Appendix 8g

PR19 WINEP Technical Appendix

YorkshireWater

1. Introduction

1.1 Purpose of the document

The purpose of the document is to set out our approach to meet the statutory requirements of the final Water Industry National Environment Programme (WINEP3). It highlights the key issues we believe need addressing and the technical detail required by Ofwat to make a determination of whether our proposals to meet the requirements of WINEP3 are cost efficient. The document is a technical appendix to the main narrative section for the associated performance commitments and the Wastewater and Water Network Plus price controls.

The document presents;

- Our approach to WINEP3 including a source to sea overview (section 2)
- The key issues that relate to our WINEP3 programme (section 3)
- The key drivers and measures in the WINEP3 (sections 4-7)
- Our approach to the cost of treatment is set out in detail, with particular reference to our approach to phosphorous removal (section 8)
- A list of sewage treatment and sewerage water quality drivers (sections 9-10).

1.2 What is the WINEP3?

The Government's strategic policy statement to Ofwat (SPS) set out the priorities for the water industry in PR19. Subsequently, the Environment Agency and Natural England published the obligations and expectations for the water industry for PR19 in detail in the Water Industry Strategic Environmental Requirements (WISER) document. Strategic steer to water companies on the environment, resilience and flood risk for business planning purposes. The document sets out the obligations and expectations for the water industry during the price review period 2020-2025 (PR19). It describes the environmental, resilience and flood risk obligations for companies to take into account when developing business plans.

We have worked with the Environment Agency and Natural England to apply and interpret the strategic environmental requirements to Yorkshire Water. The final WINEP3 agreed with Environment Agency and Natural England lists the extensive obligations to meet the regulatory requirements and ambition as set out in the WISER document.

Our final business plan meets the strategic environmental requirements and includes the full content of the WINEP3 programme for the region. That is, both the green 'certain' schemes, and the yellow 'indicative' schemes, as described in the Environment Agency's document 'Guiding Principles - Managing Uncertainty for PR19'. Our plan covers the statutory obligations, statutory obligations-plus, and non-statutory action expectations (S, S+ and NS) as described in the WISER document.

Our WINEP programme is our most extensive and ambitious in terms of its breadth of scope and scale of ambition. The range of solutions vary from conventional engineering approaches, to our largest ever programme of catchment interventions. Collaboration, partnership and innovation are key themes in our WINEP programme and across our whole PR19 business plan. The WINEP programme is integral to and a major element of our business plan and relevant aspects were also integrated within our Drinking Water Quality submissions to the DWI (appendix 14a) and our draft Water Resource Management Plan submitted to Defra (appendix 16a).

The Yorkshire Forum for Water Customers (the Forum) and the Forum's environmental sub group, have played a significant role in the evolution of our approaches, and we thank the Forum and the sub group for their valued contribution. The sub group includes representation from the Environment Agency, Natural England and other third parties with environmental interests. The strategic environmental requirements was subject to considerable challenge by the sub group and helped us ensure our plan reflect the ambition and needs of customers and the environment.

Our close working relationship with the Environment Agency and Natural England through the PR19 Joint Management Group established timescales that reflected the relevant guidance and informed the WINEP3 programme. The WINEP3 dates have been assimilated into our business plan, and are reflected in our performance commitments.

The WINEP applies to our entire region, from source to sea, for our clean and wastewater activities, and to several of our land based activities. Looking at this in a catchment source to sea approach, it covers the management of:

- Our land
- The sources of our clean water
- The environmental impacts of our reservoirs and abstractions
- The impacts of the wastewater we release.

The WINEP3 focuses on new or enhanced environmental obligations, while other parts of our business plan deal with maintaining and improving our performance against existing environmental obligations. Similarly, there are other parts of our business plan that deal specifically with ensuring that population changes within the region do not increase the overall environmental impact of our activities.

2. WINEP: a source to sea overview

This section provides a brief overview of the WINEP driven activity to protect our water sources; ensure sustainable abstraction; protect and enhance biodiversity and manage the impact on the environment of wastewater discharges. It also covers how we intend to deliver the requirements in the WINEP3 to maximise benefit to customers through working in partnership. We also explore the opportunities to increase the environmental benefits delivered through our innovative approach – Catchment Sense.

2.1 Drinking Water Protected Areas (DWPAs): uplands; water sources and habitats

A significant proportion of our drinking water supplies come from upland water sources, from the Peak District in the south, to the Pennines and Dales in the west and north of the region. Most of these uplands are peat dominated landscapes which degrades to form dissolved organic carbon, or colour, increasing treatment costs, and presenting drinking water quality compliance risks. This degradation reduces reliability and resilience of the sources. Water quality deteriorates markedly with the seasons and over the longer term due to climate change.

To address these challenges means we have to change how land is managed to mitigate the competing drivers of climate change and cleaner air enhancing colour solubility. Since much of the land and catchments that make up our upland water sources are not under our ownership, we need to work effectively with others, to bring about change. We have gained

significant experience and a good reputation over the last decade by working with others in our upland areas, and have already implemented significant changes in the region as a result. Our PR19 programme includes measures to further this approach.

2.2 Biodiversity

As a very significant landholder in the region, our land is also an important environmental resource, as well as being a water source. Significant tracts of our land are formally designated under legislation for their highest conservation status, and it is our role to conserve and enhance that status.

An active example of our land management in practice is Humberstone Bank Farm, part of our current 'Beyond Nature' initiative. We gained vacant possession of this farm in 2016, following retirement of the tenants. After a thorough evaluation, which considered a wide range of societal benefits, a farm business tenancy has been granted to a local farmer, and is now demonstrating the 'Beyond Nature' natural capital outcomes in practice. The findings from this project have already been incorporated into our catchment land strategy and a further three farms are now signed up, with 'Beyond Nature' management plans in place.

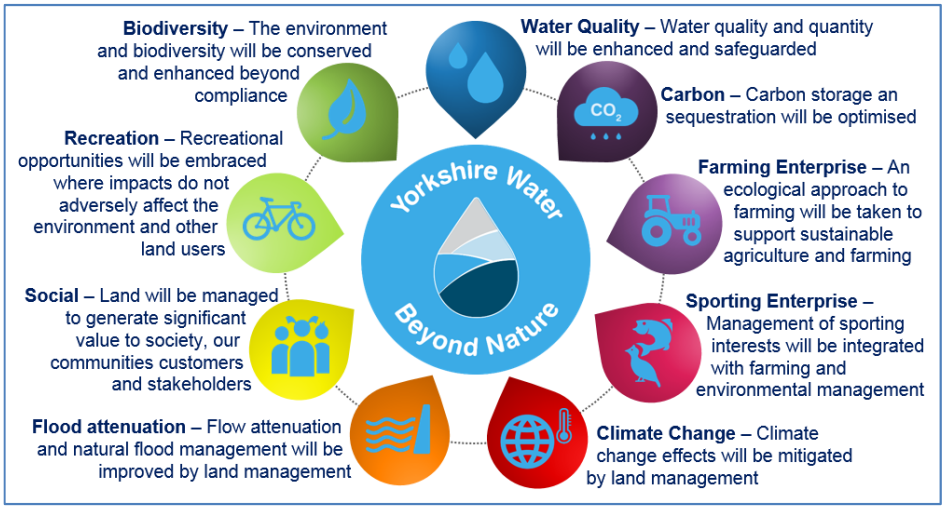


Figure 2.1 - Nine themes within the Beyond Nature integrated approach to Yorkshire Water owned catchments

Table 2.1 - How Beyond Nature activities benefit the environment and customer

Activitie(s)	Environmental Benefit	Customer and Community Benefit
Upland catchment management	Prevents drinking water source deterioration in sustainable ways and delivers other environmental advantages.	Prevents deterioration in drinking water sources and delivers at an affordable cost.
Land conserved and enhanced	Environmental status of land is improved, including for specifically designated areas	Provides increased recreational potential.

2.3 Water Framework Directive (WFD) measures and Heavily Modified Water Bodies (HMWB)

A significant part of the water supply for our region comes from upland reservoirs, which results in the downstream watercourse, and sometimes the contributing catchments being changed. Those catchments affected are known as HMWB.

To mitigate the impacts of such “modifications”, we are planning several investigations and improvements. These include:

- Understanding how and where flows released from reservoirs can be modified, to make them more beneficial to the downstream ecology, and implementing those changes.
- Understanding how sediments released from reservoirs can impact on ecology, how to reduce those impacts, and implementing those changes.
- Identifying opportunities to change the physical nature of watercourses downstream of reservoirs, to make them more beneficial to the ecology, and implementing those changes.
- Changing physical barriers such as weirs in watercourses, to allow fish to pass upstream.

Table 2.2 - How WFD activities benefit the environment and customers

Activitie(s)	Environmental benefit	Customer and community benefit
Modifying flow releases	Supports improved ecology downstream of reservoirs	Prevents existing reservoir supplies from being reduced.
Modifying sediment releases	Supports improved ecology downstream of reservoirs	Prevents existing reservoir supplies from being reduced.
Changing the physical nature of river	Supports improved ecology downstream of reservoirs	Prevents existing reservoir supplies from being reduced.
Removal or reduction in physical barriers in rivers	Allows passage of migratory fish	Provides increased recreational potential.

2.4 Drinking Water Protected Areas (DWPAs) Lowland water sources

As well as upland reservoir water sources, we also abstract water from several rivers, and take water from a range of groundwater sources. Our PR19 approaches includes:

- Implementation of lowland catchment measures in partnership with land owners, to prevent and redress deterioration in the quality of our drinking water sources.
- Investigations to identify risks to schemes and to manage risks to several of our groundwater sources.
- Implementation of improvements to several of our wastewater treatment works (WwTW) discharges, to ensure that they are not a cause of groundwater deterioration.

Table 2.3 - How DWPA activities benefit the environment and customers

Activitie(s)	Environmental Benefit	Customer and community Benefit
Lowland catchment management	Prevents drinking water source deterioration in sustainable ways and delivers other	Prevents deterioration in drinking water sources and delivers at an affordable cost.

	environmental advantages.	
Groundwater investigations	Ensures that the environmental cause of problems and the likely solution is correctly identified.	Ensures that any subsequent investment will target the right assets, and in the best way.
Groundwater schemes	Protect groundwater from pollution and manage water resources	Prevent deterioration in drinking water sources and deliver affordable cost. Ensure there is sufficient water for customers and surface water providing community resources is protected.
WwTW improvements	Prevents groundwater deterioration.	Prevents deterioration in drinking water sources.

2.5 Wastewater impacts

Significant parts of wastewater legislation continue to drive traditional point source end-of-pipe solutions, rather than catchment oriented approaches. Some of these requirements, particularly parts of the Urban Waste Water Treatment Directive (UWWTD), are designed to ensure consistent minimum levels of treatment are provided at all treatment works, and do not consider differing degrees of environmental sensitivity. As such, they offer only limited scope for flexible, catchment based approaches.

Areas in our business plan that are covered by the UWWTD include:

- Removal of phosphorus at WwTW that discharge to waterbodies that are currently proposed for designation as sensitive for eutrophication
- More stringent treatment as certain population equivalent thresholds are crossed
- The flow treated to be kept alignement with the population served
- Providing additional visibility that our sewage works are fully treating all the required flows.

Two other sets of interventions in our business plan that do allow for upstream (sewer network) catchment approaches are:

- Keeping storm tank capacity at the receiving sewage works aligned to the flows coming from the sewer network.

- Understanding and managing frequently operating sewer overflows.

The largest single driver for wastewater investment in the region in the next five years comes from the need to address potential eutrophication problems, under both the UWWTD, and the

Water Framework Directive (WFD). As the graph below shows, the Yorkshire Humber basin already has one of the best phosphorus compliance positions in the UK.

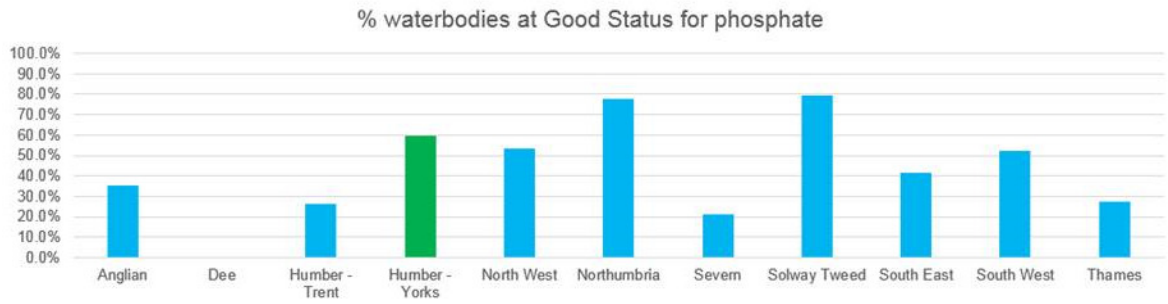


Figure 2.2 - Phosphorous compliance in the UK

The situation for our region is complex as there are two sets of EU legislation that relate to phosphorous. The UWWTD,is a mandatory requirement determined by population equivalent and an assessment of likely eutrophication. In contrast, the requirements of the WFD are based on the needs of the receiving water and include tests for technical infeasibility and cost benefit.

Under the UWWTD the Environment Agency has proposed to the Secretary of State that a significant proportion of South and West Yorkshire, and a small mumber of other locations in our region are either eutrophic, or at risk of becoming eutrophic. As a result a certain level of phosphorous treatment needs to be installed at the identified works, which may or may not result in significant environmental improvement.

This is a statutory requirement and, as such, we have made provision for it in our business plan, even though, at the time of writing, no such new designations have been made. The inclusion of these uncertain schemes is in accordance with the Guidance and as the UWWTD Phosphorous removal schemes are Amber status, they are covered by the cost adjustment mechanism described in Section 3.12. Should the obligation be removed in the future, customers will be protected.

The WFD in contrast, is related to making significant environmental improvements in catchments, and means that the standards applied are often much more stringent than those under the UWWTD. Even with those more stringent requirements however, to achieve good

ecological status under the WFD for phosphorous will require performances several times more stringent than the best that can currently be achieved.

We have investigated the opportunity for limiting phosphorous in catchments by reducing the amount coming from other sectors, such as agriculture. Unfortunately, in our region, unlike other parts of the UK, phosphorous loads from other sectors are below 10%, so there is limited possibility of using alternative approaches.

We have examined the amount of improvement for phosphorous that can be achieved in our region. Even allowing for an extension of the current timescale for the WFD, improvements to good ecological status will stall at the end of the next cycle of river basin planning, unless alternative catchment based approaches that address ecology directly are adopted. That is why, in parallel with our business plan, we are developing an alternative ecological based approach, known as Catchment Sense (appendix 2), and we have presented this to Defra for consideration.

The need to understand and manage specific trace chemicals in the environment is driven by identified problems in watercourses, and is watercourse specific. The solutions also offer the potential for integrated thinking, both in terms of controlling potential sources, and in potential alternative centralised treatment approaches.

Table 2.2 summarises how the wastewater legislation and requirements of WINEP3 benefit the environmnet and customers.

Table 2.4 - How legislation benefits the environment and customers

Activitie(s)	Environmental benefit	Customer and community benefit
Population thresholds	Rivers prevented from deteriorating, as populations served by sewage works get bigger.	Local environments continue to be protected as population increases.
Frequently operating overflows	The cause and course of action is identified to address such overflows.	Customers want to see overflows operating less often.

Visibility of pass forward flows at storm overflows	Demonstrates that all the required flows are receiving full treatment before any storm discharge takes place.	Provides confirmation to customers and third parties that we are compliant with these requirements in our permits.
Increase of pass forward flows and storm tank sizes	Rivers prevented from deteriorating, as populations served by sewage works get bigger.	Local environments continue to be protected as population increases.
New locations requiring phosphorous treatment	Reduction in phosphorous loads from identified works. Note however, that this investment on its own will generally not result in improving the environmental status of affected watercourses (for phosphorous) to Moderate. This will generally require further investment under the WFD (see below).	Facilitates a more diverse environment for enjoyment.
Class changing improvements	The environmental status of watercourses (for phosphorous) is improved.	Facilitates a more diverse environment for enjoyment.
Preventing deterioration	Rivers prevented from deteriorating, as populations served by sewage works get bigger.	Local environments continue to be protected as population increases.

Investigations	Ensures that the environmental cause of problems and the likely solution is correctly identified.	Ensures that any subsequent investment will target the right assets, and in the best way.
Chemicals investigation, monitoring and standstill limits	Rivers prevented from deteriorating due to impacts of chemicals, whether these are from individual industries, or society. (Focus on metals).	Improved clarity on where controls can be implemented at source, which will reduce cost to customers.
Activitie(s)	Environmental benefit	Customer and community benefit
Population thresholds	Rivers prevented from deteriorating, as populations served by sewage works get bigger.	Local environments continue to be protected as population increases.
Frequently operating overflows	The cause and course of action is identified to address such overflows.	Customers want to see overflows operating less often.

In the following section, we discuss how we intend to deliver the requirements in the WINEP3 to maximise benefit to customers through working in partnership. We also explore the opportunities to increase the environmental benefits delivered through our innovative approach – Catchment Sense.

2.6 Customer and community benefits

Whilst the WINEP3 is a regulatory programme, it is important, wherever there is choice, to adopt approaches that unlock benefits for customers, communities and the region. These benefits are measured through our 6 capitals approach and cover a wide spectrum, including:

- Improved access to an enhanced water environment.
- Partnership and engagement opportunities on a variety of levels.
- Involvement in the process.
- Stimulating alternative employment opportunities, including developing capability and capacity in others.
- Opportunities to catalyse investment through third party funding.

Our approach to understanding the benefit of solutions has been broadened to consider the six capitals, for example, the consideration of natural and social capital ensures our decisions are resilient and sustainable. This means that rather than just valuing customer willingness to pay and financial benefits to us, we are now looking at the wider benefits of our investment decisions, including their impact on the environment (natural capital), people (human capital) and society as a whole (social capital).

2.7 Working in partnership

As the climate changes and our population grows, we face a growing number of challenges to our ability to deliver services. We can achieve better resolution of these challenges by working with others, and mutual benefits can be gained by collaborating with customers, landowners, local authorities, and businesses. For example, working with farmers we can encourage better land management to protect raw water quality, or by working with local authorities we can manage surface water flood risks. Tackling these issues in partnership often achieves better, more affordable solutions than working alone, resulting in greater benefits for our customers and the environment.

Partnership schemes delivered so far have had multiple benefits including, building relationships with stakeholders, avoiding future costs, leveraging additional funding, delivering better solutions for less, aligning delivery of different activities across organisations, enabling access to specialist expertise and allowing us to trial innovative techniques.

We were one of only two water companies to set ourselves a target for collaborative working during AMP6 and we plan to expand on this for AMP7, setting ourselves a stretching target to deliver more than 45 partnership projects over the period 2020-2025.

In the 2020-25 period we anticipate that the areas where partnership schemes may be realised include:

- Flooding alleviation and protection schemes.

- Biodiversity and habitat improvement schemes.
- Water quality, for example catchment restoration, working with farmers on pesticide management projects.
- River quality, for example river restoration, invasive species projects, fish passes, pollution mitigation.
- Bathing water quality.
- Customer participation projects.
- Activities with our customers and other third parties, for example community fats, oils and grease collection and re-use schemes.
- Local management arrangements, for example where a local group manages a site or asset on our behalf, such as a “friends of” group managing a pond or nature reserve on our land.
- Activities with partner organisations on communications and messaging, for example sharing good practice on tenancy and land management with the National Trust.

As part of our business plan for PR19, we have worked collaboratively to explore a radically different catchment approach, both in scale and ambition. Our new approach, which we propose to deliver by working with others is called “Catchment Sense” and is described in section 2.8 of this document.

2.8 Catchment Sense

Whilst our business plan is, by necessity, one which is compliant with current legislation (and requires traditional solutions), we remain concerned that a significant portion of the required investment under WINEP3 does not represent a good deal for customers. We have, therefore, developed an alternative approach, which we have called “Catchment Sense”. This section sets out our alternative plan to measures for phosphrous removal in WINEP3 (appendix 2 contains further detail).

Yorkshire’s rivers have seen huge improvement in the last 30 years. The Aire and Don, once biologically dead in many stretches, now host iconic species in former industrial areas of the county. The question for Asset Management Plan 7 (AMP7) and beyond, is what is the most cost-effective way of achieving future improvements?

Catchment Sense is an approach which blends chemical removal with other ways of improving ecology. This approach is consistent with the 25-year national environmental strategy and could set a template for future environmental regulation.

The current approach, under UWWTD, focuses on outputs targeting reductions in chemicals such as phosphorus from wastewater treatment works and relying on these chemical reductions to improve ecosystems. However, evidence suggests that ecology improvement occurs even when phosphorus levels are rated poor in rivers. The increasing presence of salmon in Leeds and Sheffield help to demonstrate this. In addition, focusing on point sources – wastewater treatment works – the opportunity to leverage wider economic and community benefits are missed.

Our evidence shows that over the equivalent three AMP periods, it is possible to achieve greater ecological improvement than traditional approaches, these also help ensure that cost to customers is affordable now and in the future. These approaches also unlock health, wellbeing, education, tourism and regeneration benefits to our customers, communities and the region. We will continue to deliver output improvements at treatment works where they are cost effective. We also propose other catchment interventions such as river restoration, and removing barriers to fish migration, particularly in urban areas, which will produce an improvement in the overall health of the region's rivers. It is a new approach for alternative objectives under the WFD when good ecological status cannot be achieved.

Appendix 2 contains and overview of our Catchment Sense proposal which has three components:

- Installing conventional phosphorous treatment at locations where the benefits outweigh the
  costs, without requiring the support of a free phosphorous improvement under the UWWTD, as is the case currently for 36 of the 80 locations.
- A set of alternative interventions that do not focus on phosphorous removal but improve ecology directly and enhance the WFD classifications of waterbodies.
- Alternative treatment of phosphorous, which will also bring other environmental benefits, such as control of sediments, provision of ecological habitats or less resource intensive phosphorous removal.

Our alternative is based on detailed supporting evidence and analysis and is eagerly supported by the Rivers Trust and other environmental stakeholders, including representatives of the Forum environmental sub group. The plan would deliver more than the current performance commitment to length of river improved targets, at better value and would allow improvements to continue beyond the next decade. Such approaches are also

more resilient and sustainable than conventional approaches, as they are not energy or chemical intensive, and seek to work with the natural environment.

As well as delivering more environmental improvements, we believe that our approach would bring significantly more benefits to customers, communities and the region, than a solely conventional approach, for the following reasons:

- By delivering alternative solutions, we want to work with others to improve access to the river systems wherever possible, so that customers and communities can gain real and lasting benefit from those improvements.
- We want to improve the way customers and communities can find out about Yorkshire's rivers, including new ways of interacting with us.
- We see partnerships and engagement as integral to making this work, and we will work with others to develop and support those partnerships, for the long-term.
- We will also look beyond existing approaches to ways we can attract support from others, whether that is in kind, through materials and services, or financially.

Whilst we know our approach is new and ambitious, it is founded on experience and successes gained in recent years. That experience includes development and co-delivery of projects as part of a partnership approach, assisting others to secure third party funding, and programmes of community engagement. With the partnerships we have already developed, these encourage and facilitate a more strategic and co-ordinated approach and help us in building a long-term capability within the region. We also believe that the current EU review of environmental legislation will support such an approach.

Further opportunities to progress Catchment Sense might exist with the EU's current public consultation on the UWWTD. The consultation addresses effectiveness, relevance and cost-benefit of the directive. We intend to provide a full response as well as contribute to any wider industry response.

We can only adopt this approach, if our regulators and government support it. An area of concern for the government is, of course, compliance with European legislation. The proposed UWWTD sensitive area designations have not yet been formally made. Once this happens then the UK must comply and that will demand end of pipe phosphorous removal. Until those designations are formally made, there remains an opportunity to address any evidenced eutrophication in more sustainable ways, like Catchment Sense.

We believe this is the right approach. Right for the environment, our customers and Yorkshire's communities.

We have formally requested the information and data which support the proposed sensitive area designations from the Environmnent Agency under the Environmental Information Regulations (EIR) so we can further develop our Catchment Sense plan – focusing on areas most likely to benefit from ecological approaches. At the time of writing, we still await a response to our request.

Until we receive Governmental confirmation of support for our approach, we are required to submit a compliant plan, which can only include conventional treatment solutions as detailed within this document. Should our alternative, or a variation of it, be accepted by regulators and government, we will then submit a revised WINEP section of our business plan.

3. Key issues and information about our WINEP

The environment plan for PR19 is our largest for over 20 years with over 1000 individual obligations. Compared to our environment plans over the last three reporting periods, it is 30% larger than any programme delivered since AMP4, as shown in Figure 3.1.

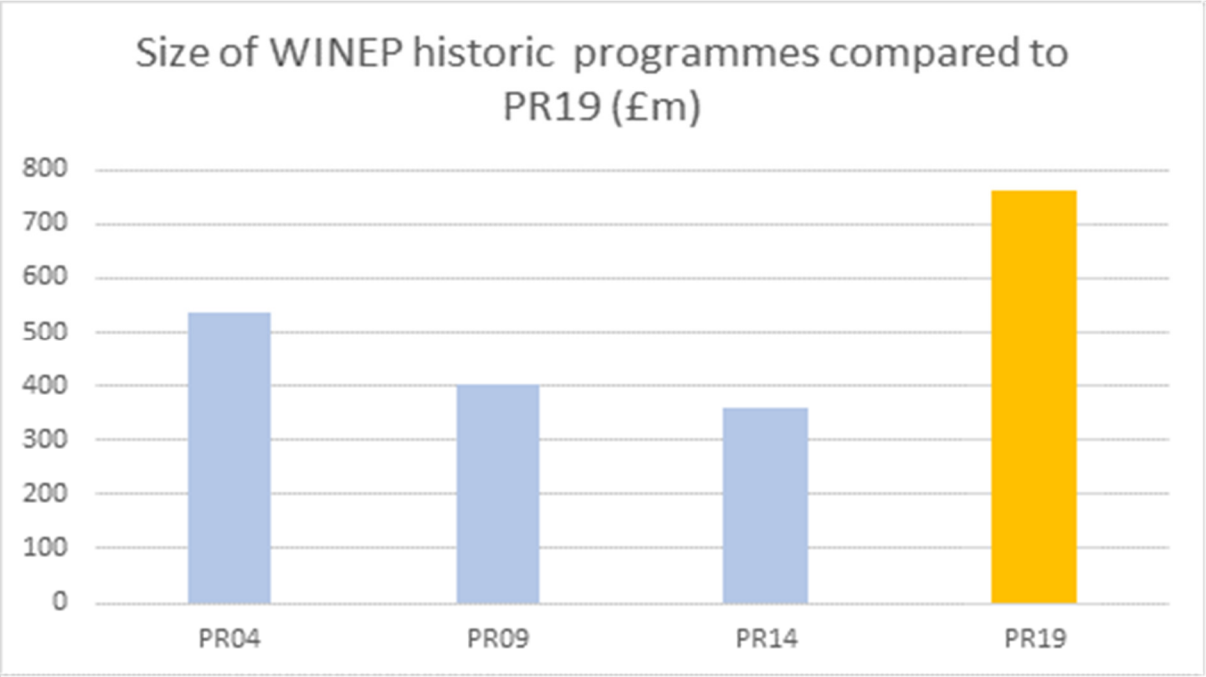


Figure 3.1 - Comparison of size of WINEP programme

Beyond the size and scale of the WINEP programme there are a number of key issues which we discuss in this section:

- Our approach to efficiency in phosphorous removal
- A cost summary of the WINEP business case proposals
- Customer priorities and stakeholder support
- Benefits assessment of the plan
- Performance Commitments and out performance delivery incentives
- Approach to markets and procurement
- WINEP unit cost estimation report
- Other programme considerations

3.1 Our approach to efficiency in phosphorous removal

The plan is dominated by 80 phosphorous removal obligations as part of the UWWTD sensitive area designations and WFD measures and it is these measures that make our plan so large compared to previous reporting period.

The size of this part of the plan presents us with several significant and unprecedented challenges that we will have to overcome to get to the point of operation and beyond. These are:

- Building the notional costs and phasing as part of the price review to ensure our customers are protected as far as possible from exceptionally high programme costs.
- Designing, building and commissioning the schemes to ensure compliance dates will be met and the required limits can be achieved.
- Operating the assets to ensure continued, sustainable compliance to standards that we have not been required to achieve.

Our focus to date has been to build a notional plan that is cost efficient and protects customers. To ensure this we have followed a process whereby we have scrutinised our baseline costs to ensure we have a lean phosphorous removal plan.

Late in 2017 there were discussions between the Environment Agency and Ofwat regarding our costs, which were submitted in November 2017 to allow optimisation and planning. When compared to an industry level phosphorous model, our costs for phosphorous removal appeared to be greater than the industry average. The Environment Agency informed us that they had taken this planning assumption into account when using our costs in cost benefit analysis (CBA) and have reduced our costs accordingly for use in their analysis.

We can confirm that the costs visible to the Environment Agency and subsequently Ofwat in late 2017 represented the full cost of delivering the schemes (enhancement and base elements) before the application of Regulatory Accounting Guidelines, and before the application of significant internal challenge and efficiency on the costs.

In order to meet the expected efficiency challenge and to ensure customers are protected from unnecessarily high costs in the plan, we have scrutinised all the components of our costs and systematically

Figure 3.2 - process for efficiencies in the phosphorous removal programme

challenged them to ensure the plan is as lean and efficient as it can be.

The process is summarised in the illustration (Figure 3.2). The graphic shows the process we followed to reduce the cost of the phosphorous removal plan.

A summary of each key component of the efficiency challenge is discussed below:

- **Baseline cost**: this is the initial baseline total cost of all our phosphorous obligations in WINEP using the process design sheet described in section 8 and applying the asset standards for phosphorous removal through chemical precipitation and biological nutrient removal.
- **On-cost reduction**: using data collected from previously delivered capital schemes, we calculate an 'on cost' to assess the internal overheads of delivering a capital project. For example the costs of our Project Managers. The on-cost was approximately 20% when we submitted costs to the Environment Agency in Autumn 2017 which was based on our AMP6 estimate. However we have since reviewed and challenged this assumption based on AMP7 schemes, resulting in a reduction to ~ 9% in our plan which is in line with the oncosts applied to the rest of our programme.
- **Scope challenge**: WINEP3 covers a range of required limits in the UWWTD and WFD drivers from 0.25 mg/l (deemed the technical limit) to 4 mg/l. Our first principles approach was to apply a universal asset standard to cost all proposed limits in WINEP3 using our design and valuation tool. It was this approach that informed the costs submitted in 2017.

  However, we have since used a risk-based approach to apply value engineering principles to elements of the scope. These aspects are discussed in more detail below but include key elements such as primary and final settlement tanks, 1 or 2 stages of chemical dosing and the requirement for alkalinity dosing. We have adopted a similar process for our 2015-20 schemes. This has led to further reductions in cost.

- **Delivery efficiency**: during 2015-20 for the schemes in the pathway to good ecological status in NEP5, we have continued to negotiate direct delivery frameworks to provide best value. Areas that have specifically been focused on are the framework for chemical dosing and the framework for the supply of tertiary solid capture units. Through our negotiation, we have determined a reduction in overheads in our capital delivery routes associated with procuring the required assets directly from the supply and issuing them for free to the direct delivery partner to incorporate

into the scheme designs. This saving has been applied to our costs for phosphorous removal.

- **Technology optimisation**: In section 8, we discuss at length the two types of engineered treatment technologies we utilise for phosphorous removal; chemical dosing precipitation and biological nutrient removal (BNR).

