rates. We applied the 'BAU+' (Business as Usual plus) scenario in the baseline plan, with the 'Ofwat low' and 'Enhance Future Potential' scenarios used in the adaptive plan.

3.6.13 At part of the WINEP from 2025 we will be investigating the likelihood that future abstraction will cause deterioration in the ecological status of the Fylde aquifer and to identify innovative solutions. The project will initially comprise a feasibility assessment and conceptual design for a range of aquifer recharge solutions including natural flood management. The second phase will be the development of a pilot scheme to test and monitor the proposed solutions which may include injection cycle testing as well as natural filtration from surface water ponds.

Water Trading

3.6.14 In order to help address the national water resource challenges presented by climate change and population growth, United Utilities is actively participating in Ofwat's Strategic Resource Option (SRO) programme, working closely with our economic and environmental regulators in the development of new national infrastructure.

3.6.15 UUW is involved in two SRO schemes, the North West Transfer (NWT SRO) and Severn to Thames Transfer (STT SRO). The former includes the development of new water sources in the North West to offset water made available for transfer and enabling works on part of our distribution system – the Vyrnwy Aqueduct – to maintain supply resilience in the UUW operating region. The latter – delivered in partnership with Severn Trent Water and Thames Water – involves development of a new interconnector between the River Severn and River Thames to enable water to be transferred from the North West to the South East of England.

3.6.16 The new and enhanced raw water sources, and the enabling works on the Vyrnwy Aqueduct will provide a range of benefits both to customers in the North West and more widely in the Midlands and South East of England.

3.6.17 Within the North West the proposed development of additional groundwater resources through the NWT SRO will provide increased drought resilience as groundwater aquifers respond much more slowly than rivers to short term droughts, easing the abstraction pressure on rivers. The strategic delivery of Biodiversity Net Gain (BNG) for the new infrastructure required will provide for enhancement of habitats across the North West and will be aligned with UUWs strategic approach to delivering BNG.

3.6.18 More widely, the NWT SRO supports Ofwat's aims to progress the development of strategic regional water resource solutions to ensure that a reliable and resilient water supply is provided to water-stressed areas. It is part of the first steps in developing the national water transfer network first noted in the National Infrastructure Commission report in 2018. In addition to a trade within the Water Resources West (WRW) region – 25 Ml/d to Severn Trent Water - the NWT SRO could support the transfer of water to the Water Resource South East (WRSE) region if selected in their regional plan. This would provide resilience to customers in the South East and protect the environment from the effects of over abstraction in the dryer, more densely populated areas of the country, which hosts some of the most sensitive habitats such as chalk streams.

3.6.19 The NWT SRO water resource options have been assessed using best value metrics which seek to deliver wider benefits including reducing carbon emissions, reducing flood risk, increasing human health, social and economic wellbeing, enhancing ecosystem resilience and natural capital to ensure wider benefits to society and the environment are delivered as part of the scheme.

3.7 Water catchment resilience

AMP8 Plans

3.7.1 Through the Water Industry National Environment Programme (WINEP) we will continue to work with partners to raise awareness of water quality and support measures to reduce risk and improve resilience within catchment safeguard zones. Through this, by 2030 we will deliver a second phase of catchment resilience schemes related to improving the condition of habitat on our land holdings at Thirlmere, Haweswater, West Pennine Moors, Bowland Fells and South Pennine Moors. This will help to improve raw water quality in the long-term by restoring the underlying ecosystems and natural processes, building on the legacy of long-term catchment management delivered at these sites since 2005. We will go beyond the extent of our land holding to deliver catchment resilience schemes in Cumbria and Lancashire working in partnership with stakeholders at a landscape scale in the Lune (Lancaster), Wyre (Franklaw) Eden (Castle Carrock and Cumwhinton), Upper Duddon (Ulpha) and Poaka Beck catchments to improve habitat condition and hence the long-term resilience of water resources.

3.7.2 In the NEP (National Environment Programme for Wales) we have committed to working in partnership with other water companies and stakeholders in the River Dee catchment. We will implement the recommendations of our 2020-2022 turbidity investigation by delivering nature based solutions to reduce erosion in the highest priority areas. Contributions from partners will enable this project to deliver multiple benefits by combining our efforts to engage with farmers and land owners in the catchment to improve the resilience of the Dee catchment to the effects of extreme weather events and turbidity.

3.7.3 We will be implementing the recommendations for catchment management in the Wybersley sources around the Goyt Valley and Lyme Park to reduce the risk of dissolved organic carbon in the raw water. As the landowners, UUW and National Trust are working closely to align future investment plans for the area. We will implement the recommendations of our 2020-2022 dissolved organic carbon investigation by delivering peatland restoration and other nature-based solutions to stabilise the peat soils and increase the water table. Co-funding from National Trust, Natural England and others will enable this project to deliver multiple benefits by combining our resources to engage with tenants and land managers in the catchment to improve the resilience of the landscape to the impacts of climate change.

3.7.4 We will be implementing a second phase of catchment management in the Stocks catchment (Hodder) to address deteriorating raw water colour from dissolved organic carbon.

3.7.5 We will continue to monitor and build on our data collection of post-intervention water quality data at sites in Bowland and the South Pennines, which have been continuously monitored since 2005. This valuable evidence helps us to understand the scale and rate of change that is possible following interventions to restore degraded peat soils in upland catchments.

3.7.6 Beyond 2050, we expect the investment in catchment management to provide benefits, as the restored ecosystems become fully functioning and producing high quality raw water. In line with Defra's 25 year Environment Plan, we will develop natural capital accounting and an outcomes based approach to agri-environment funding to provide opportunities to support those managing our catchments for water quality, benefitting customers and other stakeholders.

3.7.7 Since 2010, we have worked collaboratively with owners of non-UUW land for the protection of water quality within catchments for rivers, reservoirs and groundwater. This work has comprised a mix of advice, partnership working, investment, incentive schemes, benefits in kind (e.g. targeted hire of weed wipers to reduce pesticide use) and joint catchment activities. In line with our CaST approach we will continue to work collaboratively with third party landowners, regulators (Environment Agency, Natural England) and stakeholders (e.g. National Trust, rivers trusts etc.) to support activities that benefit the quality of raw water, helping them to deliver outcomes aligned with our objectives. This work will focus particularly on the catchment of the Rivers Dee, Eden, Lune, Wyre, Upper Duddon and Poaka Beck.

3.7.8 We recognise that awareness and education is pivotal to achieving our ambitions to maintain and protect raw water quality. Building on the success of our engagement with farmers through the employment of catchment advisers we are expanding our reach to the equine community in 2020-2025. Particularly in Cheshire, where the catchments are predominantly groundwater and impacted by the use of fertilisers and animal manure management practices. Through a series of events, educational talks about the risks to water quality and best practice demonstrations, in partnership with local equine centres, we have created a bespoke series of guidance leaflets endorsed by the British Horse Society. We promote best practice land management for the benefit of water quality by organising and sponsoring competitions such as the "The Great Farm Challenge", which in the North West is a partnership between Natural England, Environment Agency and UUW.

3.7.9 All of this work builds on and expands the activities we have been leading on since the inception of SCaMP in 2005. Continuing to deliver in this way will help secure the longevity of the benefits from landscape interventions which can take time to realise but yield great results.

Case study: Thirlmere and Haweswater Resilience

Delivering across whole catchment systems to achieve resilient ecosystems that support long term sustainable abstraction, thriving biodiversity and excellent amenity value for customers is not something that can be achieved in isolation and requires partners to support working in the landscape.

United Utilities has a long standing relationship with RSPB on the Haweswater Estate that began in the late 1960's. Consistency and longevity are key in landscape management as the impacts of action taken can take years or even decades to materialise, so in 2012 the RSPB took on a 45 year tenancy to manage circa 3,000 hectares of land as part of a joint project to deliver nature friendly farming at a landscape scale.

The project has already delivered a wide range of environmental improvements, building on United Utilities' SCaMP project. Most notable to date is the restoration of Swindale beck (CIEEM award winner) which has greatly improved the habitat for salmon spawning and reduced the impacts on our abstraction infrastructure[25].

One of the key aims of the project is to better understand upland farming and how this can be managed sustainably for both farmer and the environment which will in turn deliver benefits to water quality in the catchment. RSPB have produced a number of valuable reports looking into the economics and sustainability of upland farming and these have gained real traction[26] [27]. The lessons learnt from Haweswater are helping to inform

[25] youtube.com/watch?v=fmzjRJUi9UY

[26] Farming with nature report

[27] Farming at Haweswater Report

policy decisions particularly around nature recovery in the uplands and at a local level have made a valuable contribution to Lake District National Park State of the Park review and Management plan.

Figure 24: RSPB Reports into sustainable farming at Haweswater

RSPB are looking into farm diversification opportunities around eco-tourism and most recently the development of a new tree nursery in partnership with UUW. This new nursery will not only provide local employment opportunities, creating three full time jobs but will supply specialist upland trees, shrubs and arctic alpine plants to help us to deliver ambitious restoration projects across our catchment land. This diversification helps to attract new sources of funding into the catchment which in turn spreads the cost of enhancing and maintaining this landscape, protecting customer bills[28].

The UUW RSPB partnership project takes a Catchment Systems Thinking approach to all its work, with the improvement and protection of raw water at the heart of decision making. We have successfully gained the IUCN Nature Based solutions accreditation for the project, which is an international recognition of our work towards a more environmentally sustainable future for farming and land management.