  Chemical dosing has a significantly lower capital cost however it includes a much greater ongoing operating cost than removing phosphorous biologically. Our analysis of the applicability of BNR suggests it is economic over a 40-year period for large ASP sites, where ASP already exists. However we have only included 7 of the 20 sites in our plan because the additional capital costs in the AMP7 period would have led to a significant bill impact for customers. For these 7 sites the BNR solution is the most economic in both the short and the long term.

- **Further programme reductions**: Using the regulatory accounting guidelines we have identified quality, growth and base maintenance elements of the costs to achieve compliance with the WINEP3 phosphorus drivers.

  The base maintenance element of the WINEP programme is typically early replacement of existing assets i.e. enabling work to ensure that the quality elements can be installed and achieve the required compliance. Since our initially submitted costs, the value of this base maintenance has been challenged to ensure that we maximise any ovelap benefits to our ongoing base maintenance programme. The base maintenance costs are not included in the enhancement data tables.

  The growth element relates to the cost to ‘future-proof’ our assets to be able to maintain compliance whilst absorbing predicted growth for at least 10 years after the scheme is delivered. We therefore design all our schemes to an end of reporting period plus 10 year design horizon.

  This approach ensures that assets are resilient in the face of climate change and population growth. However, in building an affordable plan we have challenged ourselves to be more efficient and have not included the growth costs in the plan. This doesn’t mean we will not future proof our assets, it simply means that we will find new efficient ways to do that.

3.2 Application of regulatory accounting guidelines (RAG)

As described above, we re-evaluated our application of the RAG to ensure that it was being applied correctly to the output of our design model. For clarity, we derived the following rules when apportioning costs over the key purpose areas; Base, quality and growth.

- Existing asset replacement – base.
- Marginal increase in capacity – quality.
- New asset (did not exist before) – quality.
- Asset driven by population growth only – growth.

While the application of the RAG did not reduce our overall costs, it has significantly changed our ratios between purpose areas from the costs we submitted to the Environment Agency in autumn 2017. The enhancement element of the costs has reduced significantly.

Table 3.1 shows the relative shares before and after this exercise.

Table 3.1 - Table showing relative share of investment purpose areas

Expenditure area	Est.original avg.share (%)	Es. New avg.share (%)
Base	14	41
Quality	74	44
Growth	12	15

3.3 Other drivers and measures in the plan

Other drivers and measures in the plan represent a relatively ‘normal’ level of investment (compared to historic) and therefore do not warrant special cost efficiency commentary. The methods for costing and cost efficiency measures applied are described in later sections of this document.

3.4 Cost summary of the WINEP business case proposals

Table 3.2, outlines the investment agreed with the Agency to meet our obligations within the WINEP.

Table 3.2 - WINEP investment programme with reporting table line references and page number for this document

Driver	Capex (£m)	Opex (£m)		OFWAT table line ref.
DrWPA_INV or DrWPA_ND – Drinking Water Protected Areas	17.237	6.265	23.502	WS2- Line 17
WFD_IMP_WRHMWB or WFD_IMP_FISH or WFD_INV_WRHMWB or WFD_NDINV_WRHMWB or WFD_ND_WRHMWB or WFD_NDINV_WRFlow WFD Measures including HMWB and Fish Passage	9.707	0.07	9.777	WS2- Line 18
INNS_INV or INNS_ND – Invasive Non native species	7.651	0	7.651	WS2- Line 3
NERC_IMP1 or NERC_INV(1/2) or SSSI_IMP – Ecological Improvements at Abstractions (NERC, SSSI, Habitats Directive)	8.125	0.152	8.277	WS2- Line 1
WFDGW_NDINV_GWR – Groundwater Directive	0.264	0	0.264	WWS2- Line 15
U_IMP1 - Urban Waste Water Treatment Directive > 2000PE	6.095	0	6.095	WWS2- Line 9
U_IMP(5/6) – Urban Waste Water Treatment Directive Flow – Storage schemes at WwTW	81.731	0.182	81.913	WWS2- Line 10
U_MON(3/4/5) – Urban Waste Water Treatment Directive Flow - Flow monitoring at WwTW	19.707	0	19.707	WWS2- Line 7
U_IMP2 – Sensitive Area Designations for Eutrophication	290.019	16.073	306.092	WWS2 – Line 18 and 19
WFD_IMP(g/m) – Water Framework Directive – improvements in phosphorous to moderate and good ecological status	186.260	18.913	205.173	WWS2- Line 18 and 19
WFD_IMP(g/m) – Water Framework Directive – improvements in ammonia to moderate and good ecological status	3.951	0.83	4.781	WWS2- Line 20
WFD_ND – Water Framework Directive - No deterioiration	4.59	0	4.59	WWS2- Line 41
INNS_INV – Bioresource impacts - Sludge	60.35	0	60.35	WWS2- Line 2
WFD_INV_CHEM(1-14) – Water Framework Directive: Chemical Investigations Programme	2.256	0	2.256	WWS2- Line 13
WFD_NDLS_CHEM(1/2)Water Framework Directive : Chemicals No Deterioration	12.24	0	12.24	WWS2- Line 12
WFD_INV – Water Framework Directive investigations	8.018	0	8.018	WWS2- Line 16
U_INV – Urban Waste Water Treatment Directive: Frequently Operating Overflows Inestigations	35.899	0	35.899	WWS2- Line 42

WFD_IMPg – Water Framework Directive Urban Pollution Management	60.901	0.103	61.004	WWS2-Line 11
Quality to base allocation	158		158	
Total	973.001	42.588	1015.589	

3.5 Customer priorities and stakeholder support

Our ambitious WINEP programme is supported by our customers and the inclusion of the full proposals significantly increases the acceptance by customers of our whole business plan. The principles and activities we proposed within WINEP form major elements of the delivery of our strategic direction and our environment big goal in particular.

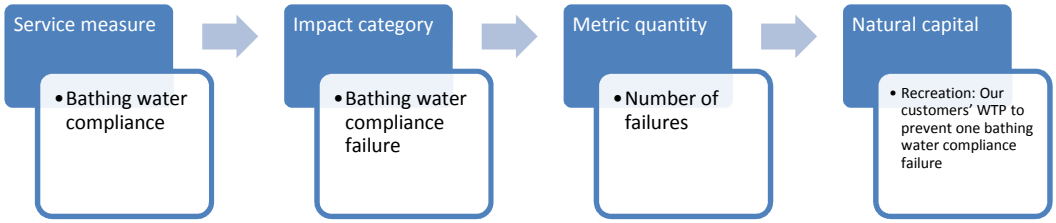
Figure 3.3 - Our Big Goals

Supporting the delivery of the 5 Big Goals is a suite of regulatory performance commitments for the 2020-25 period. Our performance commitments, targets and incentives have been developed through extensive engagement with customers and stakeholders and provide complete transparency as to what services the WINEP3 and the wider strategic environmental requirements investment will deliver. We have 41 performance commitments, of which 31 relate to our wholesale service (with 10 relevant for our residential retail customers). For these, the WINEP3 programme contributes directly to the delivery of 19 of the commitments.

The delivery of WINEP3 and the wider strategic environmental requirements are embedded in the commitments, providing certainty to customers and stakeholders that, should we fail to meet our obligations and customer expectations, we will be held to account. Accompanying the performance commitments are financial incentives, which ensure that if we do not deliver the performance targets, customers will be compensated. Similarly, should we exceed the targets there is the potential for outperformance payments. These incentives are linked to outcomes/outputs which will be challenging to deliver, and will only be available where we have delivered an exceptional level of service beyond expectations.

3.6 Benefits assessment of the plan

The cost-benefit analysis of the WINEP programme compares present value costs and benefits in the need or do nothing scenario with present value costs and benefits in the scenario where WINEP solutions are implemented. The costs referred to in this instance are capital and operational expenditure (i.e. capex and opex, or totex). Following the Spackman approach to discounting, capex is annuitised over a 40-year period using an annuity rate of 2.4% (the weighted average cost of capital). The annuitisation of capex reflects how much the company will pay back per year if it borrows money over 40 years at the borrowing cost of 2.4%. On the other hand, the benefits are measured and valued according to the different service impacts on natural, social, human, financial and manufactured capitals. The diagram below shows an example of how a service measure translates to a benefit impact. The total benefit value of a service measure impact at a point in time equals the unit benefit value for that service measure impact (e.g. customer willingness to pay (WTP) to prevent one bathing water compliance failure) multiplied by the quantity of service impact (e.g. number of failures).



All costs and benefits are expressed in present value terms through discounting, using the HM Treasury Green Book discount rate of 3.5% for the first 30 years, dropping to 3% for the next 10 years.

The cost-benefit analysis is performed for each WINEP3 need and associated solution, where the net present value benefit is calculated by:

$$\left(\sum PVcost_{need} - \sum PVcost_{solution}\right) + \left(\sum PVbenefit_{need} - \sum PVbenefit_{solution}\right)$$

For a given time period, a net beneficial scheme is one where the total present value costs and benefits in the need scenario are greater than the total present value costs and benefits in the solution scenario. The net benefit of the whole WINEP3 programme is the sum of the net benefit of individual schemes.

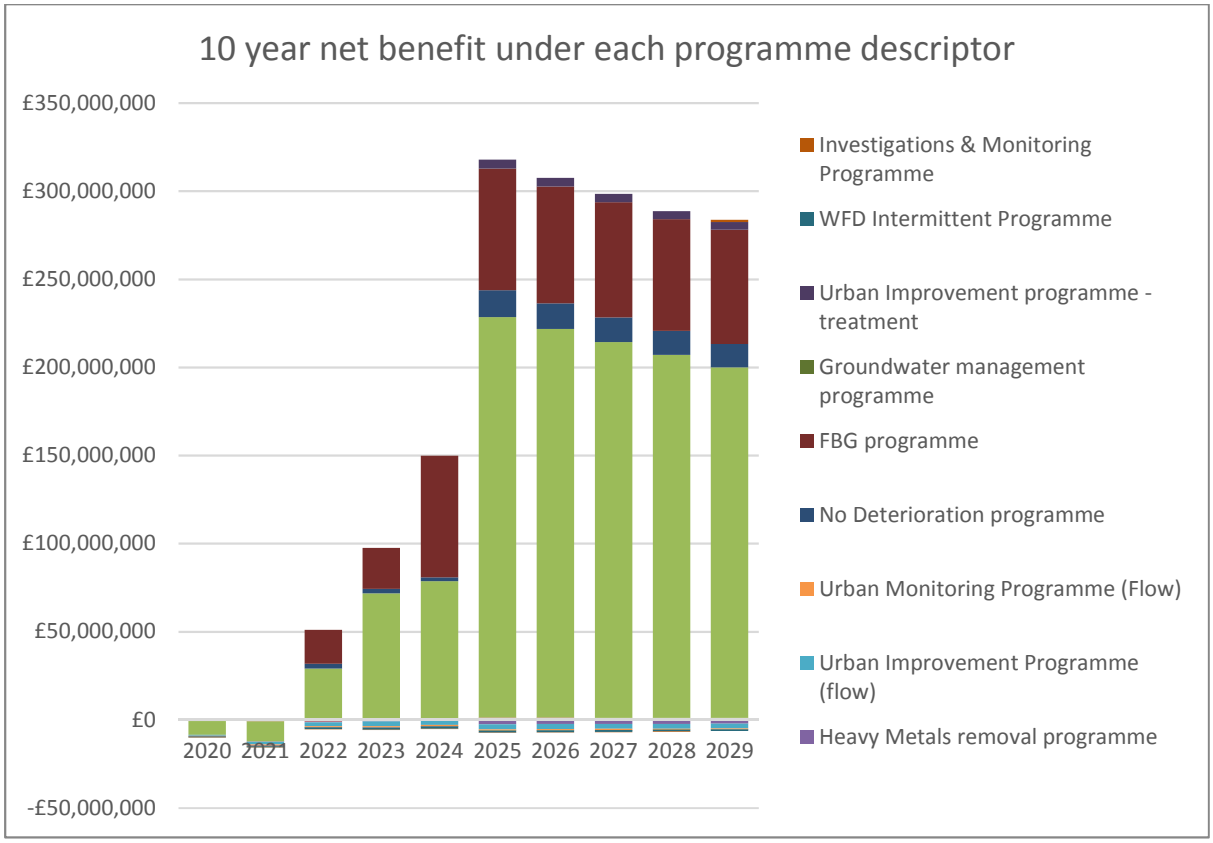


Figure 3.4 - WINEP benefits assessment

Figure 3.4 shows that overall the WINEP3 programme is cost benefical in our analysis to a value of £256m. We will continue to look for more efficient ways to deliver the programme such as pursuing our Catchment Sense approaches, but we can confirm that our costs submitted in this plan are cost benefical.

3.7 Compliance with regulatory guidance

In the lead-up to the submission of our PR19 business plan, the Government and our regulators published a series of guidance documents. In summary, these set out expectations to secure the long-term resilience of our business in the face of climate change and a growing population. The focus was on environmental protection and innovation. Overall the guidance documents promote a PR19 plan that is longer-term in its perspective and our plan meets these ambitions in general and for the WINEP3 programme.

We established a joint management group (JMG) which includes ourselves, the Environment Agency and Natural England. We have worked collaboratively to build our business plan in line with extensive guidance from regulators, government and in particular strategic environmental requirements as outlined in the Environment Agency's WISER document and their many other supporting PR19 guidance documents. The group was

supported by extensive collaboration between subject experts from our business and the Environment Agency.

The Yorkshire Forumn for water Customers (the Forum) and the its environmental sub group have played a significant role we would like to thank the Forum and the sub group for their valued contribution. The sub-group includes representation from the Agency, Natural England and other third parties with environmental interests the strategic environmental requirements have been subject to considerable challenge by the sub group and it has helped us ensure that our plan reflects the needs of customers and the environment. The challenge helped develop understanding of where alternative approaches would produce added value, in line with the aspirations set out in the WISER document. The sub group also challenged and built upon key aspects of this plan such as its detailed work on the WINEP.

On the 17th August 2018 we submitted an assurance report to the Environment Agency to confirm that our business plan will include actions, investment and approaches to meet the strategic environmental requirements as outlined in the Environment Agency and Natural England's WISER document. The WINEP3 programme delivers a significant element of our strategic environmental requirements and additional components have been integrated into other parts of our business plan. Our strategic environmental requirements have been embeded in our outcomes, performance commitments and investment decisions. The programme will deliver a Yorkshire environment that is cleaner, healthier and managed in a way that is more resilient to floods and drought and better supports people, wildlife and the economy because it puts the environment at the heart of our decision making

Our ambitious WINEP programme is supported by our customers and the inclusion of the full proposals significantly increases the acceptance by customers of our whole business plan. The principles and activities we proposed within WINEP form major elements of the delivery of our Strategic Direction. This is outlined in our document "Not Just Water – our Strategic Direction 2018" which sets out our five big goals, based on our analysis of future pressures and what our customers and stakeholders have told us they want us to deliver on their behalf. There are 5.4 million people who live in Yorkshire and millions of people who visit the County each year who rely on our services not only for their basic health needs, but also for the part we play in enhancing the environment and their lifestyles. In addition, there are 140,000 businesses that rely on us to provide resilient water and wastewater services and enable a vibrant economy in goods and services that support not just Yorkshire, but the whole of the UK. We recognise our significant role and responsibility as a major landowner

to act as a leader in this sector, and that our activities and interventions should wherever possible support both compliance and the enhancement of the wider environment.

3.8 Performance commitment and outperformance delivery incentives

Our performance commitments, targets and incentives have been developed through extensive engagement with customers and stakeholders and provide complete transparency as to what services the WINEP and the wider Strategic Environmental Requirements investment will deliver. We have 41 performance commitments, of which 31 relate to our wholesale service (with 10 relevant for our residential retail customers). For these, the WINEP programme contributes directly to the delivery of 19 of the commitments.

The integration of our WINEP programme across our commitments guarantees that we are not just delivering the minimum obligations in isolation, but that we maximise the opportunity from our investments to deliver as many benefits as possible. We are also including wider performance commitments, such as our commitment to reduce carbon emissions, and enhancing the value we create from our existing resources, as well as improving environmental educational opportunities for customers, to indirectly help support the delivery of wider environmental outcomes.

In this section we discuss the performance commitments that link to the WINEP3. Our performance commitmens relate to our 5 Big Goals. For further detail on our 5 Big Goals, please refer to 0.1 Executive Summary of our Business Plan.

The performance commitments that link to WINEP are as follows:

- Length of river improved.
- Land conserved and enhanced.
- Biosecurity.

3.9 Performance Commitments

Length of River Improved

This performance commitment was first developed for the period 2015-2020 and measures the kilometres of river we will improve in the Yorkshire region during 2020-2025.

All relevant WINEP3 listed obligations will be measured for the performance commitment. Scheme improvements can occur on our assets as well as on assets and land owned by third parties and can relate to both waste water and clean water investment schemes.

The performance commitment target will be achieved by 2025 and is not annualised.

The wastewater LRI is 663.18km in the 2020-25 period (AMP7). Wastewater schemes will be delivered by WFD_IMP drivers and include wastewater quality permit limit improvements at WwTW, such as phosphorus and ammonia and intermittent storm discharge improvements identified through AMP6 UPM investigations. There are no biochemical oxygen demand (BOD) improvement schemes identified for AMP7. Schemes are measured in line with our LORI method using the industry accepted SAGIS-SIMCAT water quality model results to an improvement of 0.02 mg/l in-river water quality improvement. Three categories are used to identify the lengths improved:

- Lengths that improve the waterbody to WFD good classification.
- Lengths that achieve a change in WFD class to a classification including moderate, poor and bad. This category also includes improvements to high – though these are minimal.
- Lengths that achieve an improvement but remain in the same classification as that prior to investment.

The majority of schemes identified by WINEP achieve Moderate, with few schemes predicted to achieve WFD Good status, as illustrated in table 3.3 below.

Table 3.3 - Length of river improved by WFD_IMP(g/m) phosphorus or ammonia investment at WwTW

	WINEP3 Scenario		
Catchment Determinant	Improvement to Good LORI (km)	Class change other than Good (inc. High) LORI (km)	Within Class improvement LORI (km)
Don Rother			
Phosphorus	8.71	163.39	87.49
Ammonia	3.41	7.03	5.39
Sub-Total	12.12	170.42	92.88
Aire Calder			
Phosphorus	8.50	170.60	32.96
Ammonia	0.00	0.00	0.00
Sub-Total	8.50	170.60	32.96
SUNO			
Phosphorus	27.10	64.70	25.35
Ammonia	2.33	3.17	4.63
Sub-Total	29.43	67.87	29.98
Derwent			
Phosphorus	8.47	12.01	3.51
Ammonia	0.00	0.00	0.00
Sub-Total	8.47	12.01	3.51
Total	58.52	420.90	159.33
Yorkshire Water SAGIS Length of River Improved			638.74

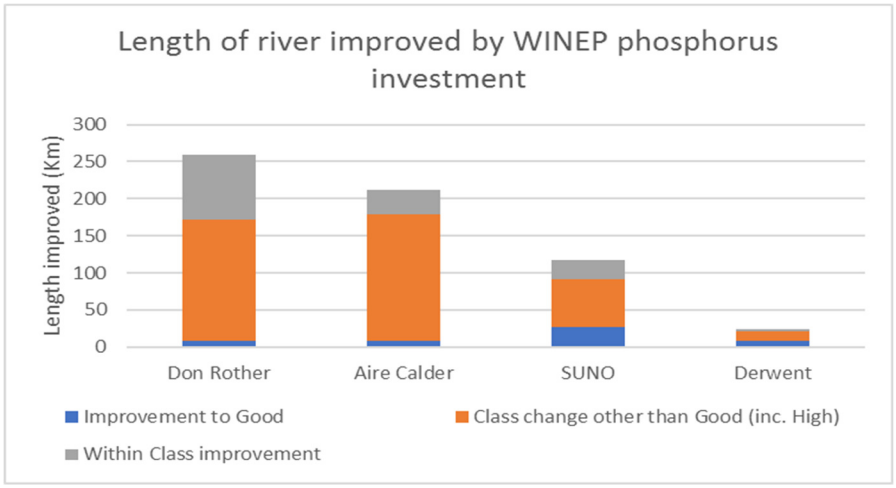


Figure 3.5 - Length of river improved by phosphorous investment at WwTW

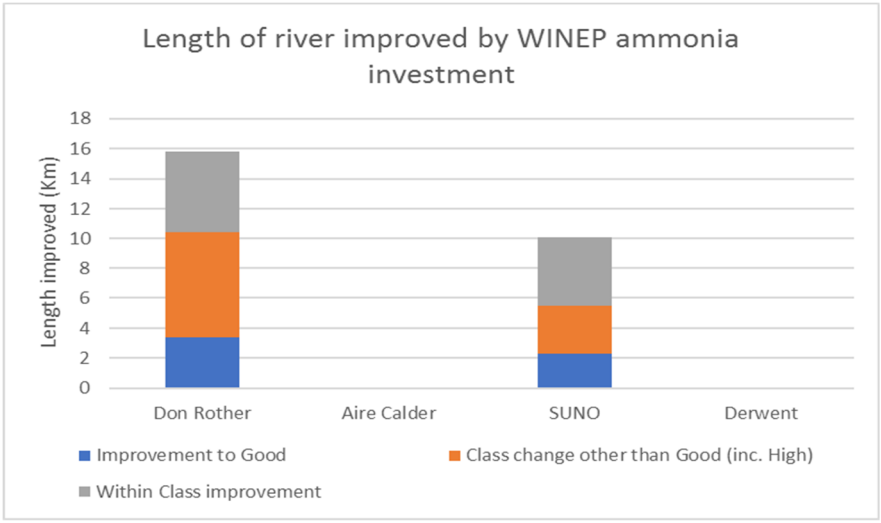


Figure 3.6 - Length of river improved by ammonia investment at WwTW

A further 24.44km will be improved by solutions identified from AMP6 UPM investigations. These will be discussed in section 10.

Table 3.4 - Length of river improved by Intermittant schemes

AMP6 UPM Solutions	LRI (km)
Pudsey	12.56
Little Don	2.1
Dearne 1	4.1
Bentley Mill Stream	1.18
Ea Beck	4.5
Total	24.44

For the clean water element of the performance commitment, schemes can be delivered anywhere within Yorkshire (i.e. not exclusively on land owned by us, or necessarily associated with our assets) and under any relevant environmental driver. This approach gives us flexibility to deliver environmental benefits where they are most required.

The end of AMP7 clean water target is 104.45km. In addition to named WINEP3 schemes which make up the current clean water target, further improvements will be defined under a biodiversity driver. The exact location of these schemes will not be defined until early AMP7, and will be done in conjunction with relevant stakeholders.

Any additional schemes delivered, will undergo a strict governance and assurance procedure to ensure they are supported by all relevant stakeholders (e.g. the Environment Agency) and adhere to our already established LORI methodology.

At the end of year three of AMP7, a revised LORI clean water target will be submitted to Ofwat to reflect our understanding at the time, and will include the additional length of river that will be improved through the Biodiversity driven schemes.

The length of river improved performance commitment is financially incentivised through under and out performance payments. The incentive type is a continuation of the PR14 measure, where rewards and penalties apply. Length of river improved is considered one of the 10 most important performance commitments for our customers. Our customers are also extremely supportive of the underperformance and outperformance payments for the performance commitments, with the incentive rates drawn directly from customer valuation research.

The outcome delivery incentive (ODI) follows the prescribed formula for calculating incentive rates, using marginal benefits and marginal costs, calibrated for the forecast totex sharing rate:

- The standard underperformance payment rate is -£176,120 per km of river.
- The standard outperformance payment rate is £176,120 per km of river.

There is no deadband for this performance commitment; standard under and out performance payments occur above or below the target level.

The ODI payments will be recovered in the following proportions across the relevant price controls 4% Water Resources and 96% Wastewater Networks plus.

Land conserved and enhanced

This performance commitment is defined as the area of land conserved and enhanced in our region through land management, biodiversity focused projects and investments on our land, and land owned by others.

The target for this commitment is 15,239 ha by 2025, a 30% increase from the 2015/20 period.

It has a proposed outperformance payment and underperformance payment, to be recognised at the end of the 2020-25 period. This allows sufficient time for conservation and enhancement projects to mature enough to ensure a measurable benefit is achieved. The delivery of this performance commitment is detailed in the Appointee narrative. It will be delivered through projects and investments which:

- Relate to protected sites, such as a Site of Special Scientific Interest (SSSI), Local Wildlife Sites or equivalent.
- Provide a conservation or enhancement benefit to biodiversity on non-protected sites through measurable benefit to regional biodiversity, in line with the government's Biodiversity 2020 strategy.

The land conserved and enhanced performance commitment is financial, with under and outperformance payments. The incentive rates are calculated directly from the results of our groundbreaking customer valuation research programme.

The ODI follows the prescribed formula for calculating incentive rates, using marginal benefits and marginal costs calibrated for the forecast totex sharing rate.

- The standard underperformance payment rate is -£1,132 per ha.
- The standard outperformance payment rate is £1,132 per ha.

There is no dead band for this performance commitment; standard under and out performance payments occur above or below the target level.

The outcome, delivery incentive payments will be recovered in the following proportions across the relevant price controls 70% water resources, 30% wastewater networks.

Biosecurity

This relates to the number of pathways of invasive species spread, where biosecurity interventions have reduced the risk of the spread of invasive species.

Invasive species and pathogens can have a large impact on our operations, our environment and our customers. Different species spread from place to place through a variety of methods. These can be grouped into common pathways, for example through transfer by fishing equipment, or through untreated water.

The best way to prevent damage by these species is to stop them arriving in the first place. This can be done through good biosecurity, the term given to interventions designed to stop their spread. We have identified the pathways under our control and will implement biosecurity along these pathways to prevent their spread.

The performance commitment supports the WINEP3 drive to reduce the spread of Invasive Non-Native Species (INNS) and prevent WFD deterioration through their establishment. The work supports the outcomes of the Yorkshire Water Invasive Non Native Species Position Statement[1], the 2015 GB Invasive Non-native Species Strategy, and the biosecurity elements of the Government's 25 Year Environment Plan. It will also ensure that we abide by our legal requirements under the Invasive Alien Species Regulations (EU regulation No. 1143/2014) and the Wildlife and Countryside Act 1981 (as amended).

To enable measurement, the categorisation of routes of spread into defined pathways has been agreed with the Environment Agency. These 12 pathways are:

[1] https://www.yorkshirewater.com/about-us/what-we-do/investment-environment/biodiversity

- Operational maintenance.
- Capital works.
- Site surveys and sampling (land).
- Site surveys and sampling (water).
- Raw water transfer.
- Grounds management.
- Bioresource movements.
- Forestry operations.
- Farming.
- Anglers.
- Boats and water sports.
- Public recreation and amenity.

An independently reviewed management plan will be produced for each pathway, and specific actions must be achieved and evidenced before biosecurity interventions can contribute to the performance commitment measurement. The pathway plans will be reviewed and agreed by the Environment Agency in advance.

Our pathway management plan approach is modelled on pathway action plans produced by GBNNSS[2] and build on its existing work. GBNNSS is responsible for coordinating efforts to follow the EU Invasive Alien Species Strategy in England.

Biosecurity is a cost efficeint way of managing the threats arising from invasive species, It costs less to prevent new species from arriving, than managing established species that have arrived.

Whilst the commitment itself is new, we have been working on improving our corporate resilience through new biosecurity measures during AMP6. We have completed work to identify the key pathways of spread where intervention is required. We have also started implementing solutions such as ensuring our capital scheme contracts require biosecurity as standard, building biosecurity infrastructure such as kayak washdown areas at Thruscross reservoir, and being one of eight water companies funding Defra's national Check Clean Dry campaign. Through our ongoing work, we have already proven the success of working with others such as the Yorkshire invasive species forum, to deliver cost effective outcomes that

[2] Great Britian Non Native Species Secretariat, a body jointly supported by DEFRA, the Scottish Government and the Welsh Government.

deliver additional benefits to our customers (such as training Yorkshire Wildlife Trust volunteers in safe herbicide use, developing a landowner engagement model to deliver catchment scale treatment programmes and brining in additional match funding which has so far returned funding in excess of our initial investments).

The commitment will be measured and reported at the end of 2020-2025 period. The biosecurity implementation performance commitment is a new measure for the 2020-2025 period and has a non-financial incentive.

3.10 Use of markets and direct procurement contracts

A substantial element of our planned approach to achieving increased performance and efficiency is to work with a wider range of companies that can help us think differently about how we provide our services. Procurement is one of the known areas we could improve as we regularly procure the same solution in the same way. External organisations have expertise that we do not, and we recognise PR19 as an opportunity to utilise these specialisms effectively in order to design an exceptional programme.

To this end we have been carrying out a series of engagement activities, aimed at gaining an understanding of how third parties can support our aspirations and at generating interest in working with us. Within the Bioresources control (which is significantly impacted by the phosphorous removal programme in WINEP3). We have carried out a large market testing exercise looking at 80% of our Bioresources capital programme. The results of which suggested significant market-driven efficiencies when compared to our original plan.

Given the success of this exercise we are now looking into whether third parties can help us deliver phosphorous recovery and recycling for less than a traditionally procured scheme. The treatment requirements of WINEP3 impact over 80 of our sites with new treatment consents, resulting in considerable and unprecedented planned expenditure to meet the new or tightened consents. We are also collaborating to understand whether a full service New Appointed Variations model may be a better solution for our customers to address a number of development schemes where growth is over and above that normally expected.

We will continue to progress these approaches and hope to understand what different options for market delivery look like. We will be exploring these alongside our conventional solutions submitted as part of the plan and will be progressing the option that meets the WINEP3 requirements and delivers the best service and value for customers.

3.11 Direct procurement for customers (DPC)

We have investigated DPC for the Huddersfield scheme in the WINEP3. Huddersfield is a large complex site with different levels of risk associated with the process. Along with the new phosphorous consent in WINEP3, there is a significant capital maintenance need at the site totalling over £100m. We have applied the criteria for DPC to Huddersfield and all candidate sites for DPC which concluded that this form of contract is not applicable. Our cost for the phosphorous consent therefore remains as a conventionally delivered scheme through chemical precipitation in the plan. We discuss our analysis and conclusion of DPC for Huddersfield in detail in our DPC appendix 11a.

3.12 Our proposed WINEP unit cost adjustment mechanism

We are required by the final methodology[3,4] to propose a unit cost adjustment mechanism to appropriately manage our WINEP3 requirements that are currently unconfirmed, i.e. those with an amber status. Based on this requirement, this section details the proposed unit cost adjustment mechanism, linking expenditure against unconfirmed requirements to an outcome and unit cost.

Below we have detailed our unit cost adjustment mechanism, including the metrics used to determine an appropriate unit cost and how we derived the final proposal as part of our plan.

We would like to note that whilst we have based our proposal on the requirements set out in the final methodology documentation[1,2], we have also used the following information to 'guide' our work in developing our unit cost adjustment mechanism for PR19;

- PR19 final methodology queries and answers namely;
  - 22 February 2018 – query and response no.17[5]
  - 15 May 2018 – query and response no.58[6]

Our WINEP programme

The WINEP3 requirements received from the Environment Agency included:

- 1071 obligations
  - of which 1069 are within the period 2020 – 2025 period (AMP7),

[3] Delivering Water 2020: Our final methodology for the 2019 price review, Ofwat, December 2017

[4] Appendix 11: Securing cost efficiency, Ofwat, December 2017

[5] PR19 final methodology queries and answers, Ofwat, 22 February 2018

[6] PR19 final methodology queries and answers, Ofwat, 15 May 2018

- of which there are 179 with an amber status.

The amber status implies that inclusion within the environmental programme has a level of uncertainty. The complexity as part of our WINEP3 means that we have single sites where we have multiple drivers at single sites where the costs of meeting the obligations are linked. Within the 179 amber schemes there are several sites that have multiple drivers and obligations within WINEP3. There are 46 sites listed in the WINEP that have multiple drivers. Where appropriate, we have costed these sites as one solution. For example, Bingley (Dowley Gap) has two obligation lines in the WINEP: one for UWWTD phosphorous removal (2mg/l) and one for WFD phosphorous removal (0.25mg/l). It is more efficient to cost and deliver the two schemes as one.

This means that we have used only 119 amber obligations listed in table 3.5 compared with the Environment Agency's 179 amber WINEP lines.

We have used the full quality WINEP expenditure in this mechanism. The proposed unit cost adjustment mechanism only includes expenditure classed as 'enhancement 'and included within Table WWS2/2a. There is a total planned quality investment of £578m that relates to the 119 obligations but will deliver the full 179 obligations with amber status.

A detailed list of amber schemes and the quality costs in our current WINEP are summarised in Table 3.5:

Table 3.5 - List of uncertain (amber) drivers in our current WINEP

Driver	Description	Number of obligations	Q cost in Plan (£m)
U_IMP5	Flow driver - Waste Water Treatment	1	9
U_IMP6	Storm Tank capacity - Waste Water Treatment	21	15
WFD_ND	No Deterioration of the Water Course - Biological Oxygen Demand	1	5
WFD_IMP M	P improvement to Moderate ecological status	2	7
WFD_IMP G	P improvement to Good ecological status*	24	65

U_IMP2 and WFD_IMP G,M	P removal combination (UWWTD SA(e) and WFD M,G)	35	375
WFD_IMP G	Sanitary improvement - Intermittent discharge	3	39
WFD_IMP G	P removal through transfer of discharge	3	6
U_IMP2	P removal through Sensitive Area (eutrophication) - SA (e) designation	12	44
WFD_IMP WRHMWB	Heavily Modified Water Bodies	7	2
WFD_IMP_Fish	Fish Passage	6	5
NERC_IMP1	White Claw Cray Fish	1	0
DrWPA_ND	Catchment Partnership	1	0
WFD_IMP G	Sanitary improvement - Continuous Discharge transfer	2	7
Total		119	578

To establish an appropriate unit cost adjustment mechanism for our uncertain WINEP obligations we have grouped the elements in table 3.6 into the following categories:

- Phosphorous removal (P removal) with the following drivers:
  - Water framework directive (WFD) - (WFD_IMP M/ WFD_IMP G/ WFD_IMP G,M)
  - Urban waste water treatment directive (UWWTD) - (UIMP 2/ WFD_IMP G,M)
  - Transfer schemes - (WFD_IMP G)
- Sanitary improvement (Intermittent discharge) - (WFD_IMP G)
- Sanitary improvement - Continuous Discharge transfer - (WFD_IMP G)
- Fish passage - (WFD_IMP_Fish)
- Flow driver - Waste Water Treatment - (UIMP 5)
- Storm Tank capacity - Waste Water Treatment - (UIMP 6)
- Heavily modified water bodies (HMWB) – (WFD_IMP WRHMWB)
- White Claw Cray Fish – (NERC_IMP1)
- And other schemes – (DrWPA_ND/ WFD_ND / WFD_IMP WRHMWB)

The reason for grouping by these categories is to ensure that when developing a unit cost, the schemes being analysed are on a like for like (fair) basis, whether that be on a solution type or the reason for the activity. There are legitimate reasons why schemes that are

assessed on the same output metric have very different unit cost profiles. We have grouped to ensure where feasible, a single unit rate by grouping.

Our proposed unit cost adjustment mechanism

We have shown in table 3.5 that we have 119 uncertain obligations. These are the schemes that we have used to determine our unit cost for our proposed adjustment mechanism. The cost in table 3.5 has also been used namely, £578m.

Table 3.6 shows our unit costs that would apply. We note that this shows a total number of obligations of 154 when the schemes in table 3.7 are included. This is greater than our 119 uncertain schemes because we have 35 obligations that have both WFD and UWWTD drivers.

One or both requirements could be removed from delivery and as such we have had to split the cost and outcome to ensure that changes of this nature do not adversely impact delivery of our environmental obligations and also that our adjustment mechanism takes account of this scenario. However due to the linked nature of delivering multiple obligations at a single site the following conditions need to occur for the unit rate to apply:

1. For sites with multiple obligations: All obligations would need to be removed from our WINEP before the adjustment mechanism would apply. This is because the total cost applies to 119 schemes but delivers 179 obligations, due to the costs of one solution for the site, where appropriate.
2. For WFD and UWWTD combined sites: We would require the full cost of both UWWTD and WFD if the WFD only obligation was required, or where both obligations remain. If the WFD is removed and the UWWTD remains the mechanism would apply for WFD elements. If both obligations are removed the mechanism would apply for WFD and UWWTD.

We have proposed a unit cost adjustment mechanism for 151 of our 154 schemes. The mechanism would apply by reducing or increasing our cost allowance by the unit cost when considered against the total output identified notwithstanding the conditions set out above. We are proposing that the sums of the total adjustment should apply as a single adjustment but be calculated on a category by category basis as shown in Table 3.6.

For the remaining three schemes shown in Table 3.7, for ‘scheme 1 - Little Don Catchment Scheme - Environmental assessment (Investigation)’ and ‘scheme 2 - Catchment partnership support’ we are not proposing a unit cost to apply for these to be adjusted. This is because the expenditures are trivial and in the case of ‘scheme 1’ the expenditure is for an investigation. In the case of ‘scheme 3 - Worsborough (WFD no deterioration)’ we are

proposing that the cost is adjusted on a single scheme basis. This is because the cost is material however there is no readily available unit of output to calculate an appropriate unit cost. Therefore, to be clear, should the 'scheme 3' in table 3.7 be removed from our required obligations we would propose adjusting by the total obligation cost (£5.66m).

Table 3.6 - our table of unit costs to apply to uncertain obligations

WINEP item (amber status only)		Number of obligations	Total cost (£m) (Quality only)	Total output	Proposed Output unit	Unit cost (£)
P removal	UWWTD (U_IMP2/ WFD_IMP G,M)	47	306.59	390.00	km (LORI)	616,675
	WFD (WFD_IMP M/ WFD_IMP G/ WFD_IMP G,M)	61	183.62	485.00	km (LORI)	339,470
	Transfer Scheme (WFD_IMP G)	3	6.39	4.00	Kg/day (load)	1,581,221
Sanitary improvement (Intermittent discharge) (WFD_IMP G)		3	39.22	59,000.00	M^3 (storage)	725
Sanitary improvement - Continuous Discharge transfer (WFD_IMP G)		2	6.54	2.05	km (LORI)	3,377,955
Fish Passage (WFD_IMP_Fish)		6	2.72	64.55	km (LORI)	41,398
Flow driver - Waste Water Treatment (U_IMP5)		1	8.59	231.98	m^3 (storage)	37,024
Storm Tank capacity - Waste Water Treatment (U_IMP6)		21	15.21	3,992.46	m^3 (storage)	8,886

Heavily modified water bodies (HMWB) (WFD_IMPWRHMWB)	6	3.49	39.90	km (LORI)	103,878
White Claw Cray Fish (NERC_IMP1)	1	0.05	1.00	km (LORI)	47,379
Total (amber status only)	151[7]	572.42			

Table 3.7 - our table of schemes with no measure (no unit cost)

Other schemes*		Number of obligations	Total cost (£m)	Category
Scheme 1	Little Don Catchment Scheme - Environmental assessment (Investigation)	1	0.17	WFD_IMPWRHMWB
Scheme 2	Catchment partnership support	1	0.25	DrWPA_ND
Scheme 3	Worsborough (WFD no deterioration)	1	5.66	WFD_ND
Total (amber status only) including other schemes		154[8]	578.50	

In the following sections we set out how we have determined our proposed unit cost adjustment mechanism.

Timing and application of the adjustment mechanism

Our preference is that the unit cost adjustment mechanism is applied prior to our Final determination. This is obviously subject to the timing of our final WINEP, and whether this allows for the necessary assessments to take place both by ourselves and by the relevant regulators. Should there not be sufficient time or that there is agreement that this is not

[7] This is not the same as in Table 3.5 because of the 3 other schemes in Table 3.7 and the 35 WFD and UWWTD combined schemes have been split out to develop a unit rate for WFD and UWWTD

[8] This is not the same as in Table 3.5 because 35 WFD and UWWTD combined schemes have been split out to develop a unit rate for WFD and UWWTD

possible, we would propose reverting to the mechanism being applied at the end of the next regulatory period.

We are happy to work with the relevant regulators on our proposed mechanism to ensure that it is appropriate for all key stakeholders, including protecting our customers from the uncertain elements of our environmental programmes. We believe that due to the size and complexity of our WINEP3 it would be key to work collaboratively with Ofwat in applying the mechanism proposed above. The issue of multiple obligations at single sites with costs that are linked, i.e. single solutions that deliver multiple obligations, is one that we have aimed to address in our proposed mechanism, but we are aware that there may be limitations and complexity in the method set out.

Our data and possible unit cost options

We have set out above in tables 3.5. that we have 119 uncertain obligations in our WINEP3, and that we have a total of 151 data items that we have used to develop unit costs that are appropriate for the groupings we have established set out in table 3.6. Additionally, there are 3 schemes we are not proposing unit costs for in table 3.7. To develop the unit costs for the 151 data items we first established what available units there are for those groups.

Below we set out the analysis and results by each category in turn. We start with the P removal schemes and follow in the order they are set out in tables 3.6 and 3.7.

Phosphorus removal (P removal) UWWTD and WFD drivers

There are 76 schemes for P removal under WFD and UWWTD driver contained within the overall 119 obligations, with an amber status. These are made up of;

- 12 with an UWWTD only driver
- 26 with a WFD only driver
- 35 with a combination of both UWWTD and WFD drivers
- 3 proposed transfer Schemes for P removal (with a WFD driver)

Within the uncertain elements of WINEP3, P removal is the biggest category both in number of schemes and total required investment. We have therefore undertaken extensive analysis to establish the most appropriate unit cost. We have proposed a unit cost by the following categories:

- Urban Waste Water Directive (UWWTD) driver
- Water Framework Directive (WFD) driver
- Transfer Scheme

For the schemes with a combination of WFD and UWWTD drivers, we have split them by calculating 70% for UWWTD and 30% for WFD this reflects the assumed cost split of delivering the various drivers within these single schemes.

This gives us 47 schemes for UWWTD and 61 WFD that make up 108 out of our 151 data points used of the unit cost mechanism. Where:

- 47 UWWTD: 12 schemes for UWWTD only and 35 split UWWTD
- 61 WFD: 26 schemes for WFD only and 35 split WFD

We have identified there are two appropriate metrics available for calculating a unit cost of P removal. This applies to both UWWTD and WFD drivers. The metrics are;

- Population equivalent (PE)
- Length of river improved (LORI measured in km)

Therefore, the possible options considered for unit costs are as follows:

- Cost per 1000 population equivalent (PE) (£ per PE['000])
- Cost per km for length of river improved (LORI) (£ per km)

To reach a decision on which one to use in our unit cost adjustment mechanism, we have calculated the unit cost for LORI and PE by simply dividing the relevant cost value by LORI and PE values for each of the schemes. However, before we did this we did some simple tests on the data. The resulting analysis confirms that all the data for P removal schemes are not normally distributed. Because of the highly skewed distribution, there are large differences between the mean and median values, and significant variations from the values of Range and Standard Deviation.

Statistically, the highly skewed data makes it invalid to use all the statistical parametrical methods under the assumption of the normal distribution including use of the mean as the average representative value.

Figure 3.7 shows the data with normal curves for original data and transformed data for UWWTD or WFD. The original data is highly skewed; and after transformation the logged data still was not normally distributed. Therefore, we are proposing that the median value should be used as a unit cost as opposed to the mean to make it statistically justifiable.

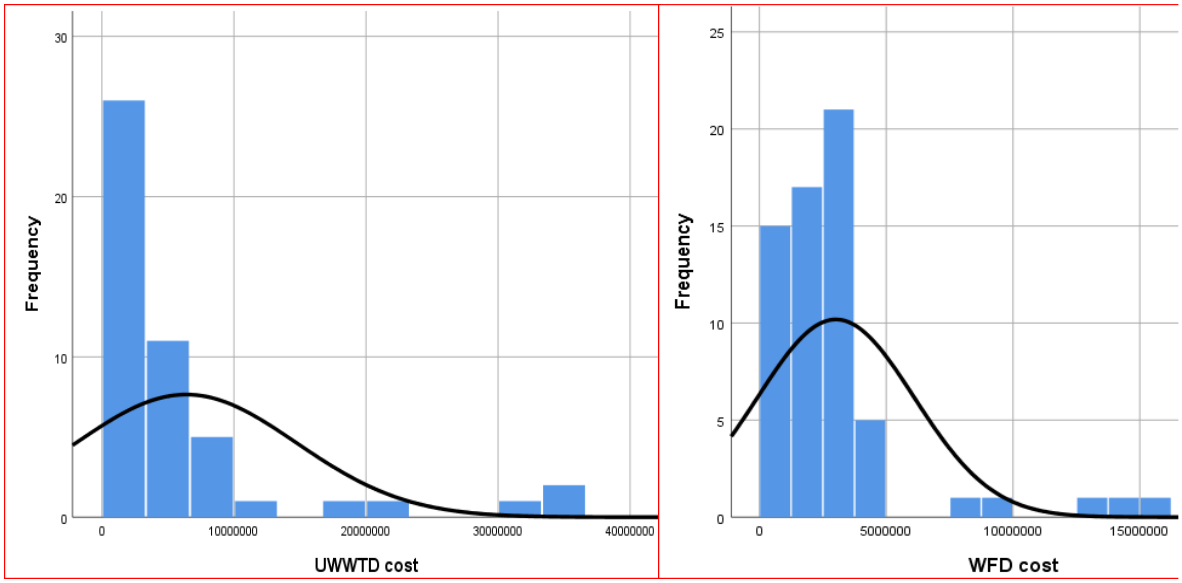


Figure 3.7 - Histogram with normal curve plots for original data for UWWTD and WFD drivers – Illustration of skewness

Using the median unit cost values, we tested the differences (absolute value and relative percentage) between the estimated cost and planned cost. This aided us in making a judgement of which one of the metrics, either PE or LORI, could give more close and precise estimation using the median unit costs (see Table 3.8).

Table 3.8, shows the estimated results from the unit costs for the metrics we have identified. This shows that for PE there is an overestimation and that for LORI there is an underestimation of the actual planned cost for P removal under WFD and UWWTD drivers.

The LORI underestimated actual cost by 10.4% and 21.6% for WFD and UWWTD respectively. Additionally, it performed better than PE which overestimated by 81.2% and 44.5% for WFD and UWWTD respectively.

Since using PE unit cost provided a large difference to actual cost and significantly overestimated the cost, we are proposing to use LORI as the unit for P removal schemes under UWWTD and WFD drivers.

Table 3.8 - Compared P removal estimation results between unit costs for PE and LORI for WFD and UWWTD drivers

	LORI (£ per km)		PE (£ per 000s)	
	WFD	UWWTD	WFD	UWWTD
Obligations	61	47	61	47
Mean (£ per unit)	535,000	1,022,118	1,130	117

Median (£ per unit)	339,470	616,675	86	87
Min (£ per unit)	2,644,315	51,659	10,160	4
Max (£ per unit)	523,200	6,221,728	2,324	347
Std. Deviation	515,726	1,212,504	2,295	85
Skewness	2.0	2.6	2.5	1.1
Actual cost (£m)	183.62	306.59	183.62	306.59
Difference to actual based on unit cost (£m)	-19.04	-66.09	149.00	136.33
Difference (%)	-10.4%	-21.6%	81.2%	44.5%

Having established that unit cost performed best using LORI as the output metric, the next step is to investigate whether it is possible to develop a better unit cost option with the aim of limiting the difference to actual cost within the plan. The results are displayed in Table 3.9 below.

Exploratory statistical analysis provided us with the insight of splitting the data into some logical groups such as by:

- Proposed process
- PE band (for <10,000, 10,000 to 30,000 and 30,000+)
- and LORI band (by distributional difference with <4.5km, 4.5-7.9km and 7.9+km).

Table 3.9 - Resulting performance by splitting LORI unit cost by groups for P removal schemes

		WFD	UWWTD
Actual cost		183.62	306.59
Difference to actual based on unit cost (£m)	By Proposed Process	-18.75	-199.98
	By PE band	-10.90	-184.90
	By LORI band	-15.87	-232.82
Difference (%)	By Proposed Process	-10.2%	-65.2%
	By PE band	-5.9%	-60.3%
	By LORI band	-8.6%	-75.9%

As shown in Table 3.9, splitting the data provides an improvement on the unit cost estimation for the WFD drivers. For UWWTD it has the opposite effect, widening the gap between actual cost and estimated cost using the unit costs developed. Therefore, based on the testing set out above we are proposing to use LORI without any splitting or further grouping of the data.

Transfer Schemes (WFD_IMP G)

For the three Transfer Schemes for P removal there are output metrics for load (kg/day) and LORI (km) that could be used to develop a unit cost. We are proposing to use a unit cost based on load (£ per kg/day). This is because the estimation is much better than that of LORI (see Table 3.10 below) and limits the difference to actual.

Table 1.10 – Transfer Schemes

	Cost (£m)	Load (kg/day)	LORI (km)	Unit load (£ per kg/day)	Unit LORI (£ per km)
BISHOP WILTON WPC WO	1.58	1	15.4	1,581,221	102,544
INGBIRCHWORTH STW	3.84	1	6.0	3,844,395	640,733
KIRK SMEATON/STW	0.96	2	2.8	481,020	346,057
Total (and median unit cost)	6.38	4	24.2	1,581,221	346,057
Estimation (£m)				6.32	8.37
Difference (%)				-0.98%	31.11%

Sanitary improvements (intermittent discharge) (WFD_IMP G)

There are three Intermittent Discharge schemes to address sanitary measures under the WFD, with possible metric of storage volume measured in m^3 and length of river improved (LORI) measured in km. In assessing the appropriate measure, we tested the median unit costs for both for m^3 and km this is shown in Table 3.11.

Table 3.11 - Resulting performance by storage and LORI unit costs for intermittent schemes

Intermittent discharge	Cost (£m)	Storage volume (m^3)	LORI (km)	Unit (£ per m^3)	Unit LORI (£ per km)
Little Don	5.89	4000	2.10	1,473.42	2,806,506
Pudsey Beck	29.00	40000	2.74	725.09	10,585,211
Ea beck	4.33	15000	4.50	288.51	961,704
Total (and median unit cost)	39.22	59000	9.34	725.09	2,806,506
Estimation (£m)				42.78	26.21
Difference (%)				9.06%	-33.17%

It is clear from the analysis that using the median unit cost in m3 is the most appropriate value for our three Sanitary improvements (intermittent discharge) schemes.

Sanitary improvement - Continuous Discharge transfer (WFD_IMP G)

We have only identified one possible measure of output for the Sanitary improvement - Continuous Discharge transfer (WFD_IMP G) schemes. This is LORI measured in km and we are proposing that the unit cost estimation can only be based on this output. In Table 3.12 we show the schemes their output, our proposed unit cost and how the estimation compares to cost within the plan.

Table 3.12 Resulting performance by LORI unit costs for Sanitary improvement - Continuous Discharge transfer (WFD_IMP G) schemes

Sanitary improvement - Continuous Discharge transfer (WFD_IMP G)	Cost (£m)	LORI (km)	Unit cost (£ per km)
Bentley Mill	3.48	1.30	2,678,473
West Bretton	3.06	0.75	4,077,437
Total (and median unit cost)	6.54	2.05	3,377,955
Estimation (£m)			6.92
Difference (£m)			0.38
Difference (%)			5.81%

Fish passage (WFD_IMP_Fish)

For the six Fish Passage schemes we established that there was only one appropriate measure of output which is the length of river improved (LORI) measured in km. In Table

3.13 we show the schemes their output, our proposed unit cost and how the estimation compares to cost within the plan.

Table 3.13 Resulting performance by LORI unit costs for Fish passage (WFD_IMP_Fish) schemes

Fish Passage (WFD_IMP_G)	Unit cost (£ per km)	LORI (km)	Unit cost (£ per km)
Farnley Beck Fish Passage	26,730	3.29	26,730
Aire Banks Mill Fish Passage	23,557	4.5	23,557
Cononley Weir Fish Passage	24,230	45.54	24,230
Cheesebottom Weir Fish Passage	139,107	9.5	139,107
Watson Mill Fish Passage	56,065	0.94	56,065
Schole Hill Fish Passage	62,477	0.78	136,422
Total (and median unit cost)	41,398	64.55	41,398
Estimation (£m)			2.67
Difference (£m)			-0.05
Difference (%)			-1.84%

Flow driver - Waste Water Treatment (U_IMP5) and Storm Tank capacity - Waste Water Treatment (U_IMP6)

We have only identified one possible measure of output for U_IMP5 and 6 which is storage volume measured in m^3. Therefore, we are proposing that the unit cost estimation can only be based on this output.

We have however split our unit costs to determine one for U_IMP5 and one for U_IMP6. This is because the nature of the single U_IMP5 scheme is very different to the 21 U_IMP6 schemes and as such affects the unit cost adversely if grouped together.

Table 3.14 Resulting performance by storage for UIMP5 and UIMP6 schemes

Intermittent discharge	Cost (£m)	Storage volume (m^3)	Unit (£ per m^3)
U_IMP5	8.59	231.98	37,024.31
Estimation (£m)			8.59
Difference (£m)			0.00
Difference (%)			0.00%

Intermittent discharge	Cost (£m)	Storage volume (m^3)	Unit (£ per m^3)
U_IMP6	15.21	3,992.46	8,885.61
Estimation (£m)			35.48
Difference (£m)			20.27
Difference (%)			133.27%

Heavily modified water bodies (HMWB) (WFD_IMP WRHMWB)

We have only identified one possible measure of output for the six HMWB schemes which is LORI measured in km. Therefore, we are proposing that the unit cost estimation can only be based on this output. In Table 3.15 we show the schemes their output, our proposed unit cost and how the estimation compares to cost within the plan.

Table 3.15 Resulting performance by LORI unit costs for Heavily modified water bodies. (HMWB) schemes

Heavily modified water bodies (HMWB) (WFD_IMP WRHMWB)	Unit cost (£ per km)	Unit cost (£ per km)	Unit cost (£ per km)
Winscar Catchment Scheme	49,852	49,852	49,852
Little Don Catchment Scheme 1	3,387	3,387	3,387
Little Don Catchment Scheme 2	151,045	151,045	151,045
Agden River Restoration Scheme	523,918	523,918	523,918
Grimwith Sediment Scheme	71,334	71,334	71,334
River Burn Catchment Scheme	103,878	103,878	103,878
Total (and median unit cost)	103,878	103,878	103,878
Estimation (£m)			4.14
Difference (£m)			0.66

Difference (%)	18.97%

White Claw Cray Fish (NERC_IMP1)

For our White Claw Cray Fish (NERC_IMP1) scheme we have only identified one possible measure of output for which is LORI measured in km. Therefore, we are proposing that the unit cost estimation can only be based on this output. In Table 3.16 we show the schemes their output, our proposed unit cost and how the estimation compares to cost within the plan.

Table 3.16 Resulting performance by LORI unit costs for White Claw Cray Fish (NERC_IMP1) schemes

White Claw Cray Fish (NERC_IMP1)	Cost (£m)	LORI (km)	Unit cost (£ per km)
White Clawed Crayfish CSO mitigation	0.05	1.00	47,379
Total (and median unit cost)	0.05	1.00	47,379
Estimation (£m)			0.05
Difference (£m)			0.00
Difference (%)			0.00%

Other Schemes

There are three other schemes with no metric information recorded. For 'scheme 1 - Little Don Catchment Scheme - Environmental assessment (Investigation)' and 'scheme 2 - Catchment partnership support' we are not proposing a unit cost adjustment mechanism as they are investigation schemes with nominal expenditure against them. For 'scheme 3 - Worsborough (WFD no deterioration)' we are proposing that the total scheme value (£5.66m) is reduced should the scheme not be required as part of our final WINEP.

Conclusions and final proposed unit cost adjustment mechanism

Table 3.6 sets out our proposed unit costs to be used as part of our adjustment mechanism in PR19. This will apply to the uncertain elements of our WINEP3 as identified in this section. In conclusion we are proposing that:

- **LORI unit cost per km** is used for P removal both UWWTD and WFD, Fish Passage, Heavily modified water bodies (HMWB), White Claw Cray Fish (NERC_IMP1) and Sanitary improvement - Continuous Discharge transfer (WFD_IMP G)
- **load cost per kg/day** should be used for the P removal transfer schemes;

- and for Intermittent discharge and UIMP 5/6 schemes we are proposing a unit cost based on **storage volume in cost per m^3**

Table 3.6 shows our unit costs that would apply. We note that this shows a total number of obligations of 154 when the schemes in table 3.7 are included. This is greater than our 119 uncertain schemes because we have 35 obligations that have both WFD and UWWTD drivers.

One or both requirements could be removed from delivery and as such we have had to split the cost and outcome to ensure that changes of this nature do not adversely impact delivery of our environmental obligations and also that our adjustment mechanism takes account of this scenario. However due to the linked nature of delivering multiple obligations at a single site the following conditions need to occur for the unit rate to apply:

1. For sites with multiple obligations: All obligations would need to be removed from our WINEP before the adjustment mechanism would apply. This is because the total cost applies to 119 schemes but delivers 179 obligations, due to the costs of one solution for the site, where appropriate.
2. For WFD and UWWTD combined sites: We would require the full cost of both UWWTD and WFD if the WFD only obligation was required, or where both obligations remain. If the WFD is removed and the UWWTD remains the mechanism would apply for WFD elements. If both obligations are removed the mechanism would apply for WFD and UWWTD.

We have proposed a unit cost adjustment mechanism for 152 of our 155 schemes. The mechanism would apply by reducing or increasing our cost allowance by the unit cost when considered against the total output identified notwithstanding the conditions set out above. We are proposing that the sums of the total adjustment should apply as a single adjustment but be calculated on a category by category basis as shown in table 3.6.

For the three other schemes without metric data their costs have to be considered on a scheme by scheme basis and are shown in table 3.7. For ‘scheme 3 - Worsborough (WFD no deterioration)’ we are proposing that the total scheme value (£5.66m) is reduced should the scheme not be required as part of our final WINEP.

On the timing of our adjustment, our preference is that the unit cost adjustment mechanism is applied prior to our Final determination. This is obviously subject to the timing of our final WINEP, and whether this allows for the necessary assessments to take place both by ourselves and by the relevant regulators. Should there not be sufficient time, or there is agreement that this is not possible, we would propose reverting to the mechanism being applied at the end of the next regulatory period.

We are happy to work with the relevant regulators on our proposed mechanism to ensure that it is appropriate for all key stakeholders, including protecting our customers from the uncertain elements of our environmental programmes. We believe that due to the size and complexity of our WINEP3 it would be key to work collaboratively with Ofwat in applying the mechanism proposed above. The issue of multiple obligations at single sites with costs that are linked, i.e. single solutions that deliver multiple obligations, is one that we have aimed to address in our proposed mechanism, but we are aware that there may be limitations and complexity in the method set out.

Table 3.17: our table of unit costs to apply to uncertain obligations

WINEP item (amber status only)		Number of obligations	Total cost (£m) (Quality only)	Total output	Proposed Output unit	Unit cost (£)
P removal	UWWTD (U_IMP2/ WFD_IMP G,M)	47	306.59	390.00	km (LORI)	616,675
	WFD (WFD_IMP M/ WFD_IMP G/ WFD_IMP G,M)	61	183.62	485.00	km (LORI)	339,470
	Transfer Scheme (WFD_IMP G)	3	6.39	4.00	Kg/day (load)	1,581,221
Sanitary improvement (Intermittent discharge) (WFD_IMP G)		3	39.22	59,000.00	M3 (storage)	725
Sanitary improvement - Continuous Discharge transfer (WFD_IMP G)		2	6.54	2.05	km (LORI)	3,377,955
Fish Passage (WFD_IMP_Fish)		6	2.72	64.55	km (LORI)	41,398

Flow driver - Waste Water Treatment (U_IMP5)	1	8.59	231.98	m3 (storage)	37,024
Storm Tank capacity - Waste Water Treatment (U_IMP6)	21	15.21	3,992.46	m3 (storage)	8,886
Heavily modified water bodies (HMWB) (WFD_IMP WRHMWB)	6	3.49	39.90	km (LORI)	103,878
White Claw Cray Fish (NERC_IMP1)	1	0.05	1.00	km (LORI)	47,379
Total (amber status only)	1519	572.42			

Other schemes*		**Number of obligations**	**Total cost (£m)**	**Category**
Scheme 1	Little Don Catchment Scheme - Environmental assessment (Investigation)	1	0.17	WFD_IMP WRHMWB
Scheme 2	Catchment partnership support	1	0.25	DrWPA_ND
Scheme 3	Worsborough (WFD no deterioration)	1	5.66	WFD_ND
Total (amber status only) including other schemes		154[10]	578.50	

3.13 Phasing of the plan

WINEP3 specifies compliance dates for every measure. Our plan ensures that we will deliver a technically robust solution to attain and maintain compliance against every compliance date in WINEP3 that is amber or green. This includes measures that started in

[9] This is not the same as in Table 3.5 because of the 3 other schemes in Table 3.7 and the 35 WFD and UWWTD combined schemes have been split out to develop a unit rate for WFD and UWWTD

[10] This is not the same as in Table 3.5 because 35 WFD and UWWTD combined schemes have been split out to develop a unit rate for WFD and UWWTD

2015-20 reporting period. This forms part of our early start programme and includes assets delivered and commissioned throughout 2020-25.

The graph below shows our intended delivery phasing, which can also be seen in submission tables WS2 and WWS2. The data excludes transition expenditure. See section 3.13.

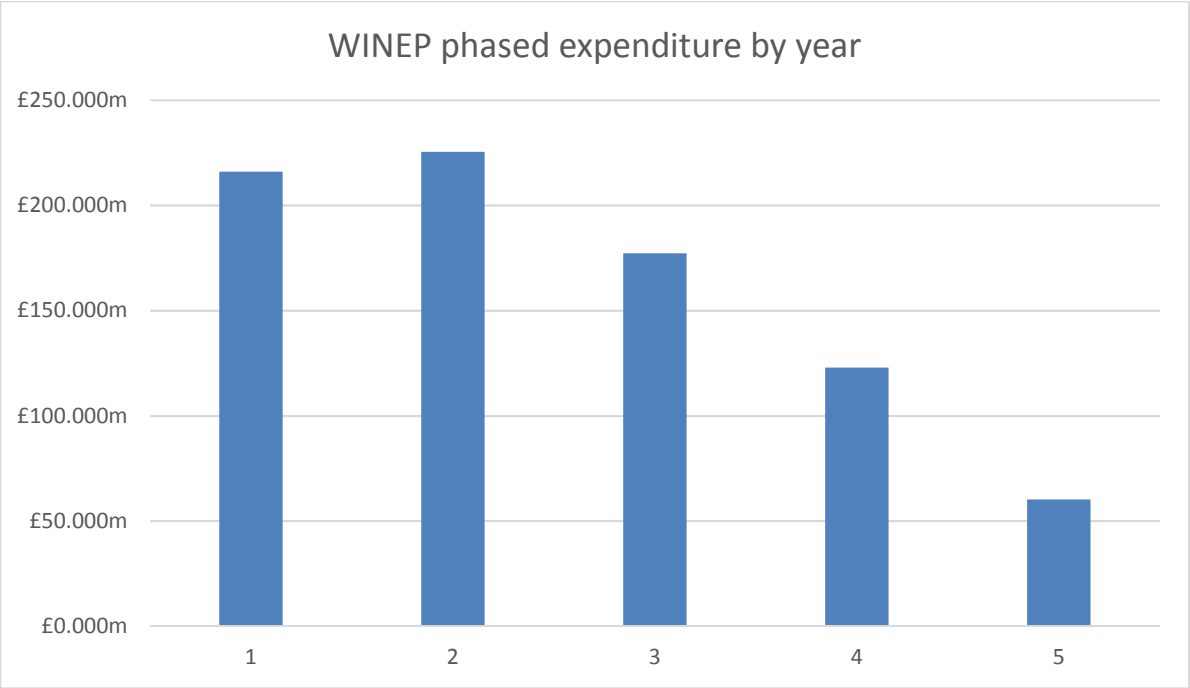


Figure 3.8: WINEP expenditure by phasing

Table 3.19 shows the number of obligations phased within each year. There are two obligations with 2027 dates making a total of 1071 however we have not included expenditure in the plan for these. Obligations with early compliance dates have driven a need for transition expenditure to ensure efficient and effective delivery.