One of the main lessons learned from the more frequently occurring storms experienced in the last five years is the susceptibility of upland catchment systems to significant high consequence but infrequent storm events. For instance, the 2015 storm named Desmond, which at Thirlmere had a return rate of approximately 1 in 1,300 years, caused significant damage to the catchment. This resulted in a significant deterioration in raw water quality, which exceeded the treatment envelope of the water treatment works (WTW) and resulted in a net reduction in the resilience of supply to customers. The net consequence caused by these types of events appears to be increasing. To address this issue we have reviewed the resilience of our catchments and will undertake work over the next 25 years to improve catchment resilience.

Our first catchment resilience scheme was at Thirlmere, chosen due to its regional significance and susceptibility, caused by historic land management practices. Supported at PR19 by DWI, Environment Agency and Natural England, the work being delivered in the period 2020-2025 demonstrates our approach to catchment Systems Thinking, supported by our previous successful approach of partnership working across water catchments. Co-created with stakeholders, the overarching purpose is to restore natural processes to improve the resilient functioning of the catchment hydrology and vegetation.

Since 2020 we have kick-started long-term activity in the 4,000 hectare catchment in Cumbria including:

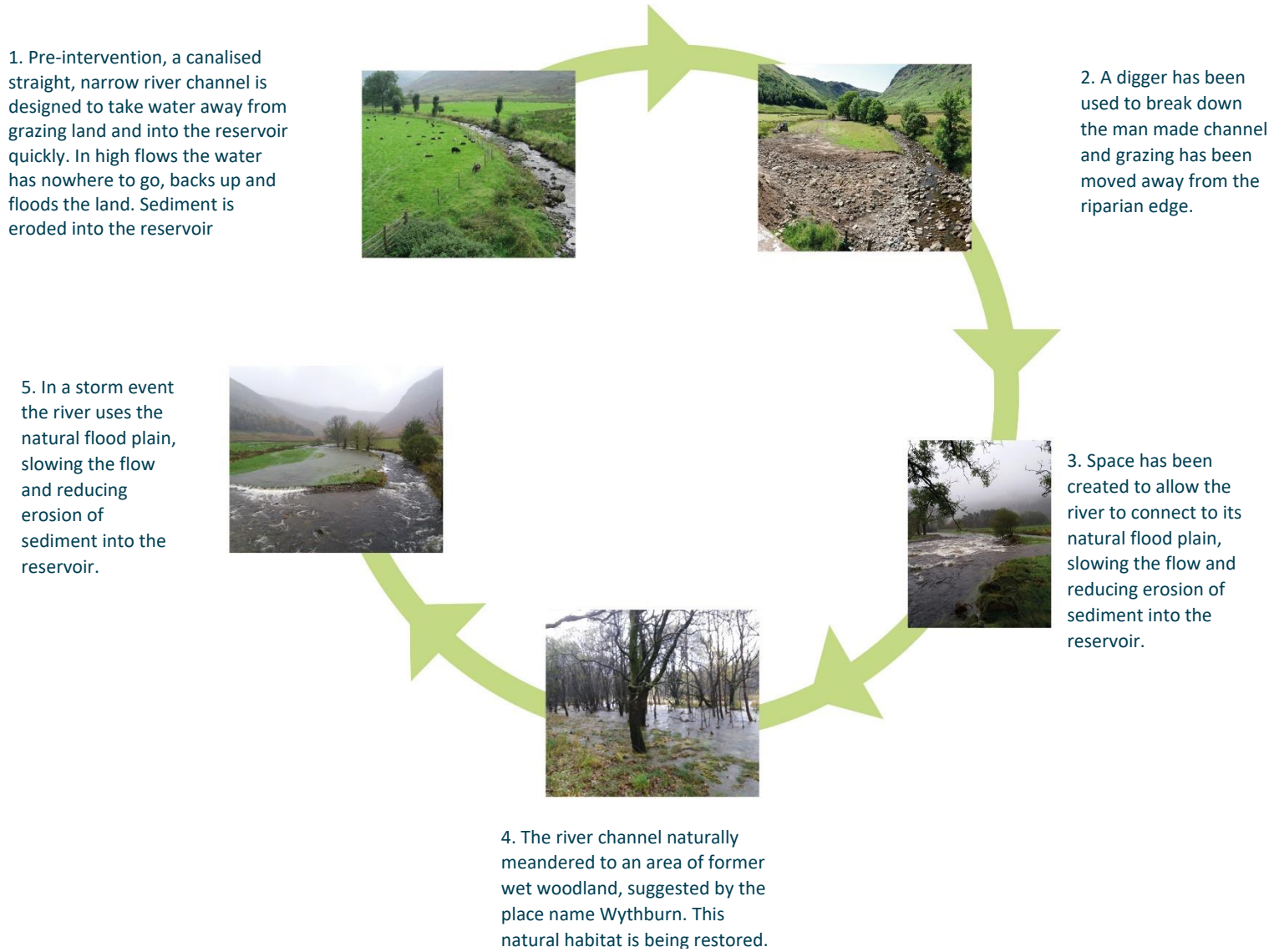
- Catchment intervention and management;
- Forestry and Woodland Management;

[28] https://wildhaweswater.co.uk/

- Farming and tenancy models; and,
- Geomorphological and hydrological studies.