Table 3.19 Total number of WINEP3 obligations in period 2020/21 – 2024/25

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
No. of obligations by compliance date	52	267	178	311	261	1069

3.14 Transitional expenditure (Pre- 2020)

Table 3.20: Tranisitional expenditure summary table

	Total cost of scheme	Assumed early start requirement as a % of total scheme	Early start to be included in transition expenditure table	
WFD investigations (10 sites)	£ 9,242,500	45%	£3,564,370	
WFD investigations chemistry (38 sites)	£2,672,694	7%	£160,335	
Phosphorous sampling programme	£3,099,624	100%	£2,656,378	
WINEP3 P removal at Sheriff Hutton, Stillington, Oxenhope and Sutton on the Forest WwTWs	£11,797,782	13%	£1,550,000	
Total transitional expenditure – Wastewater				£7,931,082

A description of the approach for transitional expenditure can be found in the reporting procedure for WWS10. Table 3.20 below summarises the transitional expenditure

associated with WINEP3. It shows that there is £7.93m associated with expenditure to meet early compliance dates in WINEP3.

3.15 Whole programme considerations

The majority of WINEP3 is associated with the provision of additional assets to improve river water quality, or improve biodiversity and fish passage. For our final business plan a solution by solution, asset by asset, review of the quality enhancement programme has been carried out, along with the proposed capital maintenance and supply/demand programmes (also see RAG section 3.2), in order to identify synergies where efficiencies can be made to the delivery programme.

Resilience

Customers highlight resilience as a top priority and we recognise the significant impacts that can result from disruption to our water and wastewater services and the direct and indirect environmental impact. The reliability of our services and the associated environmental standards are critical to our communities, economic growth, the environment, and ultimately to human life and livelihoods.

We have a resilient business, successfully maintaining services through many extreme events over recent years as well as responding effectively to long-term trends. However, there are limits to levels of resilience and we can never be complacent, especially in the context of increasing extreme weather events, climate change, population growth, growing cyber threats, complex international supply chains, and global financial instabilities.

To advance our approach to resilience at company, project and community levels, we have:

- Engaged customers and stakeholders to understand their resilience priorities to shape our new plans.
- Worked with international resilience experts at Arup to develop a best practice framework which enables us to better govern and openly report our resilience.
- Undertaken a range of detailed resilience assessments to help shape our PR19 plan and specific proposals within it.
- Started an innovative project with Arup and the Rockefeller Foundation to pilot the new City Water Resilience Framework in Hull with our Living with Water partners.
- Aligned our framework and Integrated Management System (IMS) to the British Standard for Organisational Resilience (BS 65000) and were the first UK water

company to ask the experts at the Cabinet Office Emergency Planning College (EPC) to independently assess our maturity to this best practice standard.

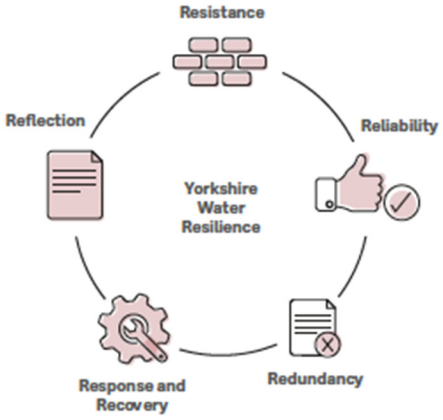


Figure 3.9: Five qualities of resilience.

In their 2011 guidance, 'Keeping the country running', the Cabinet Office shared a model of the four components of effective infrastructure resilience. We embedded the Cabinet Office model in our planning approach at the last price review. Our resilience framework has built on this approach by further developing this best practice model with a fifth quality of resilience, called Reflection.

1. **Resistance**: Protection to withstand a hazard (e.g. a flood wall)
2. **Reliability**: The ability of an asset to operate in a range of conditions (e.g. asset design)
3. **Redundancy**: Designing capacity into a system (e.g. standby pumps)
4. **Response and Recovery**: Enabling fast and effective response to, and recovery from, an event (e.g. emergency response plans; multi-stakeholder exercising)
5. **Reflection**: Continuously evolving as a result of learning from past experiences (e.g. reviewing actions and outcomes following an event).

We have developed a cost-effective business plan that maintains and further enhances resilience using a wide range of traditional, innovative and partnership options. For example, because flood resilience is a priority, we are investing in Natural Capital approaches with a range of partners in the Calder Valley to 'slow the flow', with thousands of trees already planted.

The resilience approach described covers the whole of the company and the PR19 business plan and aids the design of WINEP3 solutions. Some WINEP3 schemes directly improve ecological resilience such as the extensive catchment management of upland peatlands. Our biodiversity programme goes further to create stronger, healthier ecosystems, more able to withstand the impacts of low frequency, high magnitude events, such as droughts or floods.

Climate change

As a water and wastewater service provider, our performance is fundamentally affected by, and dependent on weather and climate. Managing impacts due to weather and climate changes is inherent in many of our plans and strategies and forms a core part of our longer term strategic planning.

Our Climate Change Risk Assessment (CCRA) looks across all areas of the business and includes physical, regulatory and other types of risk. It describes the risks and opportunities we have identified over four different time horizons; now, the 2030s, 2050s and the 2080s. Our highest priority risks include flooding (both of our assets and from our drainage network), drinking water demand exceeding supply, changes to land management affecting raw water quality, coastal erosion, storms interrupting our electricity supply, and affordability pressures.

We review and update our CCRA regularly and will next do this following publication of the new UK climate projections when they are made available. An overview of our CCRA and our strategy for managing risks is available at www.yorkshirewater.com/climatechange.

Innovation

The integration of our WINEP programme across our performance commitments guarantees that we are not just delivering the minimum obligations in isolation, but that we maximise the opportunity from our investments to deliver as many benefits as possible. We are also including wider performance commitments, such as our commitment to reduce carbon emissions, and enhancing the value we create from our existing resources, as well as improving environmental educational opportunities for customers, to indirectly help support the delivery of wider environmental outcomes.

Our innovative Decision Making Framework (DMF) is built around a new service measure framework which puts the environment and customers at the heart of our decision making by providing a common definition and a valuation of service. Our choices in decision making are based on the overall benefit delivered by an intervention. Our approach to understanding the benefit of solutions has been broadened to consider the six capitals, for example, the consideration of natural and social capital ensures our decisions are resilient and sustainable. This means that rather than just valuing customer willingness to pay and financial benefits to us, we are now looking at the wider benefits of our investment decisions, including their impact on the environment (natural capital), people (human capital) and society as a whole (social capital).

Where there is sufficient confidence to do so, we have mapped a change in each service measure to one or more of the six capitals to obtain a monetary unit rate.

The approach helps us understand the impact of existing asset failures and the benefit we retain by fixing them, as well as the ability to evaluate more creative long-term, resilient solutions. We are applying it as a framework across our whole investment programme, not just as an assessment on individual schemes.

Capital maintenance synergies

We assume that the full investment will be approved through our Ofwat determination. If not, the residual base elements. i.e. where quality investment replaces what we would ordinarily do through base maintenance, will need to be incorporated into our base maintenance provision to ensure that we maintain the quality of service delivered to customers.

Supply/demand synergies

All of the 84 treatment obligations in WINEP have synergies with the supply demand programme. Expenditure for these has been allocated proportionally between quality and growth drivers in the build-up of the programme. See section 3.1 Further programme reductions for a more detailed explaination.

2015-20 overhang obligations

There are no overhanging obligations from the 2015-20 period with regard to the NEP business case.

2025-30 period overlap

There are no plans to extend the capital expenditure required to deliver WINEP3 into the 2025-30 period and therefore there is no overlap programme.

Operating costs

The total operating costs (full year effect) included within the WINEP3 programme is £42.588m. This represents a signifciant increase in baseline operating costs for our sewage treatment asset base. The majority of this is associated with phosphorous removal. Full details of our approach to opex can be seen in section 8.15 below.

Sections 4.0-7.0 set out the detail around the key drivers and measures in WINEP3 explaining the approach we plan to take to address the driver; describes the interventions and how these have been costed.

4. Drinking water protected areas

WINEP Measure Code	DWPA_ND, INV
WINEP3 Measure summary	This section describes modelling, investigations and interventions that are driven by the Drinking Water Protected Areas Measures within WINEP3. This concerns the majority of our catchment management activity for the protection of raw water sources abstracted for drinking water supplies.
Total No.	43
Totex Cost (£m)	23.502

4.1 Summary

Approximately 45% of the water that we supply is from impounding reservoirs, 33% from rivers and 22% from groundwater abstractions (Figure 4.1). This varies from year to year depending on weather conditions. Our region is bound in the west and north by the hills of the Pennines and the North York Moors respectively. The southern and eastern parts of the region are low lying. Annual average rainfall in the region is highest in areas of the Pennines, whilst low lying areas average less than half this volume of rainfall each year.

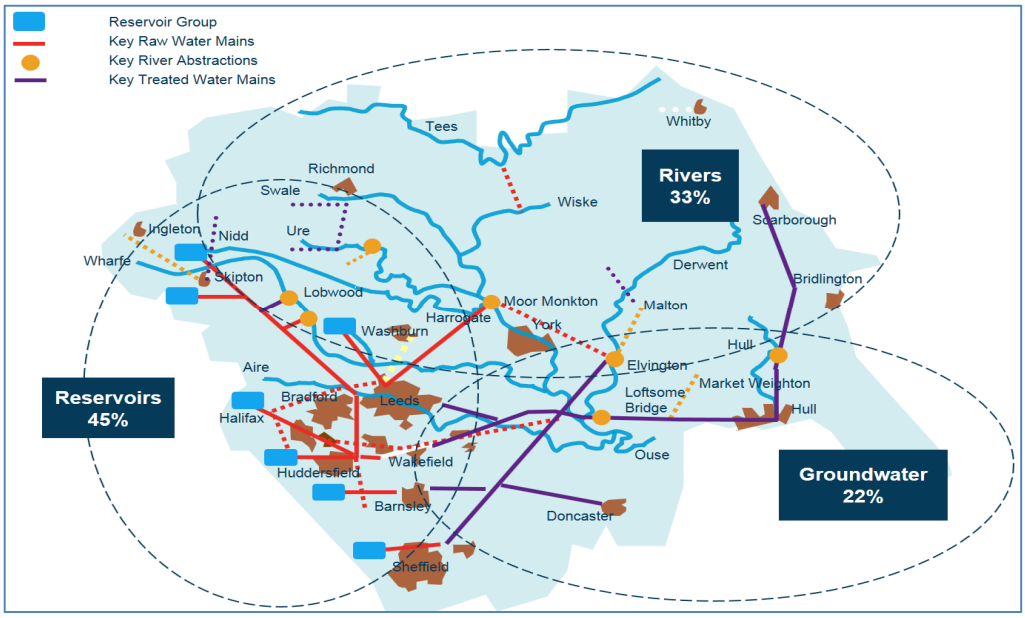


Figure 4.1: Water resources in Yorkshire

Urban areas in the west and south are principally supplied from reservoirs in the Pennines and the valleys of the rivers Don, Aire, Wharfe, Calder, Nidd and Colne. We operate over 100 impounding reservoirs, and two major pumped storage reservoirs; the total storage capacity of all the impounding reservoirs is 160,410Ml. We have an agreement with Severn Trent Water to abstract up to 21,550Ml per year from the Derwent Valley reservoirs in Derbyshire. This water is used to supply part of South Yorkshire.

In the eastern and northern parts of the region, the major water sources are boreholes and river abstractions, chiefly from the rivers of the North York Moors and the Yorkshire Wolds. Most of these water resources are now connected by a grid network. This enables highly effective conjunctive use of different water resources, which mitigates risk and allows optimal planning, optimal source operation, and resilient sources of supply both in drought and during floods.

In the following section we identify the challenges we face across all our catchments in the Yorkshire region. The risks are diverse and vary according to source type and location.

4.2 Resilience and catchment management

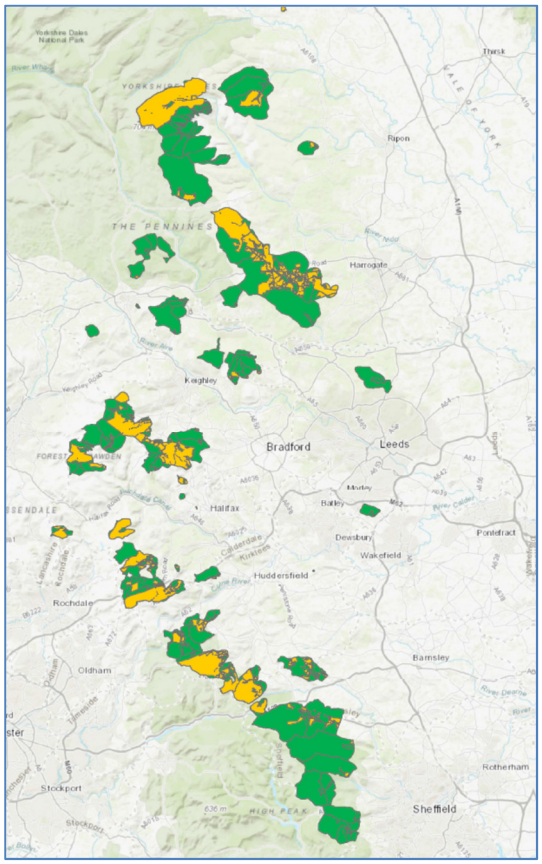


Figure 4.2: Upland Reservoir Catchments showing Yorkshire Water land ownership (yellow)

We have been undertaking significant peatland work for more than 10 years and this can be seen as developing the conditions required to repair the damage caused by decades of drainage works, the changes to atmospheric conditions, land management practices, and climate change. However, significant activity remains if we are to restore these areas to well-functioning peatland systems, rich in protective sphagnum, which maximises their resistance to the effects of climate change.

As part of their review of resilience, Arup studied the complex factors and relationships which describe the various impacts which the inherent properties of catchment land, and its management, can have on our business and water quality in particular.

Our land and property operations manage over 70,000 acres of land across Yorkshire which is predominantly located on the eastern flanks of the Pennines and in Nidderdale (Figure 4.2). In addition, we also promote activities with other landowners to protect the water environment (raw water quality).

These activities focus on improving the quality of water which runs off catchment land and into our impoundments or the regions rivers, from where it can be abstracted for delivery to treatment facilities.

Climate change presents a number of risks to our ability to deliver clean, and safe drinking water as the result of increased drying of peatland resulting in leaching of dissolved organic carbon and erosion. This is exacerbated by some land management practices, a complex area with multiple factors impacting land and water quality. Over-grazing, drainage, burning and other practices can leave bare peat and soil susceptible to erosion and therefore vulnerable to extreme weather. These practices also introduce air into the peat, allowing bacteria to break it down to form colour in water. Colour is removed through intense treatment processes to make it suitable for human supply. Healthy, vegetated peats and soils are more resilient to erosion, helping avoid water colour.

The use of fertilisers and pesticides is likely to change as farming practices respond to climate change and other factors. For example, the amount of land being sown for winter oil seed rape has increased over recent years. This explains to some degree why we are seeing elevated levels of metaldehyde in the raw waters during autumn.

4.3 Research to inform our catchment activity

Supporting our plans for WINEP3, we have a long-term, research-led and evolving approach to catchment management within the region. This has been based on knowledge and science driven by our investment in research with universities and others. This is an area where evidence continues to evolve as the complex drivers, especially of DOC production in the uplands, become better understood. We have invested significant funding into fundamental and applied research associated with our requirements for better targeting of catchment management with an aim of eliminating the need for new treatment processes in the future.

Nitrate and other parameters present risks to a number of our groundwater sources. In the past, we have applied treatment solutions to ensure water quality compliance. In-line with our catchment based approach, we have been working with Arup to gather clear evidence based on source apportionment and water age to inform our understanding of the source of these problems and allow the best targeting of measures in a sustainable long-term response.

We have investigated the saline front in the chalk aquifer under Hull to inform our risk understanding and response needs. The chalk groundwater body has been assessed as poor status under the Water Framework Directive (WFD) and is a problem for industrial and public water supply abstractions. Our source is outside the affected area but there is a risk the saline front could move inland if large abstraction is needed to maintain supplies during a drought. If our borehole supply becomes contaminated, we could lose this water source. Sampling over time will determine the dynamics of the saline intrusion and help to quantify the risk. This will allow us to undertake an options appraisal to establish the most beneficial course of action.

4.4 Impact of land ownership on our ability to act

A key area of debate is around the need for multiple interventions on peatlands to secure conditions which protect water quality for the long-term. The activity undertaken in this and the previous reporting periods can be viewed as repairing the hydrology of the catchment.

For catchment management to be a long-term solution, there is a need for further phases of restoration of a functioning bog community, dominated by sphagnum moss.
Our catchment management programme covers a range of specific water quality parameters including colour, pesticides, nitrate and saline intrusion on reservoir, river and groundwater sources. It covers both implementation and investigations. The upland management schemes for colour will deliver a wide range of additional benefits to our customers and stakeholders, including flood risk attenuation, carbon mitigation and biodiversity. The programme will also contribute to resilience to climate change, which is a current risk identified under our Climate Change Adaptation Reporting requirement. We consider that our catchment programme is consistent with specific guidance, and has support for the approach, from Defra, the Environment Agency, Natural England and the DWI.
Our activities will always be based on sound science and as an example we have recently commissioned Leeds University to undertake additional research in support of our peatland management activity; this will provide us with evidence in the areas of:

- Evaluation of catchment restoration at the landscape scale.
- A review of the success of various Sphagnum inoculation techniques and intensities.
- An investigation into the processing of DOC which occurs in pools, streams and storage within catchments and raw water transmission.

Those will inform and better target our future activities in the restoration of peatland and protection of water quality which flows from them. Our aspiration is to significantly increase the level of expenditure in catchment management in the future, in our own right and in collaboration with other partnerships such as Yorkshire Peat Partnership (YPP) and Moors for the Future. We have indicated our desire to work with a wider range of catchment stakeholders in the future, and to influence a wider area of our catchments.
This can only be achieved if there is alignment of regulatory regimes, a shift in our ability to undertake or influence activity on non-owned catchments and the availability of support schemes for capital improvements and maintenance.

4.5 Legislative drivers

The key drivers associated with the schemes included in this area of WINEP3 are:

- Water Framework Directive – Art-7.
- Water Supply (Water Quality) Regulations 2016.
- DWI Long-term Guidance for managing water quality – IL-03-2017.
- Water Industry Strategic Environmental Requirements.

- Environment Agency specific guidance on specific drivers (No Deterioration / Investigations under WFD).

4.6 Hazard identification and risk characterisation - raw water risks to drinking water quality

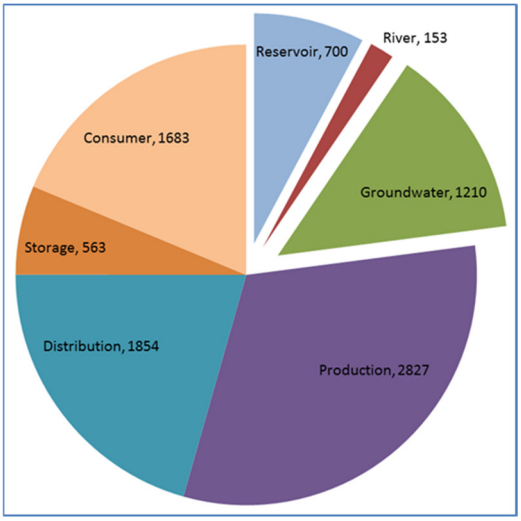


Figure 4.3: DWSP risks relating to catchment hazards

Many current and future risks to drinking water quality and acceptability relate to hazards that arise in the catchments from which we abstract. Figure 4.3 shows the proportion of our drinking water safety plans (DWSP) risks which are related to catchment hazards. In addition, many of these carry forward to treatment risks as we assess our ability to mitigate the impact of those risks.

In our DWSPs we observe significant risks to our customers that can be influenced by the impact of catchments, raw water storage, the weather and climate, from:

- Disinfection by-products (DBPs)- (particularly trihalomethanes).
- Cryptosporidium.
- Pesticides (particularly metaldehyde).
- Nitrate.
- Other substances and organisms (eg taste and odour from algae).

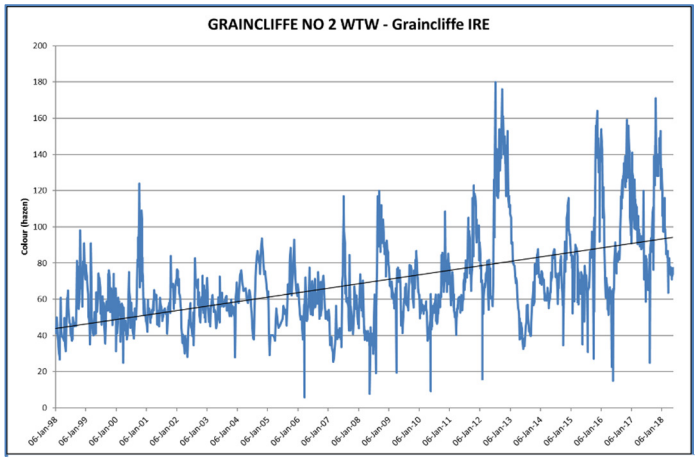


Figure 4.4: Typical upland raw water colour trend

In the following section we have mapped the location of hazards within our catchments as a means of aiding the understanding of where hazards arise and the extensive nature of their location.

Figures 4.4 and 4.5 provide an overview of the hazards arising in the catchments we rely on, and indicates the significant proportion of the Yorkshire region that requires catchment management activities to reduce current and future risks to water quality. They also highlight how a catchment can have many associated risks depending on the relevant abstractions in the area.

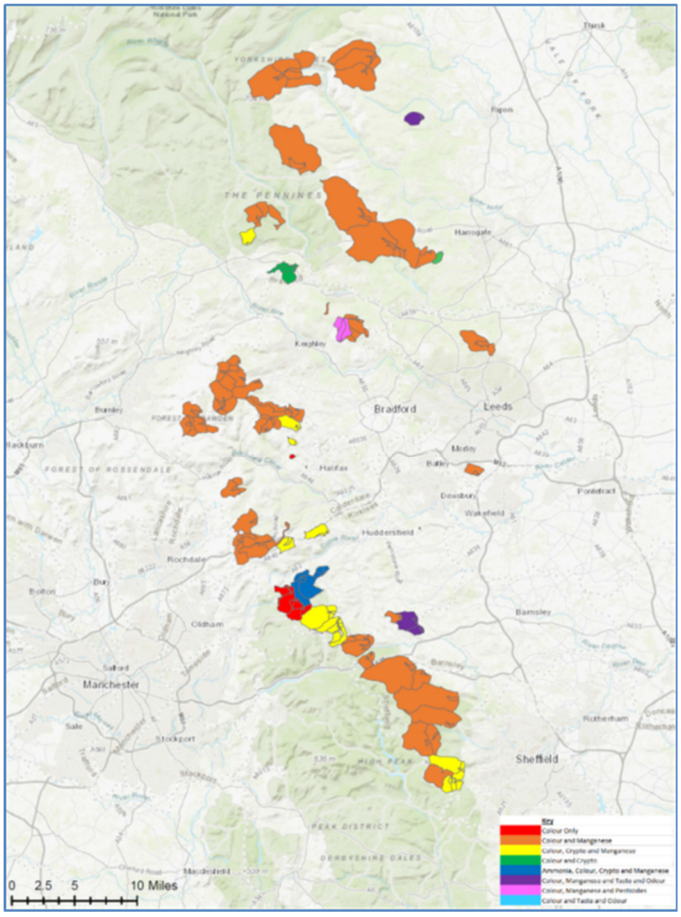
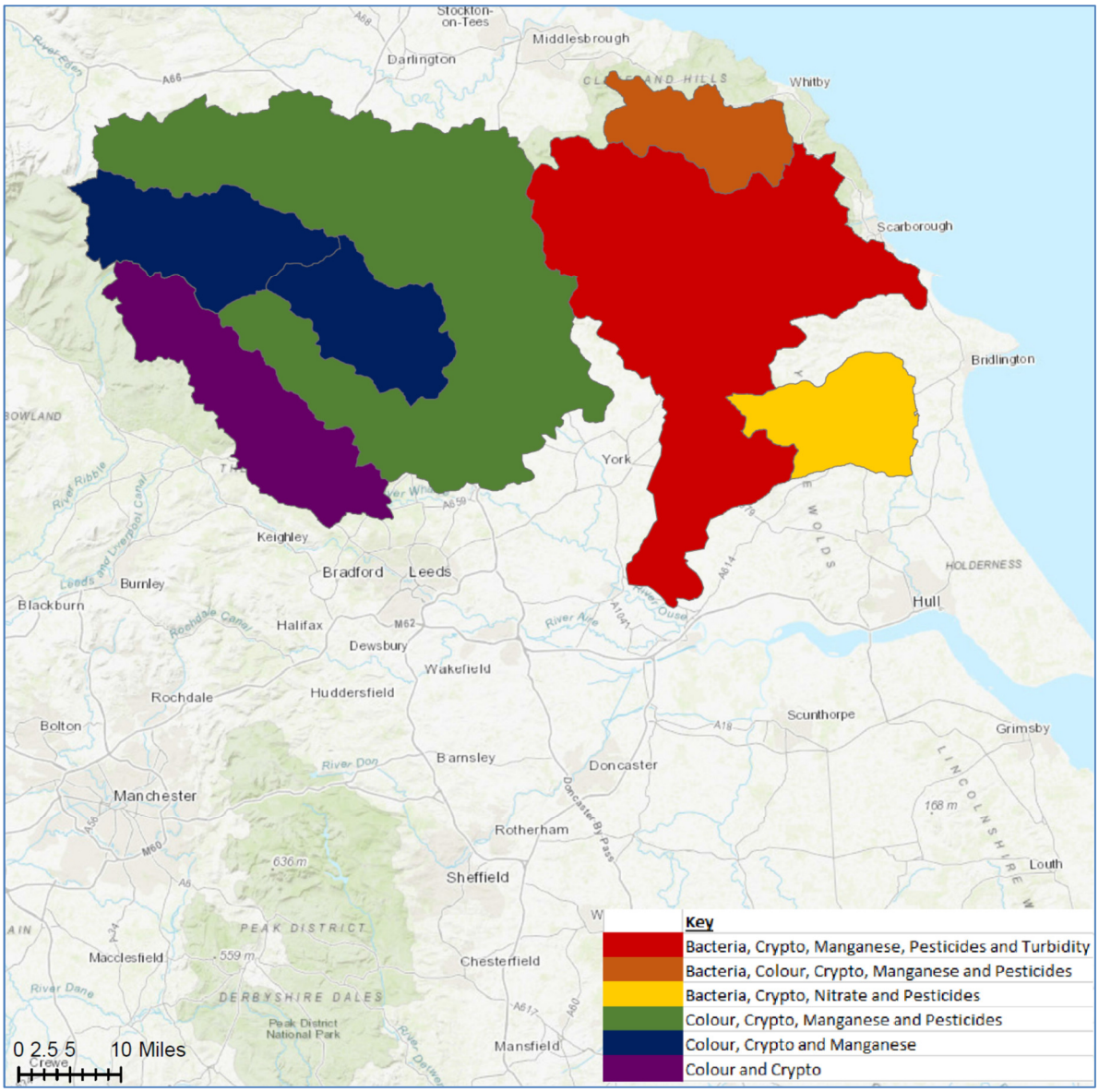


Figure 4.5: Key Upland raw water risks from Drinking Water Safety Plans (DWSPs)

Figure 4.5 identifies the key colour risks associated with our upland impounding reservoirs used for drinking water supply. The majority are at risk from colour and manganese, with several also at risk from cryptosporidium due to land use activities. In addition, there has been a rise in algal blooms at key sites, and an increase in cultivated marginal land in the catchments which poses an increased risk of pesticides and nutrients usage and potential run-off.



Figures 4.6 and 4.7 illustrate the different risks associated with our river abstractions, compared to the reservoir and groundwater catchments. These river catchments are highly influenced by agricultural activity and the majority of them are at risk from C*ryptosporidium* contamination and pesticide usage. The majority of the areas are targeted priority catchments by Natural England, such rivers include the Swale, Ure, Nidd, and upper Ouse (green, dark blue, and purple), and the Derwent (red). Increased sediment into the watercourses has associated risks such as nutrient loses, bacteria and pesticides, therefore, catchment management to reduce sediment loading on river system can have multiple benefits, as well as improving land sustainability.

Figure 4.6 – key risk associated with our rivers

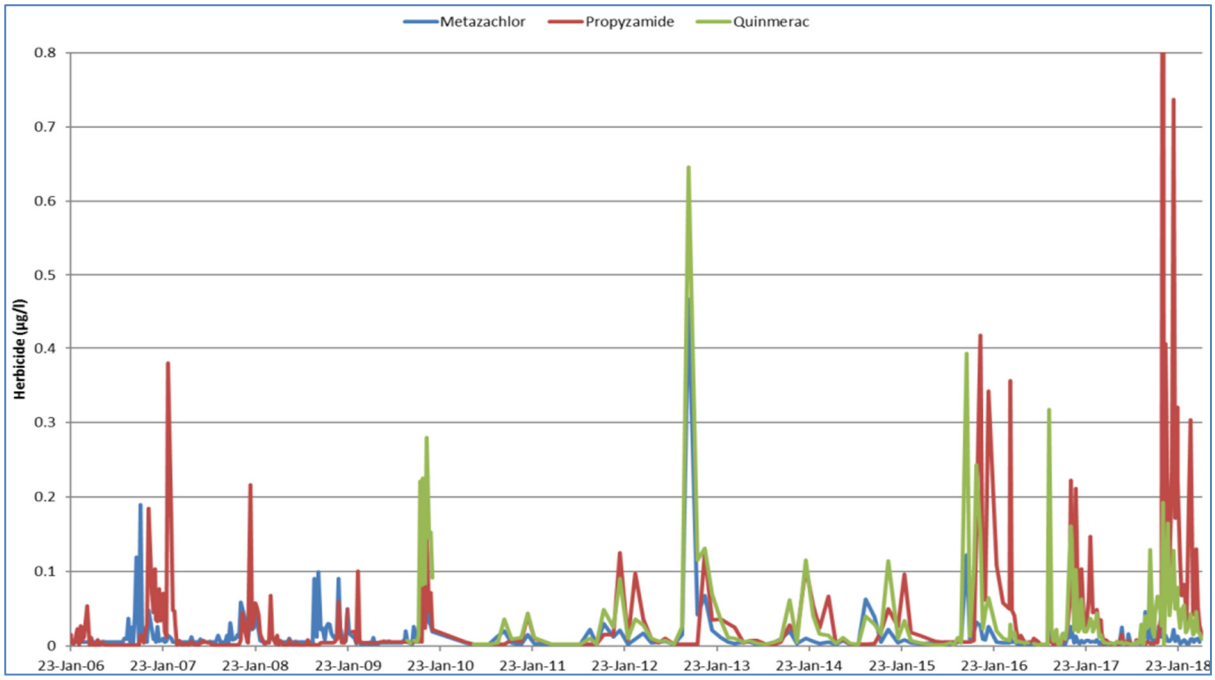


Figure 4.7: Key pesticide risks in Yorkshire Rivers

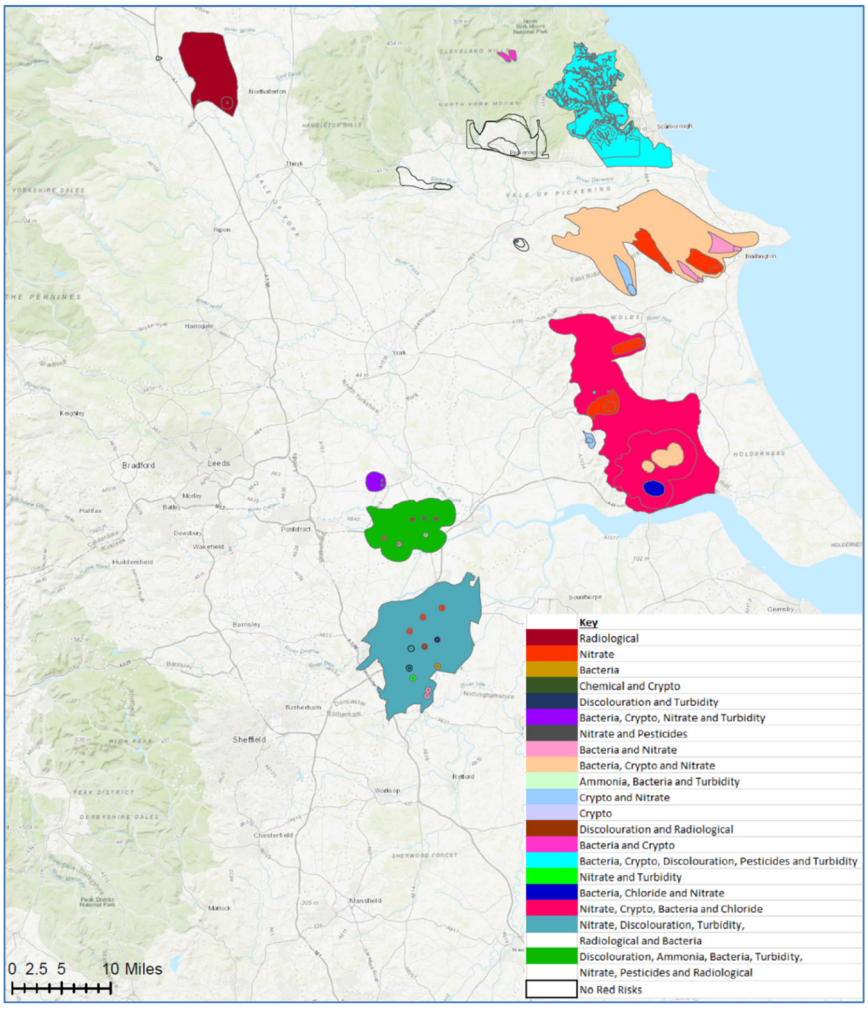
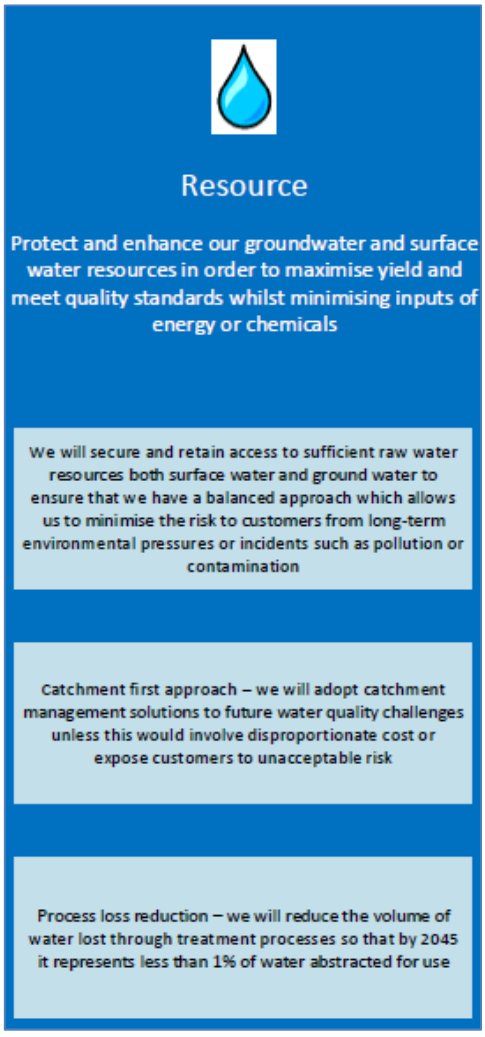


Figure 4.8: Groundwater nitrate trend – East Yorkshire chalk aquifer – 1998-2018.

The final map (Figure 4.8) identifies the key risks associated with our groundwater abstractions. It identifies a clear difference in risks between the chalk and sandstone aquifers. The chalk boreholes tend to be at risk from nitrate, bacteria and *cryptosporidium* as a result of surface activities which have an influence on the level of risk to which the boreholes are exposed. Whereas, the sandstone aquifer, as well as having a nitrate risk due to surface activities, is associated with risks such as turbidity, discolouration and uranium/α-activity, which are present due to the rock type rather than surface activity. There is however an exception associated with key borehole sites in the Selby and Doncaster areas, which are at risk from pesticide contamination. Some detections appear to be due to historic usage rather than present surface activity and require further investigation before confirming catchment activity is appropriate.



Yorkshire's resilient water resources position is fundamentally dependent on its' balanced portfolio of resources, as these come under challenge under different weather (and climatic) conditions their overall risks to service and quality are balanced.

Of the range of risks identified above we consider the major considerations for the future to be related to colour/ Dissolved Organic Carbon (DOC) from our upland catchments, and nitrate impacts on our groundwater sources. We identify these over all other risks due to the time taken for mitigation activities to have an impact on the abstracted water quality. We are also clear that the science is not yet completely understood and that this is an area where continued investment is required to finesse the evolution of interventions.

Key Risks – River sources

Pesticides - metaldehyde

Metaldehyde remains a significant risk to compliance (CRI) in those supplies drawing water from the large lowland rivers of North and East Yorkshire. With a combined catchment area of around 5,000km^2, much of which is in use for arable production. The presence of metaldehyde is normally at the greatest during the Autumn period when winter cereals and Oil Seed Rape crops are being established, particularly following heavy rainfall events within the catchments. Monitoring for this pesticide became well established in 2009 and the number of exceedances of the pesticide standard across the region since then are shown in Table 4.1.

Table 2.1: Number of metaldehyde failures by year since 2009

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	18	1	6	33	2	15	9	8	11

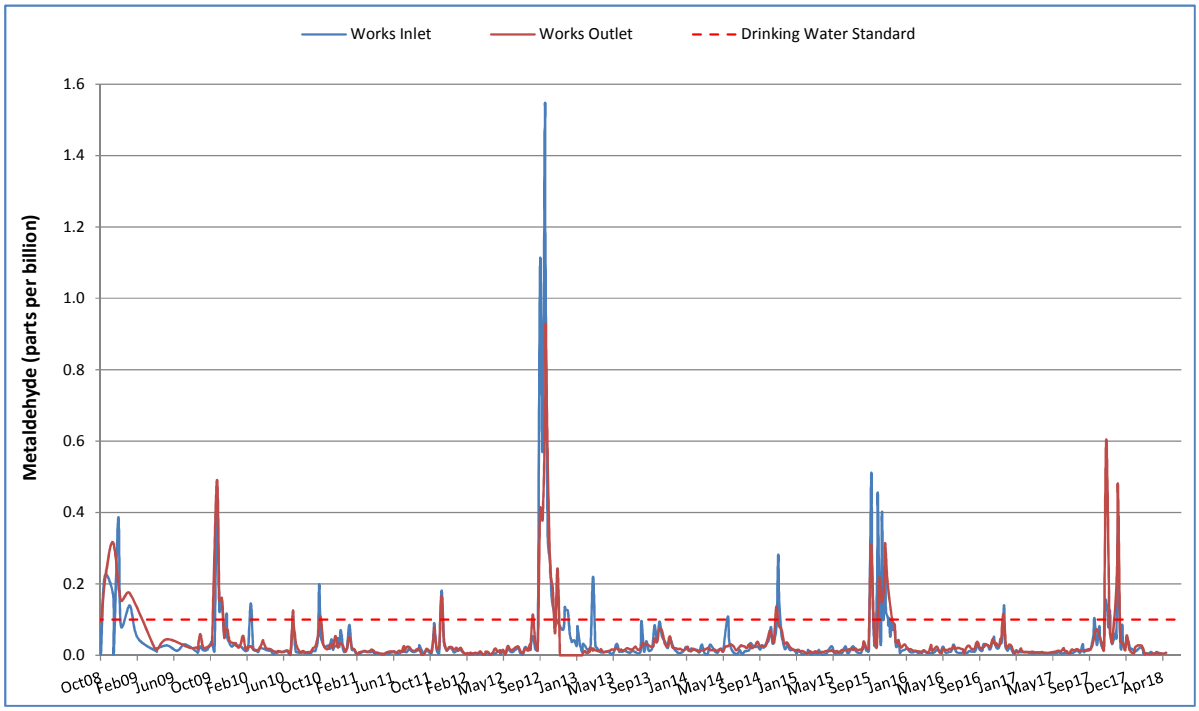


Figure 4.9: Historic metaldehyde trends on the River Derwent

We provided reports to DWI on progress toward achieving compliance with the pesticide standard. In March 2017, in the reports, we discussed a payment for ecosystem services (PES) solution for a relatively small area in the north-east corner of the River Derwent catchment. This approach was readily adopted by the farming community and they are participating for a third year.

In addition, we have identified that abstractions are at risk from a range of herbicides associated with the growth of oil seed rape or blackgrass control. The challenge remains to manage metaldehyde risk in the large river catchments and we have developed proposals within PR19 WINEP3 to scale-up the activities undertaken as investigations during AMP6 into new sub-catchments, and apply more intensive approaches in these and the existing sub-catchments identified as high risk. The activities associated with the reduction of metaldehyde risk are generally protective of risks from other active ingredients. We are concerned that if metaldehyde risk is controlled by restrictions of use we lose a key route to engagement with farming and regulatory support for many of the associated activities. We believe that it is in the long-term interests of raw water quality that these activities continue in support of a general pesticide risk reduction in raw waters, despite effective treatment being in place. This would address the WFD need to reduce the intensity of treatment required over time.

Key risks – groundwater

Pesticides

The Pesticides concentration in raw water abstracted at several of our groundwater sites on the Sherwood Sandstone aquifer shows rising trends in detections. It is proposed to investigate three ‘pilot’ sites, selected because of their contrasting hydrogeological settings and the types of pesticides observed.

At Carlton Mill Lane, bentazone regularly exceeds pesticide PCV in individual boreholes. At Highfield Lane there is a significant background concentration of Atrazine – a pesticide unlicensed since the 1990s – with occasional exceedance of 0.1 µg/l standard. Goosehouse is seeing a rising trend in Mecoprop despite the aquifer being confined in this area. The sample results for these sites are shown in Figures 4.10 and 4.11. It is of note that several other abstractions in this aquifer also show increasing trends including mecoprop and dicloprop at Nutwell, atrazine at Hatfield and Austerfield with concerns for a range of pesticides at five other sandstone sources.

The proposed investigation will determine the nature, extent and level of risk from pesticide pollution affecting our groundwater abstractions in the Sherwood Sandstone. The areas of investigation are shown in Figure 4.12. Failure to understand, assess, and mitigate the level of risk from pesticide detections in groundwater may mean failure of WFD obligations and risk to public water supply compliance.

If the investigation demonstrates there is unacceptable risk to the public water supply, from pesticides in any groundwater catchment, we will request that the Environment Agency designate a safeguard zone so that catchment scale action can be applied to reduce pesticide inputs to groundwater if these are agricultural in origin. If other sources are implicated then alternative strategies for mitigation will be developed. This will protect public water supply compliance and should avoid the need for additional treatment or blending.

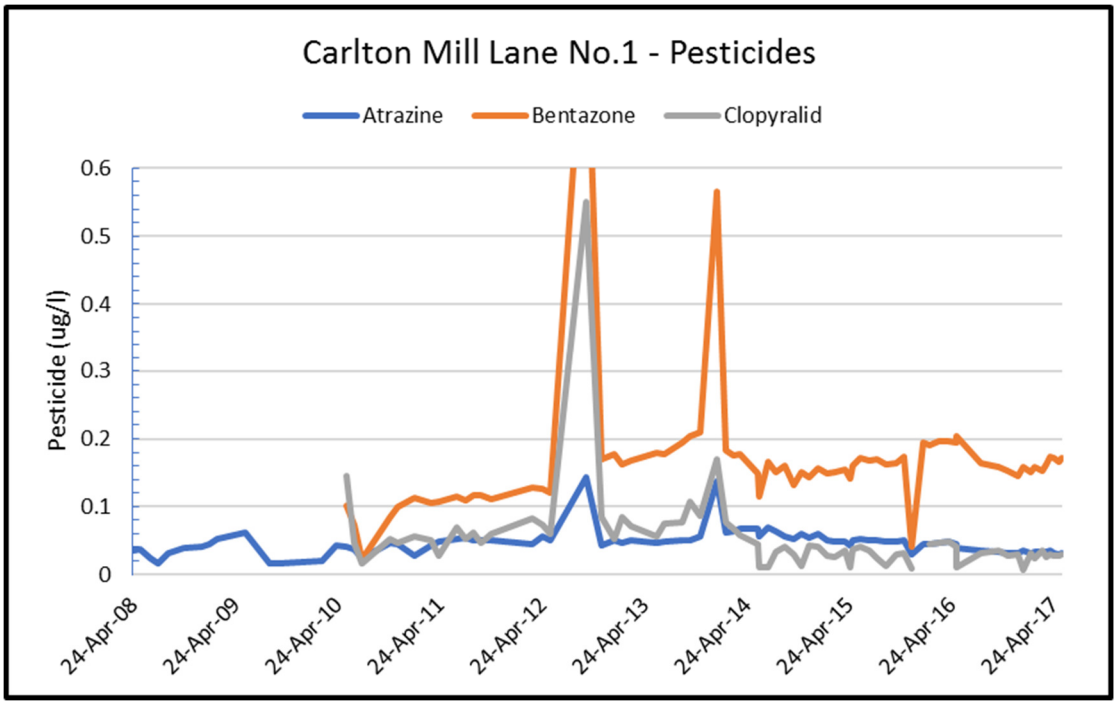


Figure 4.10: Pesticide trends at Carlton Mill Lane which supplies Pontefract

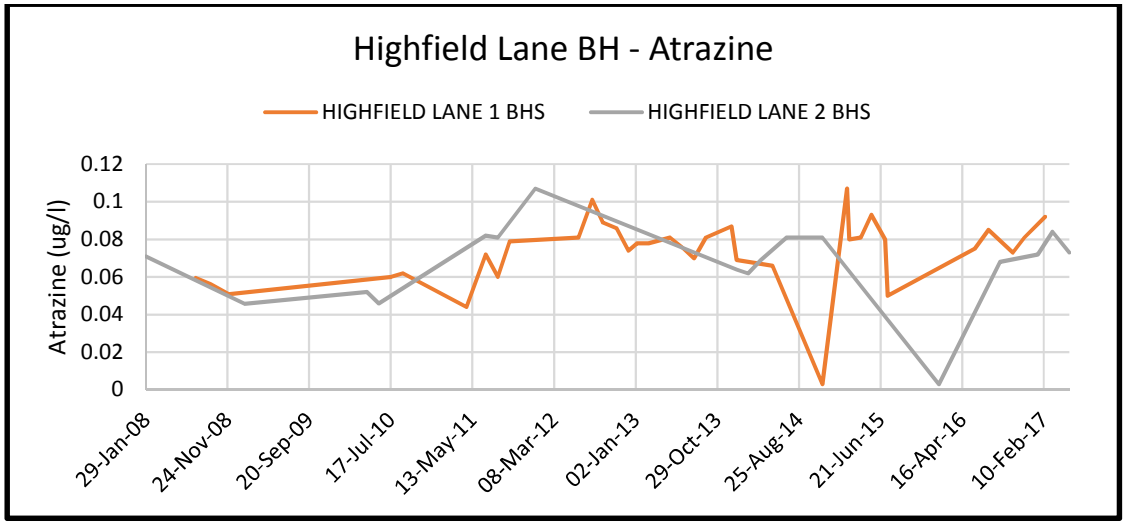


Figure 4.11: Groundwater pesticides – Sandstone Aquifer 2008-2018

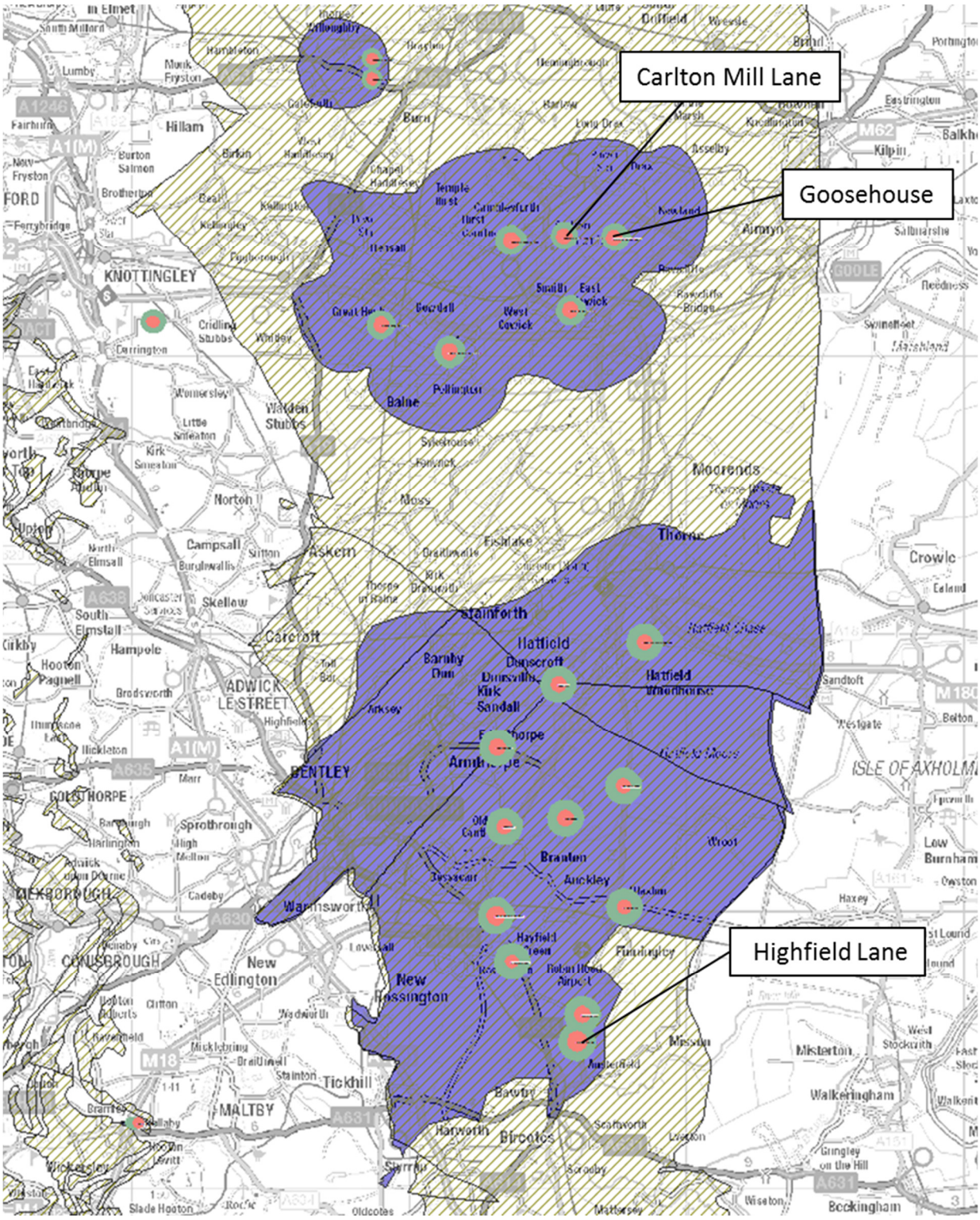


Figure 4.12: Map showing locations of Doncaster & Selby Wellfields on the Sherwood Sandstone aquifer, with the three pilot sites highlighted

4.7 Catchment Interventions for WINEP

In the sections below, we identify the interventions included within the WINEP3 for the protection of drinking water quality through catchment management and associated measures. Our approach is based on the need to seek multi-benefit, multi-stakeholder approaches where possible, as a means of leveraging the maximum water quality, environmental, and societal benefits from our investments of customers' money.

Catchment Interventions – upland sources

Colour/DOC

Our WINEP catchment management programme covers a range of water quality parameters including colour, pesticides, nitrate and saline intrusion on reservoir, river and borehole sources. We are focusing our future upland restoration activity on catchments where colour pollution is likely to overwhelm Water Treatment Works (WTW) capacity in the longer term. Our programme covers both implementation and investigations. Our activities will be delivered in partnership with a range of charities, landowners, regulatory agencies and other stakeholders where this is mutually beneficial.

We have been addressing the root causes of poor water quality for over fifteen years in order to provide an alternative to costly investment in extra water treatment capabilities. We have done this by investing in extensive monitoring, research and innovative land maintenance and restoration techniques. In addition, guided by the work of the Natural Capital Coalition, Forum for the Future, and the Crown Estate, we have defined six capitals which we will use to inform and support our Integrated Catchment Management approach.

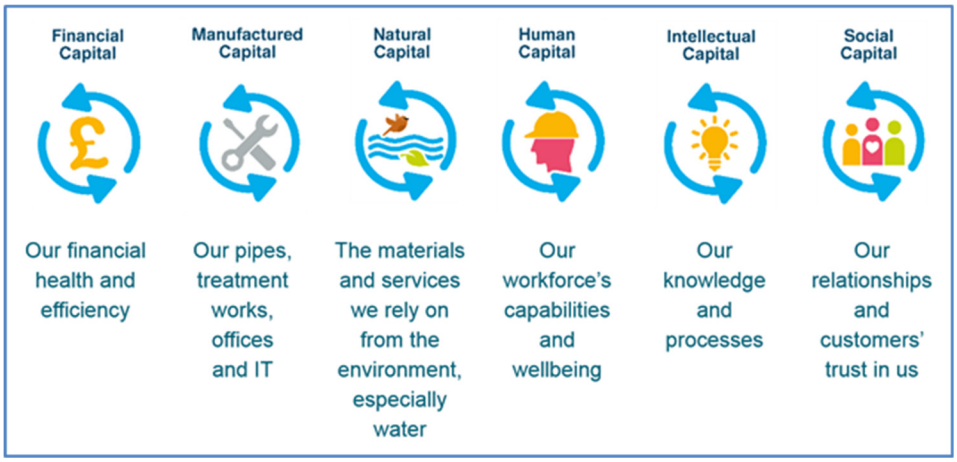


Figure 4.13: The six capitals

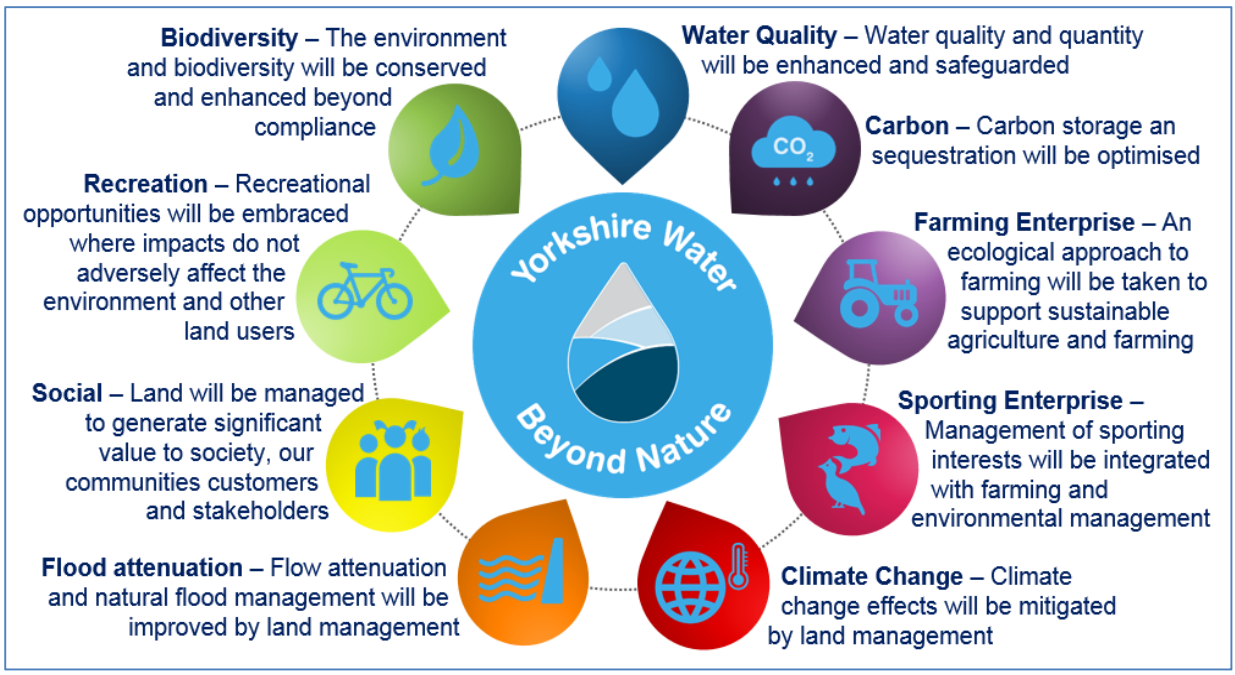


Figure 4.14: Beyond Nature approach

This commitment to an evidence led approach demonstrates that we are taking a lead to support multiple regional priorities, notably water quality and flood risk and seeking to go further by harmonising and embedding the six capitals, and the nine themes in our Beyond Nature approach.

Through multi-agency partnerships we have delivered a range of industry-leading activities, including:

- Working with our tenants and Natural England on Keighley Moor to deliver catchment restoration in practice, forming the basis of an ecosystem services valuation, published by Natural England.
- Working with, and funding, Moors for the Future to improve 114 km^2 of blanket bog owned by us and 10 km^2 of land owned by the National Trust.
- Working with and funding the Yorkshire Peat Partnership to restore 10 km^2 of peat moorlands in Upper Nidderdale.
- Working with national experts such as Durham and Leeds Universities on an extensive programme of research.

We have observed that opportunities for complementary outcomes and partnership working may be being missed due to a lack of holistic understanding of what is happening in the catchments. There is a need to understand the opportunities and synergies to then inform a robust implementation plan with recommendations for intervention. This commitment goes beyond our existing approaches, by quantifying and spatially mapping stocks and flows of all six capitals. When we can visualise the location and magnitude of the impacts of our (actual or proposed) activities, and those of other stakeholders in the catchments. We will be able

to identify opportunities for partnership working as well as opportunities to optimise natural, social and human outcomes, and ways to increase the resilience of our catchments.
We are planning to trial this approach to catchment investment within three drinking water catchments in response to a range of drivers and statutory obligations, for example the NERC Act
2006, Water Industry Act 1991 and Water Quality Regulations 2016. This will allow us to assess the potential for this approach to become the model used in future catchment management planning. This is measured through our Performance Commitment Integrated Catchemnt Management.

In addition to meeting our statutory obligations, we will also be identifying ways to add value; choosing approaches which also enhance local ecosystem resilience, communities and economies. Over AMP6 we evaluated the potential effectiveness and technical approach to catchment management for metaldehyde and nitrate. Our AMP7 plan is more ambitious than previous plans, as we seek to restore active peat formation to achieve functioning ecosystems. Through a collaborative approach we will continue to protect and improve the region's water environment. In addition, we will gain a greater understanding of the potential opportunities remote sensing and aerial imaging can offer to assist in tracking the impact of interventions and catchment understanding. Currently we have plans to undertake the following activities:

- Improve raw drinking water quality by restoring peatlands.
- Peatland restoration to increase resilience.
- Optimisation of carbon conservation and sequestration by various components of work including sediment traps, grip blocking and reprofiling.
- To develop upon and improve the condition of our SSSI land holding.
- Develop and maintain a woodland management plan for all existing woodland and identify new planting opportunities.
- Increase awareness and understanding of the cultural and historical environment surrounding Nidderdale within the Chellow Heights catchment through archaeological survey and conservation of historic environment sites.
- Biosecurity and the assessment of our risk and INNS appraisal of pathway investigations across the catchments.
- To improve the biodiversity and resilience of aquatic and riparian habitats and mitigate water quality failures.
- The inherent risks to water quality introduced through recreation requires mitigation through effective management, such as through the provision of appropriate, well

deigned and safe visitor assets (car parks, toilet blocks etc), way marked routes, information provision and appropriate recreation activities.

- Reduce the impact on raw water as a result of erosion due to access to land. Provide new opportunities to access land, particularly for those with disabilities and underrepresented customer groups.
- Habitat management on our land deemed high value for nature by Natural England mapping and Local Wildlife Status to help stop net S.41 habitat biodiversity loss.
- Promote nature tourism to capitalise on the high six capital values that the catchment brings.
- Facilitation of a wider partnership with farming and shooting tenants at landscape scale.

Figure 4.15: Typical grip block – raising peatland water table

Catchment Interventions – groundwater

Nitrate

During AMP6 we have undertaken a significant research project, with Arup, which has considered the age and residence time of the nitrate in groundwater to help inform effective response plans. We have focused on groundwater that is abstracted from three representative sources, one in the chalk aquifer and two in the Sherwood Sandstone. Key areas reviewed include:

- An assessment of the amount of nitrogen in groundwater abstracted at the representative sources. This provides the basis for discussing options with those who are contributing the greatest amount of nitrogen to the groundwater.
- The impact of climate change on crop growth and associated use of fertiliser/pesticide.
- Investigating and modelling the likely changes in cropping and how we as a water supplier might influence this to prevent adverse effects on groundwater from use of fertilisers and pesticides, or if appropriate, surface water.
- Hydrogeological investigation into sources of water to inform future land management.

- Building on existing work to improve understanding of how rainfall travels into the groundwater and ultimately reaches our water sources. Including tracer studies, source protection zone delineation and detailed geological mapping. By understanding how water moves from field to borehole we can focus effors on the areas most likely to provide a rapid improvement in groundwater quality.

With a clearer understanding of the sources of nitrate, we have begun engagement with farmers in the relevant catchments working alongside Catchment Sensitive Farming and others such as the Rivers Trusts. The nitrate concentration in groundwater abstracted at a number of our sites shows a rising trend and some regularly exceed the PCV for nitrate (Figure 4.16). The Environment Agency have designated a Safeguard Zone (SgZ) under the WFD for a total of 17 sites (figure 4.17. The SgZ requires implementation of an action plan to reverse the upward nitrate trend and establish groundwater nitrate concentration below 50 mg NO_3/l (11.3 mg N/l). We currently have an action plan in place, and our plans build on the work already in progress. Failure to achieve reductions in nitrate are likely to mean continued failure of WFD obligations and risk of additional treatment investment to prevent deterioration in water supply quality.