We are working with a number of partners and research institutions including the Centre for Ecology and Hydrology, West Cumbria Rivers Trust, John Muir Trust and Cumbria Wildlife Trust in order to maximise the benefits delivered at Thirlmere.

Figure 25: River restoration at Thirlmere to slow the flow in storm events and reduce turbidity spikes



3.7.10 Whilst work at Thirlmere commenced in 2020, our experience of catchment schemes is that commitment and investment is required over the long-term to achieve sustainable improvements. We are therefore planning to continue the delivery of works in the catchment as well as extending this approach to other catchments at risk of high consequence storm events.

Case study: Upland management partnerships for wildfire, taste and odour

An important aspect of partnership working in the uplands is the outreach activity to raise awareness of the impacts of wildfires, which are often caused accidentally by the improper use of disposable barbeques. Accidental fires can destroy habitats and have an impact on water quality, both in the short term and in the longer term because the environment can take time to restore as well as the significant impacts this can have on local communities in terms of their air quality and the safety risk.

A holistic approach is taken to managing and reducing the risk of wildfires, ranging from awareness raising with partner organisations, fire management plans and training, as well as investment in raising the water table to restore and rewet the peatland, which enables natural processes to mitigate the impact in the long run.

UUW is a member of the England and Wales Wildfire forum (EWWF) which is a multi-agency stakeholder group of public, private and third-sector parties that works to address wildfire issues driving increased resilience of the upland ecosystem. The forum is a voluntary strategic body, independent of government, created to expand knowledge and understanding of wildfire, with the overall purpose of reducing the harmful impact of wildfires by promoting joint working and collaboration.

The EWWF works with a variety of partners to develop and improve wildfire awareness and training. The EWWF and Moorland Association worked together recently to develop a short training course for land managers who may find themselves working alongside the Fire and Rescue service at wildfires. The aim of the training is to enhance understanding between the land management sector and Fire and Rescue Services and to promote safe systems of work at wildfire incidents for the benefit of all. The training consists of a presentation which will be of interest to a wide range of land managers, including estate workers, game keepers, farmers, forestry workers, countryside rangers etc. At the end of the presentation there is a link to a short online assessment to confirm understanding of key elements of the training.

Though the EWWF we are able to maintain close links with a number of other key wildfire stakeholder groups and projects around the UK and Europe supporting the sharing of knowledge and best practice. While the focus is on national wildfire issues, the EWWF works closely with regional and local wildfire groups to promote cooperation, collaboration and synergy on wildfire issues across England and Wales. There are currently 14 local and regional groups in England and Wales that are addressing wildfire issues, including 5 where United Utilities is a member.

Local wildfire groups perform a key role in bringing together a variety of stakeholders to address wildfire risk and issues at local level and have the opportunity to influence people more effectively than United Utilities could in isolation.

In addition to participation in the EWWF and local groups W is involved in collaborative research projects to understand the impact of wildfire on water quality, biodiversity, carbon and other ecosystem services. The range of stakeholder interests in the uplands is vast and complex and therefore it is important to collaborate on these topics to find common ground with other land managers and agree a way forward for managing and mitigating the impact of wildfires across the wider landscape for multiple benefits.

A report published online in 2022 by the Peak District National Park Authority[29] contains a comprehensive wildfire risk assessment and mitigation strategy; the first of its kind in the UK. Available in three easily accessible formats, the report sets out the latest evidence and research on wildfire management and mitigation. The findings of this report will be rolled into UUW's approach going forward.

The benefits of reducing wildfire through partnership go beyond the obvious safety considerations. Resilient upland catchments play a key role in water quality as uplands can be a source of organic matter; from the underlying peaty soils, as well as nutrient run off from agriculture and other human activity on the land. Where the soil becomes exposed through burning, wildfire, over grazing, and other forms of erosion the organic matter is transported downstream and this can end up in a reservoir used for public water supply. Organic matter can produce taste and odour compounds which, although not harmful to health, can lead to an unpleasant customer experience so the impacts of these partnerships in protecting upland sources is key to securing sustainable high quality raw water for customers.

[29] peakdistrictwildfire.co.uk

United Utilities Water Limited
Haweswater House
Lingley Mere Business Park
Lingley Green Avenue
Great Sankey
Warrington
WA5 3LP

unitedutilities.com

United Utilities

Water for the North West