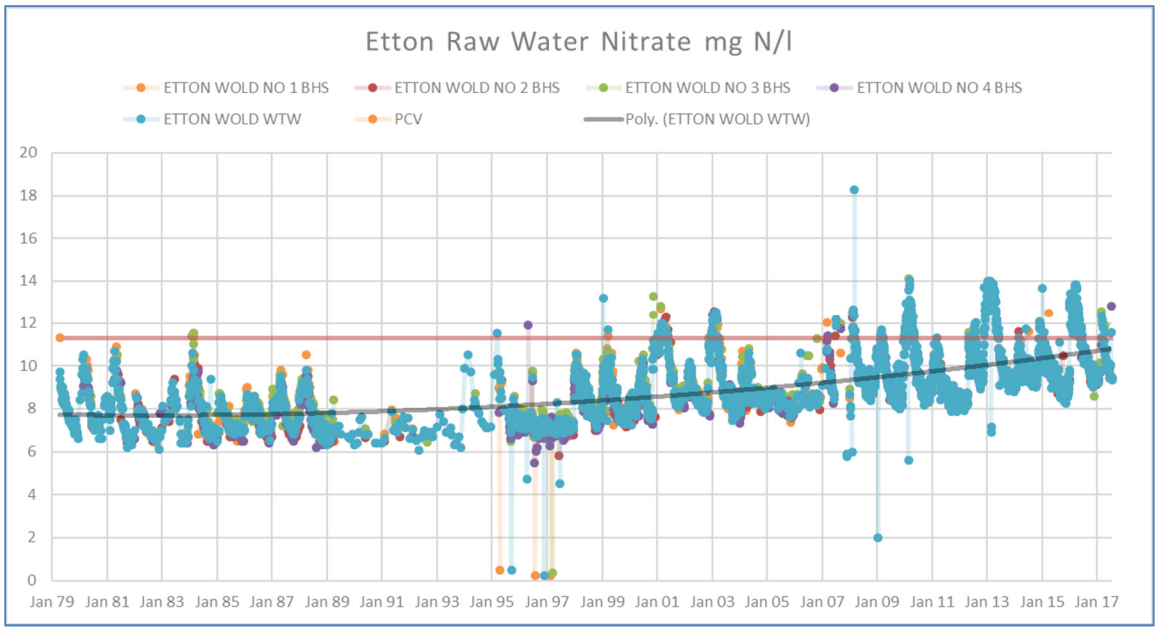
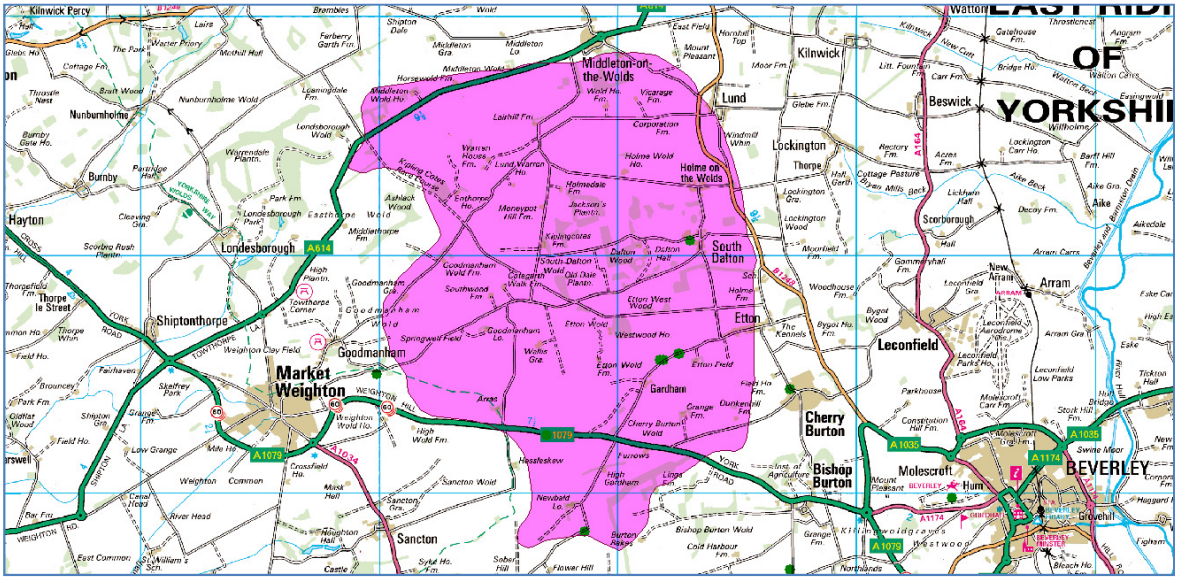


Figure 4.16: Groundwater nitrate concentration at Etton abstraction from 1979 to 2017.

Figure 4.17: Etton Groundwater zone



Investigations in AMP6 produced a robust system of catchment characterisation and recommendations for engaging land users. These investigations have shown the need to characterise each catchment so that the nitrate source, pathway and receptor are clear to land users, abstractors and the regulator. The information collected will be used to engage with land users and promote changes in land use so that nitrate input to groundwater is reduced. The methods for engagement are given in more detail below. The potentially most effective land use changes are identified in a report produced as part of our National Environment Programme (NEP) investigations in AMP6.

Additional benefits accrue from the opportunity to work with land users and raise awareness of other problems. For example, the setup of communication channels can assist with reducing nitrate contamination of surface water, pesticide contamination of surface and groundwater, and sediment loss to surface water.

Catchment management scheme outline

We have identified the following stages to implemention of nitrate catchment management, which implements the key findings from AMP6 investigations.

Catchment characterisation

It is necessary to further confirm the source of nitrate through a programme of groundwater sampling at company, private abstractions and observation wells. Samples will be analysed for:

- Total nitrate content.
- General water chemistry.
- Nitrogen and oxygen stable isotope ratios to confirm nitrate source.
- Sulphur hexafluoride to age the groundwater.

This allows us to demonstrate the proportion of nitrate from different sources with greater granularity, and better target interventions. The sources currently identified are agriculture, mains water leakage, sewer leakage, wastewater treatment works (WwTW) discharges to ground, aerial deposition and transport (from internal combustion engine emissions). Understanding groundwater age is important to demonstrate the effects of historic land use and past interventions on groundwater quality. It is critical that this data is available for each catchment to effectively engage with land users, and allow modelling to take account of historic, current and future mitigations. It also makes targeting and efficient deployment of measures possible. Identification of flow paths is required to enable targeting of action with the SgZ. It is also needed to show land users how they impact on abstracted water quality. Flow path identification will be achieved through:

- Updates to understanding of geology and geological structure in bedrock and superficial deposits.
- Refined conceptual model of groundwater flow using revised geological information; and
- Development of a geological model.

Land user engagement

With the information from the catchment characterisation it will be possible to open a dialogue with land users. The first task is to establish a working group with land owners. We will identify key stakeholders using spatial data resulting from the catchment characterisation above in collaboration with Natural England and the Environment Agency. We will undertake activity in formal collaboration with Yorkshire Wildlife Trust; the catchment based approach group and use consultancy arrangements with Askham Bryan & Bishop Burton agricultural colleges and local research organisations.

There will also be a general programme of engagement in the catchment and general area. This will be achieved by attending agricultural shows, events and meetings hosted both by us and others. We will work with other organisations such as agronomy service providers, some we have worked with during AMP6 to provide detailed farmer advice. In our AMP6 pilot schemes, this proved to be an effective method of engaging in local areas with farmers and their advisors.

Additional staff resources are needed to make the engagement possible, done in collaboration with other catchment management schemes operated by us. To undertake groundwater engagement two additional catchment officers are required. We are also looking to recruit an additional hydrogeologist to support the enlarged WINEP3 programme.

To support the work of the catchment officers we will use results of the characterisation work to generate material to reveal the 3D nature of the flow path from surface to abstraction. Examples of the material we will produce are:

- Pictorial material showing flow paths.
- Three-dimensional printed models showing geology, abstraction boreholes and flow paths (where a geographical model is available).

There is also provision to support land users by trialling new equipment, agronomic practice, outreach and communication with a range of aids showing the causes and association between nitrate at water supply boreholes and land use.

Monitoring and assessment of effectiveness

We will continue monitoring nitrate in groundwater by sampling from abstractions and observation wells. This is necessary to demonstrate the effectiveness of the catchment management, and allow for effective modelling.

Monitoring is critical to show the results of the catchment management actions. If monitoring shows catchment management is not proving effective it will be necessary to plan for alternative measures to ensure the company meets its obligations for public water supply.

Summary of proposed actions:

- Characterise catchment – improve geological, hydrogeological and hydrochemistry data to enable focusing of resources and engagement with land users.
- Increase staffing – recruit two full time catchment officers to work across all SgZs on nitrate catchment management.

- Engagement – set up local groups with landowners to review the issues and potential interventions; collaborative working with existing catchment based groups, farm technical visits; attend meetings and events.
- Monitoring – water quality, land use, cropping, nitrate use.
- Review and refine measures.

Pesticides

We plan to complete the following DrWPA investigation into pesticide detections at the pilot sources.

Pesticide characterisation and literature review

A desk based exercise will be conducted to understand the intended use, nature, behaviour and fate of observed pesticides in the groundwater environment. This will take the form of a review of published literature from pesticide manufacturers and academic papers. The purpose of this exercise is to aid interpretation of water quality data and potentially also indicate where other substances such as breakdown products or microbiological indicators could be useful to investigation. Consideration will also be given to the use of illegal and counterfeit pesticides in the catchments. Data on this will be sought from government agencies such as Defra and the Border Force.

Catchment characterisation

It is necessary to investigate the source of Pesticides through a programme of groundwater sampling. We will sample from our boreholes and where available, private abstraction and observation wells. Samples will be analysed for:

- Total and specific pesticides, including breakdown products.
- General water chemistry.
- Sulphur hexafluoride to age the groundwater.
- Microbiological indicators.

Groundwater ageing is important to help identify the timing of potential inputs of pesticides to the aquifer and to what extent the problem is current and ongoing, rather than a legacy impact from previous activity in the pilot catchments. Identification of flow paths is required to assist with locating the source of pesticides and to enable targeting of any action resulting from the investigation, (for example in a SgZ management plan). This is needed to show land users how they impact on abstracted water quality. Flow path identification will be achieved through:

- Updates to current understanding of geology and geological structure in bedrock and superficial deposits.
- Refined conceptual model of groundwater flow using revised geological information.
- Where a geological model is present three-dimensional printed models showing geology, abstraction boreholes and flow paths.

We will establish a network of groundwater monitoring points and carry out regular sampling during the investigation. Data quality and usefulness will be reviewed throughout the project, and the groundwater monitoring programme will be amended as appropriate. Investigatory monitoring, in addition to historic pesticide data from raw water quality samples establishes a baseline of pesticide concentrations in groundwater in the catchment.

Outcome

The principal outcome of the investigation will be to determine to what extent pesticide pollution is increasing in the Sherwood Sandstone aquifer. This will be used to inform any decision to designate or not designate a SgZ for each source and will form the basis for further work in other groundwater catchments where we are seeing apparent increase in pesticide concentrations.

An additional outcome will be a better conceptual understanding of the geological and hydrogeological setting in each catchment, which will aid future risk management for the abstractions.

The process of engagement with land users in the catchments will allow for closer ties with stakeholders such as Natural Englad, (Catchment Sensitive Farming), the Environment Agency and the National Farmers Union, which will be beneficial for catchment management and pollution control.

Summary of proposed actions:

- Carry out desk based study and literature review to identify most effective methodology for investigation, i.e. what to look for, where and how often.
- Characterise catchment – improve geological, hydrogeological and hydrochemistry understanding to enable focusing of resources and engagement with land users.
- Monitoring – water quality, land use, cropping, pesticides use.
- Resourcing plan – including catchment management roles and hydrogeological support.

- Engagement – work with stakeholders to improve management of pesticides in each catchment.

Summary

- We will carry out investigations to determine the level of risk, current and future, from nitrate and pesticide concentrations in groundwater.
- Each catchment will be characterised in terms of the geological and hydrogeological setting, and the characteristics of observed nitrate sources and pesticides will also be identified.
- This information will be used to design an appropriate groundwater monitoring programme, whose results will be analysed to determine the likely sources in each catchment.
- The results of the investigation will be used to inform any decision to designate a SgZ for pesticides, and should any such designation be made, a catchment management action plan will be produced.
- Additional catchment officers will be sought to engage with land users to address the management of pesticides in each catchment.

Catchment Interventions – Rivers

Metaldehyde

Metaldehyde remains a significant risk to compliance in the supplies abstracting water from the large lowland rivers of North and East Yorkshire. This is an area of circa 5,000km^2, much of which is in used for arable farming.

We have not proposed any proposals to DWI to install treatment at any sites within AMP7 to address metaldehyde. We have researched and costed two viable solutions for those sites which remain at risk, based on high rate PAC dosing or, as an alternative, the use of ultra-violet (UV)/peroxide based treatment. We do not believe that ozone based technologies are feasible due to the relatively high levels of bromide in the waters concerned.

We have developed proposals within WINEP3 to scale up the activities undertaken as investigations during AMP6 within targeted catchments and deploying similar methodologies into new sub-catchments. We are also applying more intensive approaches in these and the existing sub-catchments identified as high risk. In developing these approaches we are also mindful that decisions around the use of metaldehyde have been referred to Defra ministers, and that as a result of their decisions and rulings by Chemical Regulation Division (CRD) our plans may need to change.

The key activities identified are:

- The continued employment of Catchment Sensitive Farming Officers through Natural England.
- The deployment of additional catchment officer resource by us.
- Development of more granular risk mapping and GIS tools to maximise impact of Catchment Officers.
- The development of better predictive techniques for the control room to allow better decision making around abstraction.
- Consideration of targeted PES schemes.
- Consideration of soil health advice to minimise use of chemical control products in general and metaldehyde in particular.
- Identifying ways of driving best practice farming activities from the early adopters into the catchments
- Working with the supply chain for arable products to promote metaldehyde free approaches.

- Developing an innovative system for the “loan” of farm equipment which brings significant risk reduction into catchments as a means of driving the penetration of new techniques into farming.
- More sustainable links with other catchment stakeholders such as the Rivers Trust and Yorkshire Wildlife Trust.

4.8 Catchment management summary

A key principle in our AMP7 planning is a catchment first approach. Our aim was to eliminate the need for future investment due to raw water deterioration by undertaking catchment remediation in sufficient time. Our current view is that this is unlikely to be achieved until AMP8, primarily due to the uncertainty around catchment management interventions to reduce colour risk, and external constraints on our ability to act. We currently predict that trends for nitrate can be managed primarily by catchment management, or in a couple of situations by additional blending or new low-nitrate boreholes. We have some concerns about changes to the farming activities on marginal land in some of our reservoir catchments. These have the potential to introduce new hazards into the catchment (e.g. nutrients and pesticides) which current treatment processes are not equipped to mitigate. Control of such changes are largely beyond our influence, in particular where we do not own the land in question. This is an area where coherent environmental policies are required to secure raw water quality for the long-term by supporting land management practices which do not compromise it.

We ensure our customers receive high quality drinking water despite deteriorating raw water quality through our twin-track approach of catchment management, with additional treatment only deployed where there is evidence that this will be successful. However, catchment management can take 10 to 15 years for the activities to demonstrate a benefit. In the short-term, we also need to enhance our water treatment works (WTWs) capability, because the probability of failure presents an unacceptable risk to our customers. This twin-track approach is appropriate when considering future climate change because it balances the immediate need for absolute certainty in the quality of drinking water with the long-term goal for a flexible, low-carbon, sustainable solution.

- Catchment management for colour stabilisation is critical for securing the long-term resilience and quality of our upland sources – these are 45% of our resource, and failure to manage this successfully, will require ion-exchange treatment on many sources by AMP11, this would imply an investment in additional treatment in the

order of £140m capital expenditure (CAPEX), with the potential for a similar continuing commitment in subsequent periods.

- Catchment management for nitrate reduction in groundwaters is the sustainable approach and can be delivered with minimal risk of the need for further treatment. It would be supportive of our catchment management approaches if farming rules and agricultural support are developed into a soil health centred approach which is coherent and integrated to manage all risks from agriculture.
- Pesticides in groundwater – we identify the potential need for intervention at some specific sources as these are not following agricultural trends – the investigations will be completed during the early years of AMP7.
- AMP7 – should be seen as the last period of major treatment investment with a crossover to catchment management in AMP8 and beyond – this requires a supporting coordinated approach by all regulators to deliver the environment which will facilitate this.
- Metaldehyde – we have not proposed treatment interventions specifically targeted at this pesticide – however, we believe that much more could be achieved through catchment activity if the product continues in use, by adoption of a range of soil health centred interventions, supported where appropriate by targetted incentives.

4.9 Intervention costings

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.
- A thorough analysis of the historical costs to deliver comparable schemes has been made and those costs used to inform estimation of schemes for delivery in WINEP3.
- Adjustment of scheme specific costs based on site and scheme specific factors based on expert judgement and consultation with delivery partners including Natural England, Moors for the Future Partnership and YYP (Yorkshire Peat Partnership) and use of quotes and delivery partner estimates where applicable.
- Costs have been informed by site surveys and this detail is the build for quotes and cost estimates.
- Market rates for equipment hire have been used where required
- All schemes have been subject to an internal costing assurance process and external audits.

See appendix 1 for detailed list of Catchment interventions.

5. Water resource drivers

In this section we discuss the modelling and interventions for fish and biodiversity measures which are driven under:

- WFD heavily modified water bodies.
- WFD fish passage.
- Invasive species.
- NERC.
- SSSI.

5.1 WFD Measures

WINEP Measure Code	WFD_IMP_WRHWMB
WINEP3 measure summary	Schemes to modify the operation of reservoirs and abstractions to achieve compliance with WFD standards. Measures include altering reservoir compensation flows, river restoration, sediment management and investigating modification of abstraction licences
Total no.	16
Totex cost (£m)	£4.722

Summary

The WFD recognises that some rivers and lakes have been substantially altered in character to address issues like flooding and navigation or for activities associated with water regulation and storage. These waterbodies are designated as heavily modified water bodies (HMWB) and include all our reservoirs and the downstream watercourses. Through their impounding nature, the reservoirs effect the hydro-morphological characteristics of the watercourse. To be compliant with WFD, a HWMB is required to achieve good ecological potential (GEP) which represents the maximum ecological quality it can achieve, given its heavily modified nature.

The Environment Agency identified where HWMB are not currently meeting GEP and where our reservoirs contribute to failure. We have worked closely with them to identify the most

appropriate and cost beneficial measures to mitigate the effects of the reservoirs and where investigations are required to identify what actions may be needed in the future.

Legislative drivers

The WFD is the overriding legislation driving this investment, allowing for the designation of certain waterbodies as HMWB. This designation ensures the primary use of the waterbody, for example water supply, is maintained. Instead of the good ecological status (GES) WFD target, an alternative objective of good ecological potential (GEP) is set. All our reservoirs are designated as HMWB and must meet GEP unless exemptions are applied. The Environment Agency identified two drivers to ensure that HMWB reach GEP:

- **Flow** - Ensuring the HMWB structure does not impact on the downstream river flows necessary to maintain river habitats and their associated aquatic plants and animals, particularly in respect to ensuring an appropriate baseline flow regime is in place. River restoration schemes will also be implemented where the optimal flow cannot be achieved due to operational or other constraints.
- **Sediment management** – implementing measures to improve sediment delivery processes and hydromorphology in the downstream watercourses.

Hazard identification and risk characterisation

The Environment Agnecy have identified a list of water bodies failing GEP via the WINEP. In AMP5 and 2015-20 period we carried out investigations on HMWB to determine what mitigation measures would be required to meet GEP at our reservoir assets. The aims of the investigations were to establish the technical feasibility, costs and benefits of measures. We have worked very closely with our regional Environment Agency to clarify where water bodies are failing GEP and intervention is therefore required in 2020-25 period.

An industry wide project commissioned by UKWIR (HMWB, UKWIR 33) provided guidance to the water industry on how to define appropriate solutions for failing water bodies (commonly referred to as options appraisal). The outputs of this work led to the identification of the sites to be included within the WINEP3.

Intervention

Following options appraisal (including cost benefit analysis) of schemes identified at WINEP3, we have included 12 flow schemes and two sediment management schemes in our plan. Flow schemes include:

- Protecting low flows, reducing flows considered too high and formalising existing flow trials.

- Investigations to identify feasible, cost effective solutions to be delivered in future.
- River restoration schemes to improve flows and hydromorphology.
- Adaptive management to improve certainty around the technical feasibility of measures and the environmental benefits.
- Sediment management schemes include river restoration techniques to improve sediment mobilisation and retention and the general hydromorphology of the downstream river.

See appendix 1 for detailed list of HMWB interventions.

Natural water bodies – flow pressures

Unmodified water bodies are required to meet GES rather than GEP. The Environment Agency have identified three schemes where we are required to investigate and appraise options for improvements to the hydrological regime to meet WFD objectives or to prevent deterioration of ecological status from flow pressures linked to our assets. These are shown in appendix 1.

Intervention costing

The following steps were taken to cost the interventions in this measure:

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.
- A thorough analysis of the historical costs to deliver comparable schemes has been made.
- Adjustment of scheme specific costs based on site and scheme specific factors using expert judgement and consultation with delivery partners.
- Application of unit cost data and cost models where applicable.
- Using delivery partner quotes, cost estimates and information sharing with stakeholders and other water companies.
- All schemes have been subject to an internal costing assurance process and external audits.

5.2 WFD fish passage

WINEP measure code	WFD_IMP FISH
WINEP3 measure summary	Schemes to deliver fish passage to resolve water body failures under the WFD.
Total no.	9
Cost (£m)	5.055

Summary

Under the WFD driver, we are committing to deliver a comprehensive programme of fish passage during 2020-25 period. This programme also includes one investigation to enhance our understanding for future possible investment. In addition, the programme also includes one adaptive management project, which will allow us to research the impact of our fish passage schemes, providing us with the data, underpinned by scientific research, to make better future investments,

The WFD fish passage programme has been defined in the WINEP3, and will deliver passage across seven sites and four catchments, Ure, Aire, Don and Calder. Delivery of these schemes will contribute towards the length of river improved performance commitment.

In addition to these defined fish passage schemes, further fish passage projects may be delivered under additional drivers. Such schemes will be defined once 2020-25 period has begun.

Legislative drivers

These schemes are all driven by the WFD, and will be delivered to contribute towards achieving good ecological potential or status, and the Humber River basin management plan.

Hazard identification and risk characterisation

For these defined schemes, we have already carried out an initial screening to ensure that the risks to be mitigated are owned by us. This process has been undertaken in collaboration with the Environment Agency, and the scopes for these schemes have been drawn up and signed off by both parties. Any additional scheme level risks will be clarified once delivery has begun.

Intervention

The interventions in this measure are to design and build new fish passage schemes. See appendix 1 for full schedule of schemes.

Intervention costings

The following steps were followed to cost interventions in this measure:

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.
- A thorough analysis of the historical costs to deliver comparable schemes has been made.
- Adjustment of scheme specific costs based on site and scheme specific factors using expert judgement and consultation with delivery partners.
- Application of unit cost data and cost models where applicable.
- Using delivery partner quotes, cost estimates and information sharing with stakeholders and other water companies.
- All schemes have been subject to an internal costing assurance process and external audits.

5.3 Invasive Non-Native Species (INNS)

WINEP Measure code	INNS_INV,ND
WINEP3 measure summary	Measures to reduce the risks of spread and the impact of INNS to meet the requirements of WFD and EU regulation on invasive alien species. Measures include investigations to understand the risk of spreading INNS, introducing biosecurity measures and control and eradication of INNS.
Total No.	20
Totex cost (£m)	7.651

Summary

This is a new driver for the 2020-25 reporting period, primarily driven by the requirements of the Water Framework Directive (WFD) and the EU Regulation on invasive alien species (IAS).

There is around an annual £2bn[11] cost to the economy through the impacts of Invasive Non-Native Species (INNS), and at least a £5m[12] cost to water companies. We want to make sure that through our operations, we do not make it easy for invasive species to spread from site to site, or be responsible for the arrival of new species where none presently exist. This may be through transferring invasive plants from river to river through our water transfer network, or through the arrival of invasive invertebrates into our reservoirs as a result of the recreational opportunities we offer. These species can not only cause a deterioration in waterbody status, but also disrupt our operations through clogging of valves or blocking of pipework, and impact on our customers enjoyment of their rivers through infesting riverbanks and out-competing native vegetation.

Evidence and government policy[13] confirms that the most cost-effective manner to mitigate risks posed by invasive species is to follow the hierarchy of preventing arrival and spread,

[11] The Economic Cost of Invasive Non-native Species to the British Economy. (CABI, 2010).

[12] Invasive non-native species (INNS) implications on the water industry, UKWIR report 16/DW/02/82 https://www.ukwir.org/Invasive-and-Non-Native-Species-(INNS)-Implications-on-the-Water-Industry

[13] The Great Britain Invasive Non-native Species Strategy, 2015, DEFRA, The Scottish Government, Welsh Government

above eradicating established INNS, above managing INNS that are present. As such, the focus of this programme aligns with Environment Agency guidance to concentrate on improving biosecurity and preventing the arrival and spread of INNS.

Legislative drivers

The majority of the investigations and schemes contribute to prevention of deterioration for WFD. 70% of WFD waterbodies are at risk of deterioration due to INNS pressures by 2027[14].

In addition, the EU regulation on IAS aims to reduce the impact of INNS across Europe and puts in place requirements to prevent the spread and establishment of INNS.

In relation to government policy, as well as working in line with the requirements of the GB INNS strategy, our programme supports the new Defra 25-year environment plan, where one of the government's ten goals is focused around enhancing biosecurity.

Through the WINEP3 and working with the Environement Agency, we have confirmed required measures against the following two drivers:

- INNS_INV: Investigations - includes pathway analysis, prevention of deterioration and measures to achieve conservation objectives.
- INNS_ND: Delivery - schemes to prevent deterioration by reducing the risks of spread of INNS and reducing the impacts of INNS.

Hazard identification and risk characterisation

Environment Agency PR19 driver guidance outlined expectations of all water company programmes with respect to INNS. We have worked with the Environment Agency to follow the prioritisation process as set out in the guidance, to ensure that we have addressed all critical risks in a manner proportionate to the scale of the risk.

To ensure our programme is evidence based, and delivers a meaningful customer benefit, we have further prioritised investment against the GB NNSS strategy hierarchy, with the focus of the programme being biosecurity and the prevention of spread of new arrivals. We have been assisted in this, by undertaking an extensive monitoring and risk assessment process during 2015-20 period, to identify the key invasive species of concern to the

[14] Risk assessments are accessed from within the data and information guide: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/503282/RBMP_Guide_to_accessing_data_and_information.pdf

company, their locations across our estate, and their implications for our operations. This has been facilitated by further work undertaken by UKWIR across all water companies[15].

To ensure our programme meets our customers' needs as well as our own, we have worked closely with the Environmemnt Agency and other stakeholders (for example the Yorkshire Invasive Species Forum, the Yorkshire Dales INNS and Biosecurity Group and our stakeholder biodiversity advisory panel), to develop measures that will not only fulfil legislative requirements, but deliver a sustainable legacy, and mitigate problems at a catchment scale rather than focusing just on our assets. Since 2016, we have published our annual invasive species position statement on our website, to be transparent to customers about our targets, plans and performance[16].

Intervention measures to ensure we do not spread invasive species or cause them to arrive (biosecurity):

To ensure we have the facilities in place to stop the spread of invasive species (for staff and recreational users), we will build the infrastructure we need. For example, providing washing facilities so sailors can clean their boats before use, disinfectant facilities for anglers' nets, and drying rooms for our river surveyor's equipment. We are already working closely with academic partners such as the University of Leeds, to ensure the infrastructure provided is usable and meets required standards. This will be accompanied by new training and policies to ensure a beneficial outcome.

As a water company, one of our key pathways of spread is through transfers of raw water. We have committed to understanding the risks of our GRID system, and will develop suitable mitigation to minimise any chance of spread of INNS.

We fully recognise that INNS are a risk that do not respect ownership boundaries, and we have committed to continue to support local action groups such as the Yorkshire invasive species forum in their work coordinating management at a catchment scale and providing biosecurity training and equipment to other river users.

[15] Invasive non-native species (INNS) implications on the water industry, UKWIR report 16/DW/02/82 https://www.ukwir.org/Invasive-and-Non-Native-Species-(INNS)-Implications-on-the-Water-Industry

[16] https://www.yorkshirewater.com/about-us/what-we-do/investment-environment/biodiversity#ls4

Measures to eradicate invasive species:

Whilst generally eradication is complex, we are committing to working alongside other partners to develop methods to quickly identify the presence of new invasive species of concern (for example, building on our current development of environmental DNA monitoring for zebra mussels) and methods to efficiently eradicate or manage them, such as our support for the Defra funded biocontrol programme.

Measures to manage established invasive species:

We recognise that many species, such as Himalayan balsam or American signal crayfish, are now widespread and management is generally ineffective at a local scale. As such, we are working with local action groups and academic partners to develop proportionate and efficient methods to minimise the impacts of these species on destabilising river banks, increasing flood risk, impacting on native biodiversity and disrupting people's enjoyment of their river.

Zebra mussel are currently present in one main pipeline in our operational area. Together with appropriate biosecurity to mitigate the risk of spread to other areas, we will develop a proportionate management regime to ensure that the mussel population does not advance to a stage where it clogs pipes and disrupts supply, as occurs in other regions.

See appendix 1 for full list of schemes.

Intervention costings

The following steps were taken to cost interventions in this measure.

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.
- A thorough analysis of the historical costs to deliver comparable schemes has been made.
- Adjustment of scheme specific costs based on site and scheme specific factors using expert judgement and consultation with delivery partners.
- Application of unit cost data and cost models where applicable.
- Using delivery partner quotes, cost estimates and information sharing with stakeholders and other water companies.
- All schemes have been subject to an internal costing assurance process and external audits.

5.4 Natural Environment and Rural Communities Act

WINEP Measure code	NERC_IMP,INV
WINEP3 measure summary	A programme of measures to meet the requirements of the NERC Act, including management of Tier 2 sites for conservation, Biodiversity enhancement funds and species conservation.
Total no.	7
Totex cost (£m)	6.160

Summary

Through our corporate duties under the Natural Environment and Rural Communities Act 2006 (NERC Act), water companies are obliged to contribute to the following government priorities (as set out in the Environment Agency PR19 NERC driver guidance):

- The biodiversity priorities in the Defra 25-year plan.
- Halting overall biodiversity loss.
- Supporting healthy well-functioning ecosystems and establish coherent ecological networks.
- Seeking wider biodiversity benefits and linking habitats.
- Establishing more and better places for nature for the benefit of wildlife and people, and the associated Lawton principles of making our network of wildlife sites 'bigger, better and more joined up'.
- Where there is opportunity, helping more people understand how a clean environment improves their lives and livelihoods.

We believe we can only meet these priorities and many of the Defra 25-year plan key goals through ensuring a strong programme that aspires to a corporate aim of biodiversity net gain, through delivering stronger ecological resilience through partnership based projects:

- **Ecological resilience –** we want to see stronger, healthier ecosystems, more able to withstand the impacts of low frequency, high magnitude events, such as droughts or CSO spills. We recognise we have a diffuse impact on aquatic systems across the region and want to ensure that we can compensate for this in a sustainable manner.
- **An ambition of a net gain to biodiversity –** we want to ensure that our own negative impacts on regional biodiversity are minimised, mitigated, and where

appropriate, compensated for, and that we understand the natural value across our estate to enable us to manage it appropriately.

- **Innovation and partnership –** we recognise we cannot just do more of the same, and to fully catalyse benefits for regional biodiversity we need to work differently, work with others and focus on how to deliver the outcome, not record an output.

Legislative drivers

As interpreted by the Environment Agency PR19 guidance, the NERC Act places a duty on every public authority, including water companies, to have regard to conserving biodiversity. This is with the aim of restoring or enhancing a species population or habitat and reflects government's ambition for the 'prevention of further human-induced extinctions of known threatened species'. Section 41 of the NERC Act sets out a list of species and habitats which in the Secretary of State's opinion are of principal importance for conserving biodiversity in England. In addition, consideration should be given to species at high risk of extinction.

Together with the Environment Agency and Natural England, we have developed measures to meet the requirements of this duty, aligned with the following drivers:

Driver NERC_IMP1: Allow water companies to fund work on priority habitat creation, restoration, species recovery, to contribute towards biodiversity priorities and the NERC Act. This includes activities on water company owned landholdings or in catchments they influence and operate in when delivering landscape or catchment scale wider benefits and ecosystem services, either in isolation or in partnership. It must be demonstrated that the proposed action will contribute to priority habitat creation, restoration or species recovery. Such measures should be relevant to a water companies activities and responsibilities i.e. have regard so far as is consistent with the proper exercise of its functions, to the purpose of conserving biodiversity. The interventions should have positive benefits of lasting duration and provide measurable enhancement.

Driver NERC_INV1: Undertake investigations and/or options appraisal on opportunities for priority habitat creation, restoration, species recovery or ecosystem services, to contribute towards biodiversity priorities and the NERC Act. The same criteria apply as for NERC_IMP1 above. An alternative Driver NERC_INV2 exists, permitting companies to undertake investigations to change permits or licences, where there is evidence and it contributes towards biodiversity priorities and the NERC Act.

Hazard identification and risk characterisation

Throughout the process of defining our obligations under the NERC Act, we have worked closely with the Environment Agency and Natural England, to ensure a proportionate and evidenced based plan, that meets our customer's needs.

Ensuring we reflect the needs of our customers

We recognise that we cannot aspire to true biodiversity net gain by focusing inwards on our own assets, and as such we have consulted repeatedly, meaningfully and closely with key regional NGOs such as Wildlife and Rivers Trusts, to ensure our outcomes align with their expectations and key focus areas. By working jointly and at a landscape scale, we can catalyse each other's investment to deliver more sustainable and effective outcomes across the region. Whilst our planned biodiversity investment is lower than in 2015-20 period, we believe we will deliver greater outcomes through more targeted and partnership driven delivery.

Through engagement with our wider customers, through our stakeholder biodiversity advisory panel, the Forum and through customer focus groups, we know we are supported in our aims to ensure we have regard to conservation through our operations, with around 70% of customers scoring it 7 out of 10 or higher for importance.

Ensuring our investment is grounded in evidence

During 2015-20 period, we worked with Natural England to spatially map our estate against key biodiversity criteria. This has led to the development of a spatial model, screening our landholding against considerations such as protected site status, biodiversity value, landscape connectivity etc. We have been able to use the outcomes of this model to help prioritise our investment programme, in line with the Lawton principles[17] of concentrating on making sites better, bigger and connected.

Ensuring efficient delivery

The majority of the measures within this programme, build on the success of our partnership based 2015-20 period schemes, to deliver ecological outcomes through working through catchment partnerships, and with other NGOs and community groups. We firmly believe and can evidence that this delivers a better value outcome, that not only provides a conservation

[17] Lawon, 2010, Making Space for Nature: a review of England's wildlife sites and ecological network. Report to Defra

benefit, but helps ensure meaningful and sustainable future management of sites, as well as engaging with and often upskilling our customers. For example, during 2015-20 period we have delivered projects in collaboration with over 30 other NGO groups, unlocked over £1m of direct match funding, and had over 260 individual customers volunteering on our schemes.

Intervention

Aspiration to net gain

We realise that to aspire to a net gain of biodiversity across our estate, we need to understand the distribution and condition of habitats across our land holding, as well as the pressures and threats they face. We will undertake work to map our estate, to ensure our investment is aligned with the Lawton principles and focuses on safeguarding and protecting our most distinctive sites, as well as enhancing and restoring areas in poor condition.

Bigger, better and more connected habitats

Together with our existing SSSI management programme, we will for the first time, start to manage our Tier 2 sites for conservation (Local Wildlife Site or equivalent). We will continue to work with others across our operational area, in a targeted way, through our biodiversity enhancement programme, thereby facilitating volunteering and access to our sites for our customers. Through our catchment scale fish resilience programme, we will unlock the benefits of our standard obligatory investments, by working through catchment partnerships to identify and mitigate the limiting factors in a river that preclude our water quality and water resource investments from realising their maximum potential for fish populations.

Species conservation

We have committed to working to conserve key aquatic and riparian species, where we, as a water company, have a unique ability to make a meaningful difference. For example:

- The use of our reservoirs as ark sites for the endangered native white clawed crayfish.
- By investigating and implementing measures to help freshwater pearl mussel populations on the River Esk – working with partners can deliver the catchment scale water quality improvements required to help the population become sustainable.

See appendix 1 for full schedule of schemes.

Intervention costings

The following steps were taken to cost interventions in this measure:

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.
- A thorough analysis of the historical costs to deliver comparable schemes has been made.
- Adjustment of scheme specific costs based on site and scheme specific factors using expert judgement and consultation with delivery partners.
- Application of unit cost data and cost models where applicable.
- Using delivery partner quotes, cost estimates and information sharing with stakeholders and other water companies.
- All schemes have been subject to an internal costing assurance process and external audits.

5.5 Sites of Special Scientific Interest (SSSI)

WINEP measure code	SSSI
WINEP3 measure summary	Upland SSSI recovery (on our land) to restore damaged moorland and encourage ongoing peat formation
Total no.	1
Totex Cost (£m)	1.268

Summary

We own 11,339 Ha of land designated as SSSI within 13 separate SSSIs and 116 SSSI units as set out in Table 5.1.

SSSI	Number of Ha in SSSI	Number of Units in SSSI	No of units in favourable condition	No of Ha in favourable condition
Dark Peak SSSI	2432.09	30 Units	1	49.98
East Nidderdale Moor (Flamstone Pin – High Ruckles) SSSI	277.10	4	0	0
Eastern Peak District Moors SSSI	18.69	1	1	18.69
Eccup Reservoir SSSI	112.81	2	2	112.81
Gouthwaite Reservoir SSSI	149.57	1	1	149.57
Newtondale SSSI	3.50	1	Unfavourable Declining	
North York Moors SSSI	2.47	2	0	0
Rake Dike SSSI	8.50	1	1	8.50
South Pennine Moors SSSI	7441.11	62	2	109.63
Tophill Low SSSI	34.50	1	0	0
Upper Nidderdale SSSI	1.46	1	1	1.46
West Nidderdale, Baden and Blubberhouse Moors SSSI	854.54	9	1	1.53
Withens Clough SSSI	2.95	1	1	2.95
Total	11339.29	116	11	455.12

Table 5.1 – summary of SSSIs owned by Yorkshire Water

The government target for biodiversity (see Biodiversity 2020 guidance) sets out the requirement for 95% or more SSSIs to be in unfavourable recovering or better condition with 50% of SSSIs in favourable condition. Our SSSIs currently meet the lesser condition target but this needs to be maintained and in July 2018, 4% of our SSSIs are meeting favourable condition. The long-term timescales for restoration of the moors are recognised by Natural England so although working towards the guidance of 50%, we aim to have 15% of SSSI's in favourable condition by 2025.

Legislative drivers

Guidance set out within the Defra statement of obligations dated 05/10/2012:

> "3.11.5 - Statutory Undertakers….will need to include those actions deemed necessary both to remedy adverse impacts on, and to maintain and enhance the condition of, SSSIs in 2015-2020 and beyond."

This is underpinned by the requirements of the Water Industry Act, Wildlife and Countryside Act 1981 (as amended by the CRoW Act 2000), and NERC Act 2006 which set out the duties for water companies that are deemed to be Section 28G bodies.

Most of the SSSI's fall within a Natura 2000 site (South Pennine Moors special area of conservation (SACS), South Pennine Moors Phase 1 special protected areas (SPA) and South Pennine Moors Phase 2 SPA) and as such, the driver for these is the Habitats and Wild Bird Directive. The 2020-25 programme will focus on meeting or maintaining the conservation objectives of the Natura 2000 sites, developed by Natural England and informed by the Common Standards Monitoring Guidance (CSMG).

Hazard identification and risk characterisation

To assess whether previous spending has been or will continue to be justified, investigations during the latter end of 2015-20 and the beginning of 2020-25 period will be undertaken to understand the current status of the SSSI's following all previous works. A programme of surveying and close liaison with Natural England will help to inform an update of the current condition on the Natural England Major Landowners Group (MLG) database and give a greater understanding of any capital works needed going forward, allowing an understanding of how best to achieve favourable condition status for all owned SSSIs.

Intervention

Delivery will be focused on moorland restoration of company owned SSSIs. We will build on the AMP5/6 progress of peat stabilisation and take forward meeting priority site enhancement towards favourable condition targets (SAC site improvement plans). A focus will be on re-wetting the moor and biodiversity of flora, fauna and wildlife.

- Sphagnum inoculation and plug planting of dwarf shrub species - but sill carrying out stabilisation works such as lime, seed & fertilising of bare peat areas, spreading of heather brash, use of geotextile membranes on slopes where needed.
- Gully and grip blocking works.

- Control and treatment of nardus, molinia, bracken, rhododendron, weeds, scrub and trees.
- Creation of firebreaks to protect SSSI's and the investment.
- Boundary and stock exclusion fencing or walling.
- Other capital works as agreed with Natural England through Countryside Stewardship agreements.

See appendix 1 for a full schedule of interventions for SSSI.

Intervention costing

The following steps were taken to cost interventions in this measure.

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.
- A thorough analysis of the historical costs to deliver comparable schemes has been made.
- Adjustment of scheme specific costs based on site and scheme specific factors using expert judgement and consultation with delivery partners.
- Application of unit cost data and cost models where applicable.
- Using delivery partner quotes, cost estimates and information sharing with stakeholders and other water companies.
- All schemes have been subject to an internal costing assurance process and external audits.

5.6 Habitats Directive – Derwent

WINEP measure code	HD_INV
WINEP3 Measure summary	Investigation to assess the compliance of an abstraction on the River Derwent with Habitats Directive targets and model the impact of modifying the abstraction on water supply
Total no.	1
Totex Cost (£m)	0.124

Summary

Under the Habitats Directive driver, we have committed to investigate the effects of our River Derwent abstractions on the Lower Derwent special area of conservation. The abstractions have the potential to impact on this highly protected river if used to their full licence volume.

Legislative drivers

The scheme is driven by the Conservation of Habitats and Species Regulations (2017), commonly referred to as the Habitats Directive – the Directive provides for the designation and protection of European sites and species and for the control of potentially damaging operations. A licence can be amended or revoked if there is a clear proven impact on a protected site. The site was identified by Natural England and the Environment Agency in the WINEP with a HD_INV code.

Hazard identification and risk characterisation

The investigation includes modelling of abstractions to meet Common Standards Monitoring Guidance (CSMG) targets set by Natural England and Environment Agency. Currently these targets have not been agreed. If the targets have not been set by the start of 2020-25 period, the investigation will not be required and the scheme will be removed from WINEP and our business plan.

Intervention

The investigation will model the effects of different rates of abstraction on flow and level standards that are to be defined by Natural England and the Environment Agency. The modelling will create a number of scenarios that modify our current abstractions. The benefits of these changes in terms of hydrology and ecology will have to be evidenced and the impacts of any licence changes will be built into the sustainability reductions that feed into our Water Resource Management Plan.

Intervention costing

We've followed the process below to cost interventions in this measure.

- Scheme requirements have been fully understood through detailed investigation work by internal and external specialists and in collaboration with relevant stakeholders.

- A thorough analysis of the historical costs to deliver comparable schemes has been made.
- Adjustment of scheme specific costs based on site and scheme specific factors using expert judgement and consultation with delivery partners.
- Application of unit cost data and cost models where applicable.
- Using delivery partner quotes, cost estimates and information sharing with stakeholders and other water companies.
- All schemes have been subject to an internal costing assurance process and external audits.

6. Groundwater resource investigations

6.1 Saline intrusion - Hull

WINEP measure code	DWPA_ND
WINEP3 measure summary	Scheme to assess options to manage saline intrusion into chalk aquifer around Hull.
Total no.	1
Cost (£m)	

Summary

The salinity concentration in groundwater around Hull city shows clear evidence of saline intrusion (Figure 6.1). The Chalk groundwater body is failing to meet the WFD requirements on status partly due to the saline intrusion.

The saline intrusion is wholly or partly the result of extensive development on Hull waterfront and docks during the Victorian period and groundwater abstraction for industry and public water supply. Investigations during AMP6 have shown that the highest groundwater chloride concentrations (that occur close to the mouth of the river Hull) have remained stable. Further west and north however the 50 mg Cl^-/l contour has moved further inland. The reason for this is unclear but it is hoped that more detailed monitoring through out AMP6 and continuing in AMP7 will improve understanding of the situation.

At present, there are four possibilities being considered to explain the change to the extent of lower concentration salinity. Firstly, continued abstraction for public water supply may be causing migration of the saline intrusion. Secondly, old saline water present in the confined aquifer to the east may be moving west due to abstraction. The third possibility is that increased road salt use may be polluting the aquifer. Fourthly, agricultural salt application for sugar beet may be contributing.

Legislative drivers

The key drivers associated with this scheme in this area of WINEP are:

- Water Framework Directive – Art-7.
- Groundwater Directive 2006-118-EC.

- Water Supply (Water Quality) Regulations 2016.
- DWI Long-term Guidance for managing water quality – IL-03-2017.
- Water industry strategic environmental requirements.
- Environment Agency specific guidance on specific drivers (No deterioration / investigations under WFD).

Hazard Identification and risk characterisation

The current extent of the saline intrusion has been established through the AMP6 investigation – see Figure 6.1.

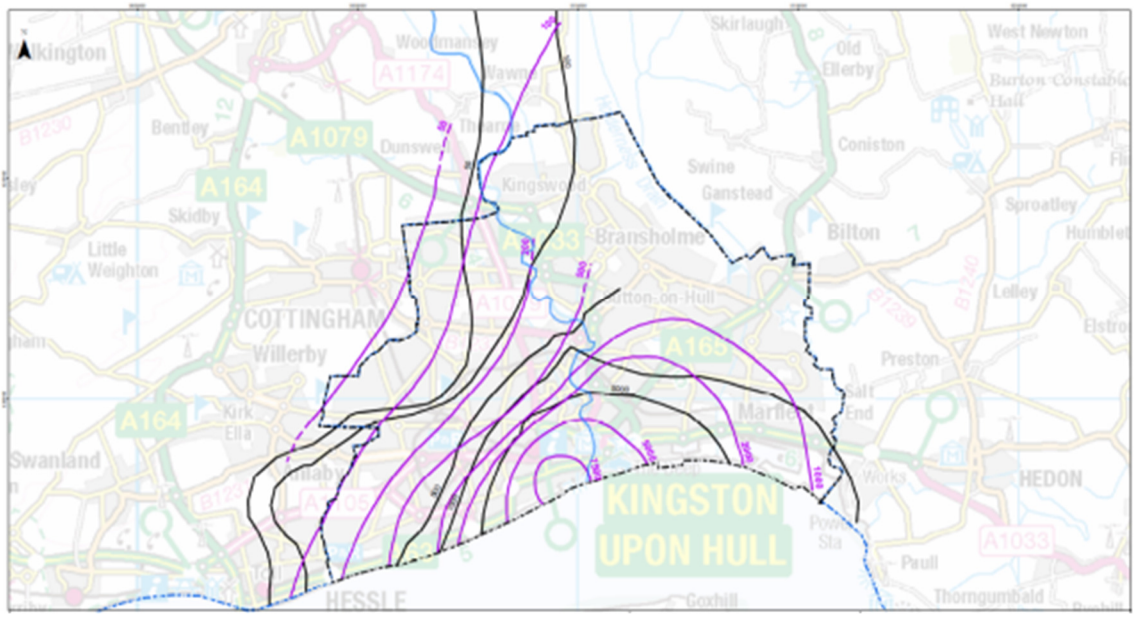


Figure 6.1 isocholors showing current extent of saline intrusion purple lines and extent in 1967 as black lines.

Unless salinity concentrations can be reduced in the aquifer it is likely that there will be continued failure of WFD obligations and risk to public water supply. The aim of this scheme is to undertake an appraisal of options to manage and if possible to reduce groundwater salinity to improve water body status and to protect public water supplies. We will use information and assessment carried out in AMP6 to help assess the options available so that salinity input to groundwater is reduced.

Interventions

To confirm the source of salinity a programme of groundwater sampling at company, private abstraction and observation wells is necessary. We will use a variety of analytical techniques to characterise groundwater samples and establish age of the groundwater.

These analyses will provide evidence of the proportion of salinity from different sources. We have identified the following as possible sources of salinity; saline intrusion from the Humber; movement of old saline water from the confined aquifer to the east; increased road salt use; agricultural use mainly for sugar beet.

Groundwater ageing may be important to determine the sources and timing of the saline intrusion. Monitoring data to date is insufficient to determine if saline intrusion is continuing or what the contribution is from the different sources. Data for the end period of the AMP6 investigation and continued monitoring in AMP7 will allow us to build robust options and give a reliable appraisal of their effectives and cost.

Establishing the source of the saline water is important in the options appraisal so that an effective scheme can be defined that we are confident will resolve the problem.

Identification of flow paths is required to demonstrate that there is a 'pollutant linkage' between the Humber and the groundwater. At present, there is little hard evidence to demonstrate that water can flow from the Humber into the Chalk. Flow path identification will be achieved through a set of improvements to geology and hydrogeology data and maps of the area.

Characterisation work will be undertaken in parallel with the initial options appraisal element of the scheme.

Intervention costing

The investigation costs have be set for different elements of the work based on preliminary discussion with contractors and experience of similar previous investigations and sampling requirements.

6.2 Groundwater Resource Assessments – Doncaster, Selby, Hull, Wolds wellfields

WINEP measure code	WFDGW_NDINV_GWR, DrWPA_INV
WINEP3 measure summary	Investigations to establish the potential impact of groundwater public water supply abstraction on groundwater balance and identified surface water bodies with possible detrimental impact on flow.
Total no.	4
Cost (£m)	£2.374M

Summary

We are proposing wellfield wide investigations to assess water balance and potential risk to resources and quality from the existing abstraction regime on groundwater and surface water bodies. If detrimental impacts are identified Yorkshire Water will undertake options appraisal to mitigate the risks whilst balancing this with the company's and Environment Agency's duties to maintain public water supplies.

Legislative drivers

The key drivers associated with these investigations in this area of WINEP3 are:

- Water Framework Directive.
- Groundwater Directive 2006-118-EC.
- Water industry strategic environmental requirements.
- Environment Agency specific guidance on specific drivers (No deterioration / investigations under WFD).

Hazard identification and risk characterisation

The Environment Agency identified potential risks to achievement of WFD objectives due to groundwater derived Public Water Supply (PWS) abstraction in the four wellfield areas. The Environment Agency ascribed WINEP3 driver codes of WFDGW_NDINV_GWR & WFD_NDINV_WRFlow to boreholes in the wellfields.

Interventions

The proposed actions are listed below:

- A literature review.
- Testing, analysis and assessment of results of catchment characterisation, water resources and quality in the investigation area.
- Water balance review.
- An assessment of the extent of correlation between PWS abstractions and groundwater levels and quality in the study area.
- A sensitivity analysis of the effects of abstraction on groundwater levels and quality.
- An assessment of the level of risk that PWS abstractions will cause a WFD failure.
- In the case an unacceptable risk of WFD failure then an appraisal of potential mitigation options, and recommendations based on cost/ benefit analysis.
- These actions will result in a quantification of the risk presented by PWS groundwater abstraction to achievement of WFD objectives in the investigation areas.

If necessary we will provide a clearly set out appraisal of the options to address unacceptable risk due to PWS abstraction in subsequent AMP cycles.

Intervention costing

For each investigation costs have been set for different elements of the work based on preliminary discussion with contractors and experience of similar previous investigations and sampling requirements.

The proposed investigation will comprise the following elements of:

- Literature review.
- Catchment characterisation.
- Review, update and refine groundwater recharge and outflow balance in collaboration with Environment Agency conceptual model updates and recharge modelling improvements.
- Programme of groundwater level monitoring to determine the effects of abstraction on groundwater levels
- Assessing the scale of the potential impact of PWS groundwater abstraction on identified surface water bodies.
- Consider the sensitivity of groundwater level and quality to changes in abstraction and possible effects of reducing abstraction on the surface water environment, particularly potential increases in flooding risk.
- A programme of groundwater sampling to measure how abstraction affects water quality at depth in the sandstone.

7. Water quality drivers – measures for Wastewater Treatment

In this section we discuss the modelling and interventions and costs for measures related to our Wastewater Treatment Works (WwTW).

These include:

- Urban Waste Water Treatment Directive – U_IMP1,2,5,6 and U_MON3,4,5 and investigations
- Water Framework Directive – WFD_IMPm,g, No Deterioration, Chemicals and Investigations
- Measures in Bioresources linked to WINEP

The detailed description of our approach to treatment costing and quality assurance is covered in section 8.19.

7.1 U_IMP1: Urban Waste Water Treatment Directive >2000 PE

Summary

Enhancing treatment required under the Urban Waste Water Treatment Directive (UWWTD) because the population equivalent (PE) served by a WwTW growth above 2,000 PE

WINEP 3 Measure Code	U_IMP1
WINEP3 meaure summary	Schemes to improve discharges that, through population growth, have crossed the population thresholds in the UWWTR and therefore must achieve more stringent UWWTR requirements
Total no.	2
Totex cost (£m)	£6.095

Legislative drivers

The UWWTD (91/271/EC) and its translation into UK regulations requires wastewater treatment works (WwTW) serving a population equivalent of over 2,000 to achieve set performance standards. For works under 2,000, these are required to achieve ‘appropriate treatment’. Appropriate treatment was defined by Defra’s predecessor, DETR, in their

AMP2 guidance document (July 1997). The Environment Agency and Natural England's expectations on requirements under the UWWTD are set out in section 2.7 of their WISER document. Detailed requirements are set out in the Environment Agency guidance. The associated Environment Agency driver reference is U_IMP1.

Hazard identification and risk characterisation

The domestic population served by each WwTW has been checked with our planning team. Similarly, the industrial component contributing to each works has been verified with our Industrial Waste team. These figures have then been combined using standard formulae to calculate the population equivalent for each works.

Intervention

Where the population equivalent exceeds 2,000, the following improvements will be made:

- Meet the of numeric standard for BOD 25mg/l (composite) or 70% reduction.
- Meet the numeric standard for COD 125mg/l (composite) or 75% reduction.
- Provision of associated composite influent and effluent sampling equipment.

See appendix 1 for schedule of schemes under the measure.

Intervention costing

See section 8 for approach to treatment costing and quality assurance.

7.2 Urban Wastewater Treatment Directive – Flow drivers

WINEP Measure codes	U_MON3, U_MON4, U_MON5, U_INV2, U_IMP5, U_IMP6
WINEP3 Measure summary	The Environment Agency has concerns that the inability for their officers to easily check compliance with the permitted pass forward flows for storm overflows could lead to infraction proceedings under the UWWTD and therefore drivers have been included for flow monitoring. These drivers apply to most storm discharges immediately upstream of treatment works where the treated effluent discharge has a flow of greater than 50 m^3/day. Where there is existing equipment that may be able to carry out the monitoring an investigation has been allowed for to confirm suitability. For works where flow has increased beyond 50m3 per day for the first time, there is a new requirement to monitor flow to Agency MCERTS standard. Historically where there has been growth in a catchment and the dry weather flow has increased there has been no corresponding increase in the storm discharge settings (pass forward flow and storm storage). Drivers for pass forward flow and storm storage have, therefore, been included as a catch-up. Increased pass forward flows are included where there is potential for overflows to operate in dry weather and storage is increased to the Agency's standard calculations.
Total No.	549
Cost (£m)	101.620

Summary

Drivers have been included in the WINEP to provide monitoring equipment and compliance investigations to allow the Environment Agency to easily check compliance with a permitted minimum pass forward flow (PFF) limit for storm discharges closest to wastewater treatment works

The Environment Agency require wastewater treatment works that surpass a dry weather flow (DWF) or maximum daily flow (MDF) of 50m^3 to have installed flow measurement that meets MCERTS standards.

There are also drivers to increase Flow to Full Treatment (FFT) and storm tank capacities to meet standard Agency definitions. The increase to FFT is to prevent operation of FFT storm sewage overflows to or from storm tanks on dry days and the increases to storm tank capacity is to reduce frequency, duration and concentration of discharges from storm tanks that have low permitted volumes.

Legislative drivers

These drivers have been introduced under WINEP to comply with the requirements of the Urban Wastewater Treatment Directive (1991/271/EC).

- The associated drivers for PFF are U_MON3, U_MON4 and U_INV2.
- The associated driver for first time flow monitoring is U_MON5.
- The associated driver for FFT increases is U_IMP5.
- The associated driver for storm tanks improvements is U_IMP6.

Hazard identification and risk characterisation

Discussions were carried out nationally at a joint water company and Environmnet Agency group to develop the drivers around PFF, FFT and storm tank capacity requirements. This provided the opportunity to explore in detail the driver requirements and resulted in the driver guidance being updated.

For PFF drivers, all WwTW with a permitted dry weather flow (DWF) above 50m^3 and a PFF controlled by a storm overflow were identified and would be included in the WINEP under monitoring or investigation drivers.

We examined the configurations of MCERTS meters and event duration monitors (EDMs) at the treatment works to assess suitability of compliance with the driver requirements - either with or without upgrading. Where it is was not clear if the existing flow monitoring equipment could be used or not the U_INV2 investigation driver has been proposed and an investigation is to be carried out.

There is no accepted industry standard for determining FFT, so for the U_IMP5 driver we developed a logical and testable method, which involved assessment against dry weather

flow (DWF), rainfall analysis and statistical tests. Any assets that 'failed' the method were included in WINEP.

Population data was used to identify WwTW that exceeded 50m^3 DWF and required first time flow MCERTS flow monitoring.

For the storm tank driver, we calculated the required volume in the two ways required by the Environment Agency: 68 litres per head of population and two hours at maximum flow. The lower of the two volumes has become the WINEP obligation.

Interventions

- There are 240 WwTW with a U_MON3 driver, 143 with a U_MON4 driver and 97 investigations (U_INV2).
- There are seven WwTW with a U_MON5 driver.
- There are six FFT increases and 63 storm tank improvements.

All the relevant assets with these meaures are are provided in Appendix 1.

Intervention Costing

U_MON3 – EDM – each identfied discharge was assessed to understand the level of upgrade or installation required and costs derived from 2015-20 period attributed accordingly.

U_MON4 – Flow monitoring – each discharge was individually assessed to see if existing equipment could be used on its own, with the addition of more flow monitors, or whether a completely new system was required. Costs for upgrading existing and installing new monitoring were based on 2015-20 period costs.

U_MON5 – First time flow monitoring – population data was used to identify WwTW that exceeded 50m^3 DWF and costs for MCERTS was based on 2015-20 period costs.

U_IMP5 – Increase in PFF – the company’s design and valuaton engine was used to identify and cost the requirements of this driver.

U_IMP6 – Additional storm storage – the required volume was calculated following the WINEP guidance. Costs derived from AMPs 5 and 6 were used to create a table showing costing bands across a range of tank sizes.

7.3 UIMP2: Urban Waste Water Treatment Directive – Sensitive Area Designations for Eutrophication

WINEP Measure code	U_IMP2
WINEP3 Measure Summary	Phosphorus removal schemes identified for WwTW which discharge into or upstream of a waterbody designated as Sensitive Area for eutrophication by the Agency. These are statutory requirements under the UWWTD and are not subject to cost-benefit assessment. The environmental benefit of these schemes is included in the cost-benefit assessment for WFD phosphorus schemes by the Agency, while the associated cost is not included. Phosphorus removal is dependent upon the population equivalent (PE) of the WwTWs: >10,000 PE at 2 mg/l annual average phosphorus >100,000 PE at 1 mg/l annual average phosphorus
Total No.	50
Cost (£m)	308.222

Summary

The Environment Agency has recommended new Sensitive Area (eutrophication) designations within Yorkshire. Whilst the statutory designations have not yet been formally made by Government, we have complied with the requirements of the guidance and made provision in our 2020-25 business plan.

Legislative drivers

The UWWTD, which was introduced into UK law in 1994, defines minimum uniform end of pipe treatment standards for Wastewater Treatment Works across the UK and Europe. Where the Environment Agency determine that there is evidence (or high future probability) of eutrophication in a waterbody, it is required to make recommendations to the Secretary of State for the Environment that the waterbody be designated as a Sensitive Area. This drives end of pipe phosphorous removal at wastewater treatment works. This driver is statutory and is not subject to cost-benefit assessment.

Hazard identification and risk characterisation

The Environment Agency has developed a summary spreadsheet of its evidence to support designation of Sensitive Areas in Yorkshire. The spreadsheet is based on an Agency written methodology, which involves assessment of environmental data, to determine whether a waterbody should be designated. The final decision can be overwritten by local Agency Environment Officers if they believe they have local knowledge that disagrees with the outcome of the spreadsheet method.

Our investment under this driver is significant and we have asked the Agency for the data and information that went into the summary spreadsheet so that we can better understand the designations. We also need this primary data to help us define measures in our Catchment Sense approach. At the time of writing, we have not received this evidence.

Interventions

The interventions required to comply with the proposed designations have been identified by the Environment Agency.

The required level of treatment is determined by the population equivalent of each identified WwTW. Those with population equivalents between 10,000 and 100,000 require phosphorous removal to 2mg/l and those with a population equivalent greater than 100,000 require a more stringent 1mg/l.

There are 50 wastewater treatment works that require P-removal under the proposed Sensitive Area designations: 40 to 2mg/l and 10 to 1mg/l. The location are shown in figure 7.1.

Figure 7.1: Location of 50 works identified as potential designations under UWWTD

The environmental benefit of this investment is not significant: 57.58km improved to Moderate or Poor using Water Framework Directive (WFD) metrics for good ecological status (GES). There are no water bodies improved to the default WFD good ecological status under the UWWTD driver.

This analysis has been the prime driver for our innovative Catchment Sense approach described in section 2.8 above and appendix 2, an ambitious approach to achieving healthy, functioning river ecosystems. This is the fundamental aim of the WFD.

The UWWTD aims to protect the water environment from the adverse effects of discharges of urban waste water and certain industrial discharges by specifying minimum treatment requirements as well as more stringent tertiary treatment when needed to protect 'Sensitive area designations' for eutrophication. It does not measure the outcome is actually achieved. Eutrophication is when waters become over-rich in plant nutrient and becomes overgrown in algae and other aquatic plants.

The WFD is much broader in scope than the UWWTD as it aims to maintain and improve the aquatic environment. The WFD was a landmark in a more sustainable approach to water management that looks at cost and benefits to address the complexity of ecosystems.

The WFD nutrient requirements are site specific and consider the receiving water standard, the load already in the river and the load added to it from each wastewater treatment works (and other sources). Hence for many locations the requirements are up to four times as stringent UWWTD and a much greater phosphorous reduction is required for many wastewater treatment works than under the UWWTD. Crucially, however, it also includes tests for technical feasibility and disproportionate cost, so requirements for sites only progress when both of those tests are met.

The following graphs illustrate the minimal environmental benefit that is achieved at a number of main rivers as a result of the investment driven under the UWWTD alone. The graphs show the pre and post UWWTD investment profile of phosphorous concentrations along each of the rivers under consideration for designation as Sensitive Areas along with the phosphorous concentrations to achieve the high, good, moderate, bad and poor WFD ecological status standards for phosphorus. The UWWTD investment has limited benefit in terms of improving WFD ecological status, the WFD standards have been set to achieve ecological outcomes.

These graphs are generated from the SIMCAT-SAGIS model. However, the costs of delivering UWWTD are discounted when undertaking cost-benefit analysis under WFD for those WWTW that have both drivers. This increases the number of schemes that become cost-beneficial under WFD.

The graphs should be read in pairs and compared. The black lines show the concentration in the river and the coloured lines show the WFD ecological status classification boundaries. The greater the concentration of phosphorous, the poorer the classification. Changes in classification have been highlighted with a red circle.

- Black lines phosphorus concentration pre and post UWWTD investment
- Concentration below the blue line is WFD high ecological status for phosphorus.
- Concentration below the Green line but above the blue line is WFD good ecological status for phosphorus. This is the default WFD status objective.

- Concentration below the Yellow line but above the green line is WFD moderate ecological status for phosphorus.
- Concentration below the Orange line but above the yellow line is WFD poor ecological status for phosphorus.
- Concentrations above the orange line is WFD bad ecological status for phosphorus.

Figure 7.2 shows pre and post UWWTD in phosphorous concentrations along the length of the River Aire, a main river running through parts of North Yorkshire and the main towns and cities of West Yorkshire before joining the Ouse in East Yorkshire. It can be seen that post-investment, there is only WFD within-class improvement and that is within the ecological status ‘poor’ classification until the very end of the reach when there is a small improvement to WFD ecological status to ‘Moderate’ classification.

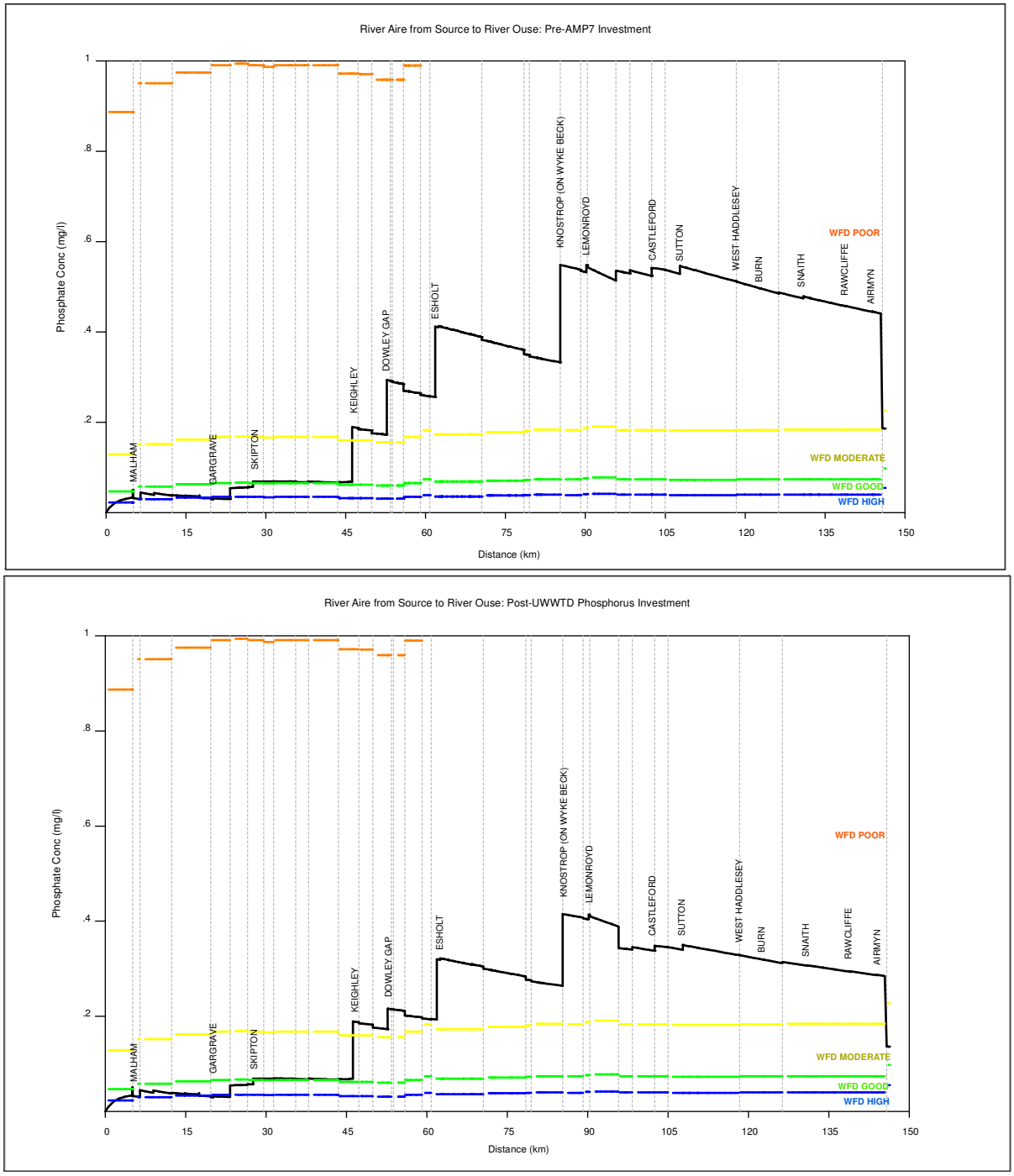


Figure 7.2: Comparison of phosphorous concentrations in the River Aire pre- and post- UWWTD investment

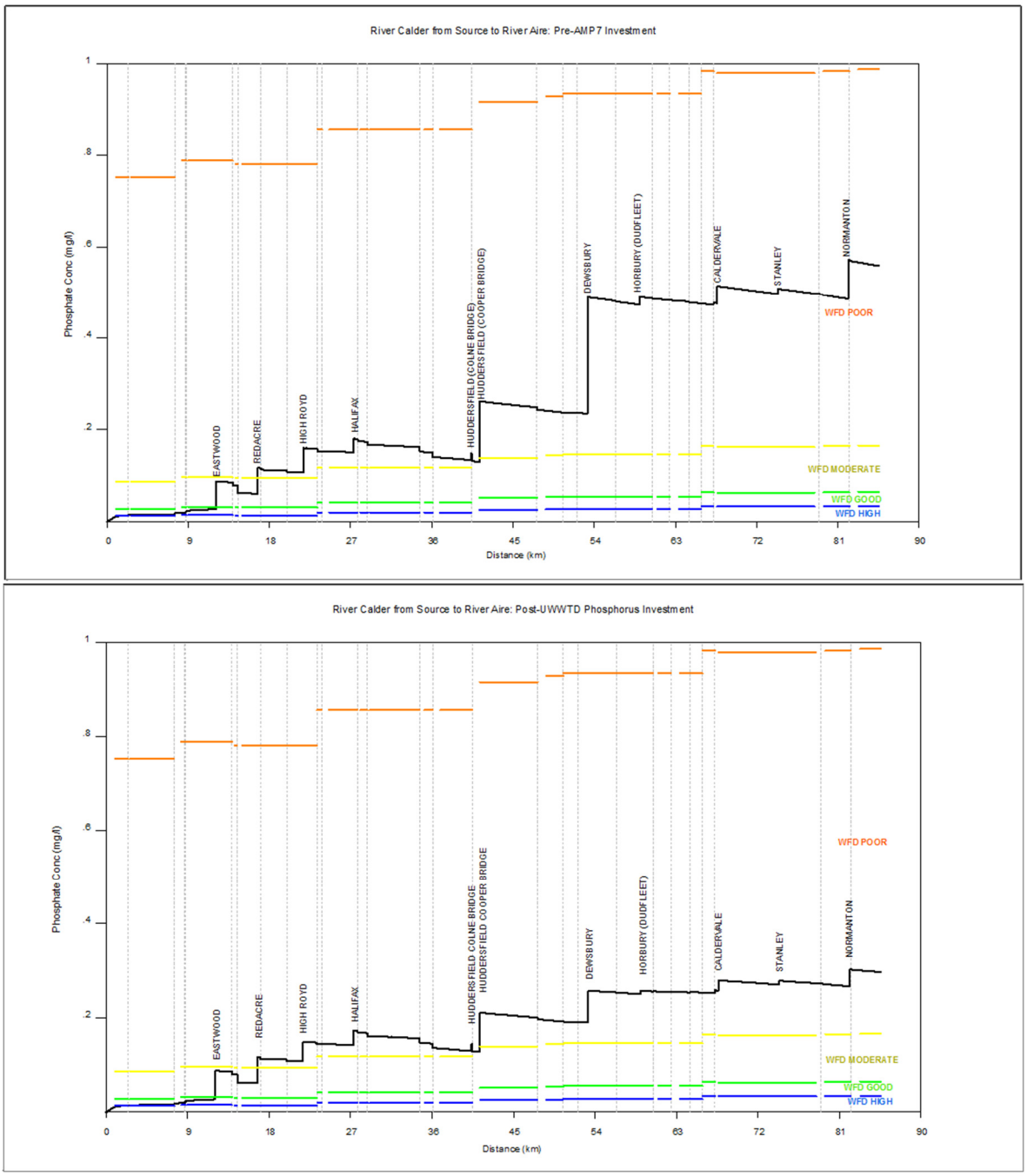


Figure 7.3 : Comparison of phosphorous concentrations in the River Calder pre- and post- UWWTD investment

The main river through South Yorkshire is the River Don and it experiences a slight improvement to WFD ecological status classification as a result of UWWTD investment. This change takes around five kilometres of river from poor to moderate WFD ecological status classification. The remainder of the river remains poor status. Figure 7.4 shows where this improvement occurs.

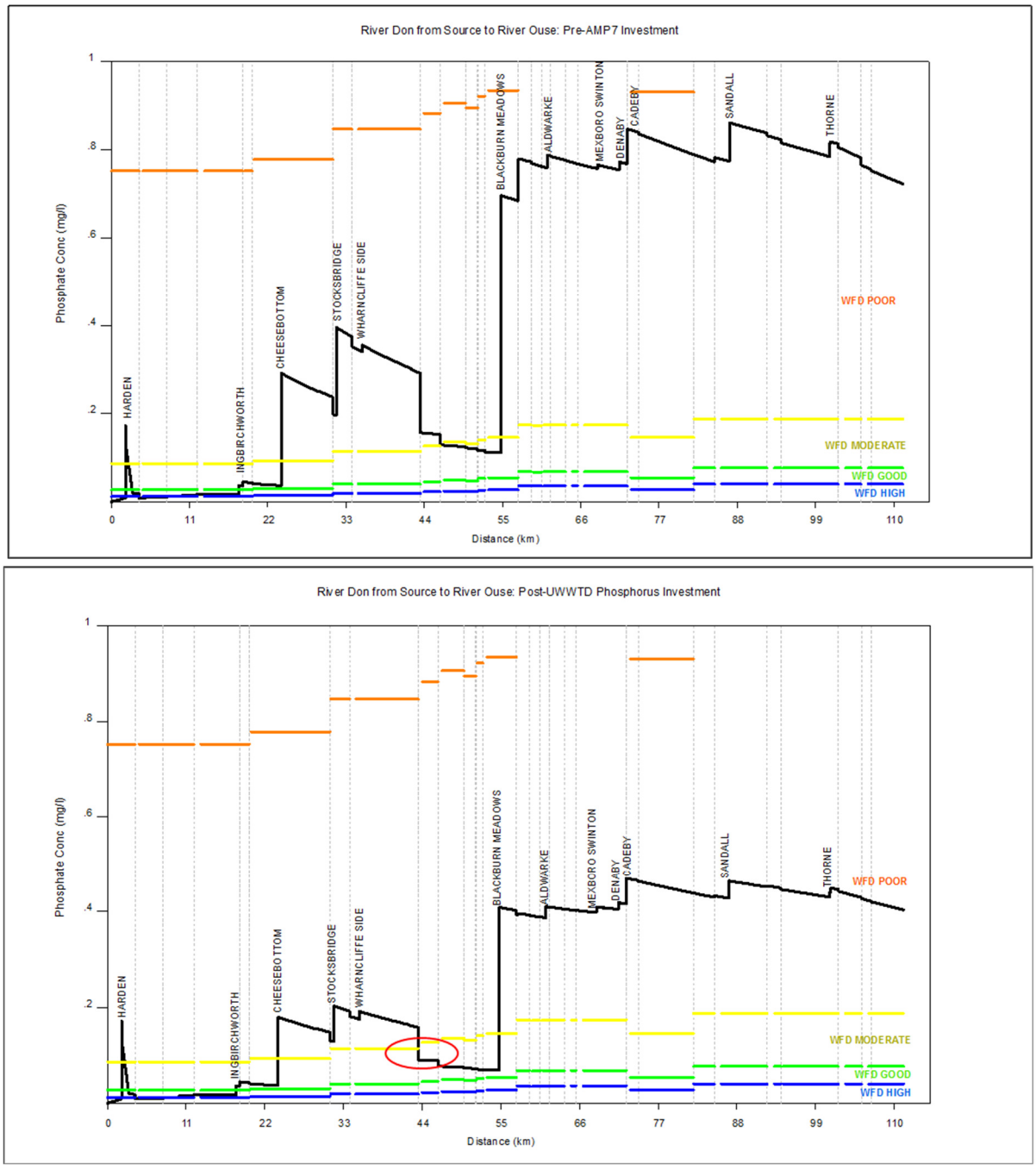


Figure 7.4: Comparison of phosphorous concentrations in the River Don pre- and post- UWWTD investment

Figure 7.5 illustrates the largest improvement brought about by UWWTD investment in P removal. This is on the River Dearne, a smaller river in South Yorkshire that flows predominantly through urban areas. Here the UWWTD effects around 20km of WFD ecological status classification class improvement from bad to poor status.

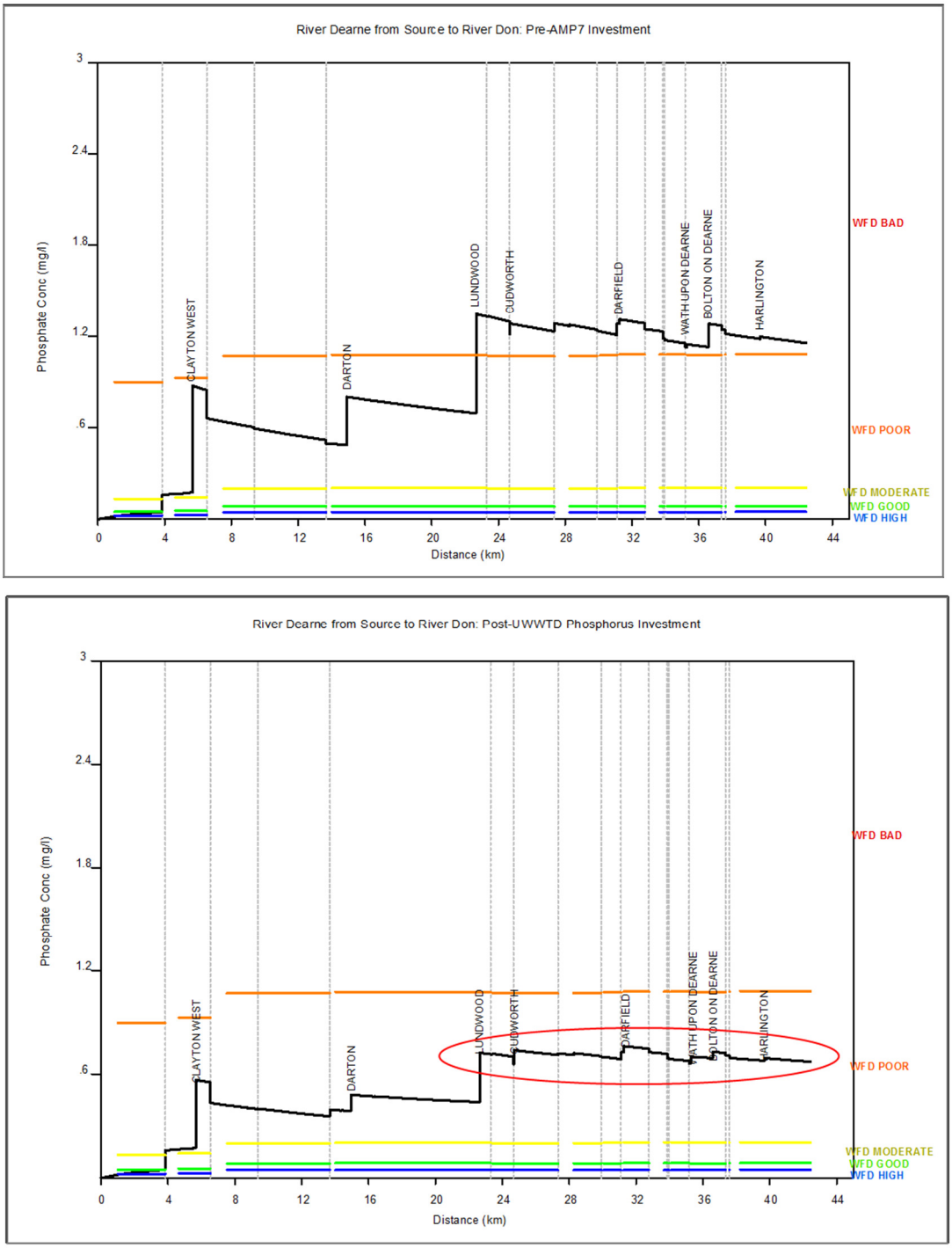


Figure 7.5 : Comparison of phosphorous concentrations in the River Dearne pre- and post- UWWTD investment

Interventions

The interventions for this measure all consist of the modification of existing biological processes and installation of tertiary treatment processes, where appropriate and assessed on a site by site basis. The basic blue print for P removal is chemical dosing and tertiatry solids capture. In a small number of cases, we propose either a biological process for

phosphorous removal or to transfer the discharge. These approaches are detailed in full in section 8.

See appendix 1 for a full list of obligations.

Intervention costing

See section 8 for approach to treatment costing and quality assurance

7.4 Water Framework Directive – Improvements in phosphorous to Moderate and Good ecological status

WINEP 3 Measure Codes	WFD_IMP M, WFD_IMP G
WINEP3 measure summary	Schemes identified to deliver phosphorus removal at WwTWs to achieve WFD moderate and good ecological status within the receiving waterbody. All schemes are assessed at the point of mixing. Schemes have been identified by the Agency using the spreadsheet optimiser tool. We have run the identified schemes through the nationally agreed SAGIS water quality model to produce the length of river improved in accordance with our method. All schemes under WFD are subject to cost-benefit assessment. The CBA includes the benefit from the UWWTD phosphorus schemes, but not the cost associated to achieve 1 or 2 mg/l annual average, only the cost for the difference from UWWTD to WFD e.g. costs from 2 mg/l to 0.3mg/l, but the full benefit.
Total no.	72 (36 that have a dual UWWTD / WFD driver)
Cost (£m)	206.416

Summary

The Agency has identified WwTWs that require phosphorous removal to achieve good or moderate ecological status under the WFD.

Legislative drivers

The Water Framework Directive is the key legislation for protecting and improving the water environment. It seeks to achieve “Good Ecological Status” wherever possible in watercourses, subject to a set of feasibility and cost tests. It functions as three sets of six-year planning cycles: River Basin Management Plans. We will enter the third cycle at the beginning of 2022.

Hazard identification and risk characterisation

The accepted national approach to identify investment is SIMCAT-SAGIS, a water quality modelling tool developed by the UK water industry in collaboration with the Environment Agency to review WwTW impact on receiving waterbodies and plan investment in line with WFD objectives. There is a nationally accepted technical limit for P-removal that can be achieved: 0.25mg/l.

The SIMCAT-SAGIS models were calibrated for the period 2010-12 by the Environment Agency. Sampled data is, generally, only collected by water companies at WwTWs where there is existing phosphorus treatment. We currently have few WwTWs with phosphorus treatment on which to base the modelling. In AMP5 we undertook WFD investigations, which included sampling several WwTW final effluent in 2011 for phosphorus. This data has been included in the 2010-12 baseline model calibration, where applicable. Where no WwTW final effluent phosphorus data is available the Agency used an assumed default phosphorus value of 5 mg/l annual average in the model to represent WwTW final effluent quality.

The Agency produced a spreadsheet Optimiser Tool to identify investment for AMP7. The Optimiser was created using the Baseline (2010-12) calibrated SIMCAT-SAGIS model. Investment post-2012 to March 2020 (end of AMP6) was incorporated into the Optimiser prior to AMP7 investment being identified.

Using the Optimiser, the EA PR19 approach to identify phosphorus investment under WFD was based on full permit limit to achieve waterbody specific WFD targets at the point of mixing. All outputs identified in the Optimiser went forward for cost-benefit analysis. Only improvements that were both technically feasible and cost-beneficial were promoted for investment. The Environment Agency did not produce a revised optimiser with only the cost beneficial schemes. There was, therefore, no back-check of the predicted WFD classifications.

On receipt of WINEP3 from the Environment Agency, we put the regulatory obligations into the SIMCAT-SAGIS model. These results have been used to calculate the length of river improved PC based solely on the obligations that achieved cost-benefit analysis for WFD drivers. Therefore, because the Agency calculated river length improved on all interventions (even when they were not cost beneficial and so will not be progressed) our predictions

differ to those of the Environment Agency. The map below (figure 7.6) shows the Aire / Calder catchment and the location of the investment.

Figure 7.6: Aire Calder management catchment and locaitons of WFD investment

Shown below, are pairs of graphs showing the environmental improvements gained as a result of WFD and UWWTD investment in phosphorous removal. As in the section on UWWTD phosphorous removal investment, the black lines show the concentration in the river and the coloured lines show the WFD classification boundaries. The greater the concentration, the poorer the classification. Changes in classification have been highlighted with a red circle.

The graphs should be read in pairs and compared. The black lines show the concentration in the river and the coloured lines show the WFD ecological status classification boundaries. The greater the concentration of phosphorous, the poorer the classification. Changes in classification have been highlighted with a red circle.

- Black lines phosphorus concentration pre and post investment
- Concentration below the blue line is WFD high ecological status for phosphorus.
- Concentration below the Green line but above the blue line is WFD good ecological status for phosphorus. This is the default WFD status objective.
- Concentration below the Yellow line but above the green line is WFD moderate ecological status for phosphorus.
- Concentration below the Orange line but above the yellow line is WFD poor ecological status for phosphorus.
- Concentrations above the orange line is WFD bad ecological status for phosphorus.

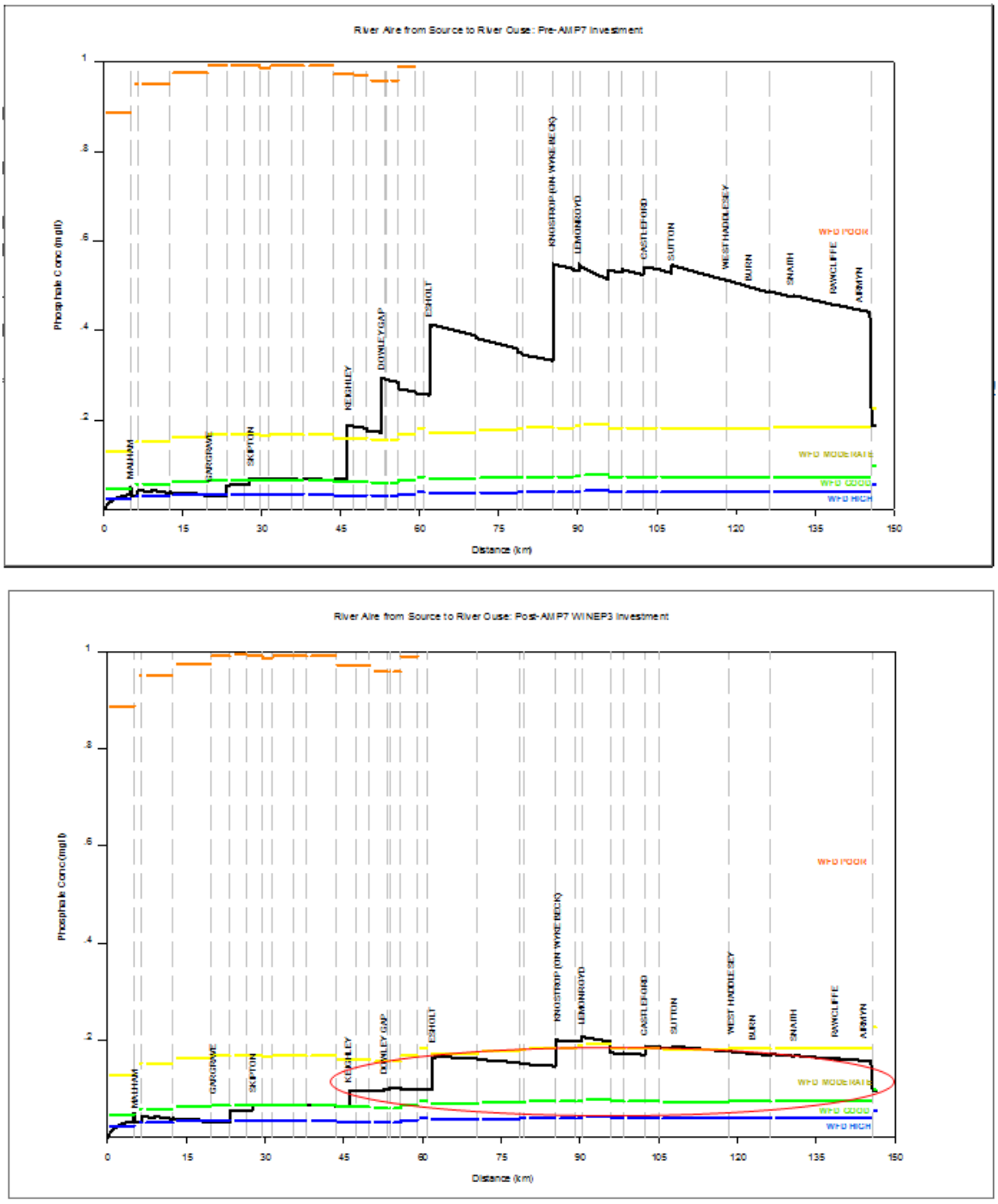


Figure 7.7: Comparison of phosphorous concentrations in the River Aire pre- and post- WFD and UWWTD investment

The River downstream of Keighley to the confluence with the River Ouse is moves from poor status to borderline moderate status.

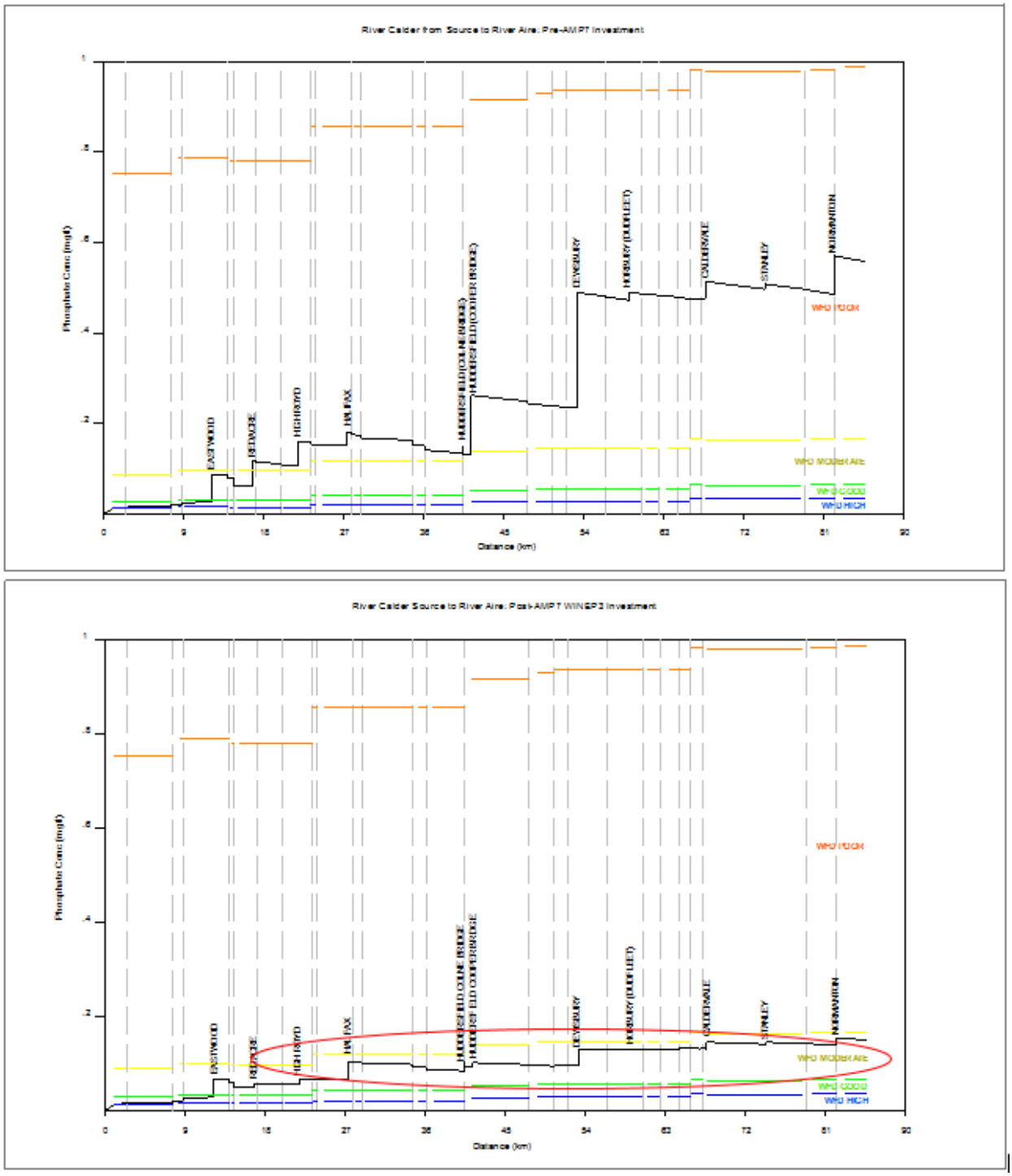


Figure 7.8: Comparison of phosphorous concentrations in the River Calder pre- and post- WFD and UWWTD investment

As a result of investment, the Calder improves largley to moderate status.

Figure 7.9: Don Rother management catchment and locations of investment identified in WINEP

The River Don shown in figure 7.9 is in general WFD poor ecological status for phosphorus. This is due to the large urban population that discharges into it from the source to the confluence with the Ouse. The technical limit in 2015-20 (0.5 mg/l) did not improve water quality and schemes did not pass the cost-benefit analysis test. Following UK WaSC phosphorus trials in AMP6, the technical limit was reduced to 0.25 mg/l from 2020-25. As such, investment has been identified in the Don catchment.

Following the 2020-25 period, approximately 30km will be improved from Cheesebottom to Blackburn Meadows from poor to moderate WFD ecological status. Even with the tighter

technical limit the Don cannot achieve good ecological status, and from Blackburn Meadows to the confluence with the Ouse, the river remains at poor.

The tighter technical limit does not allow the Don to achieve good status, and from Blackburn Meadows to the confluence with the Ouse, the river remains at poor.

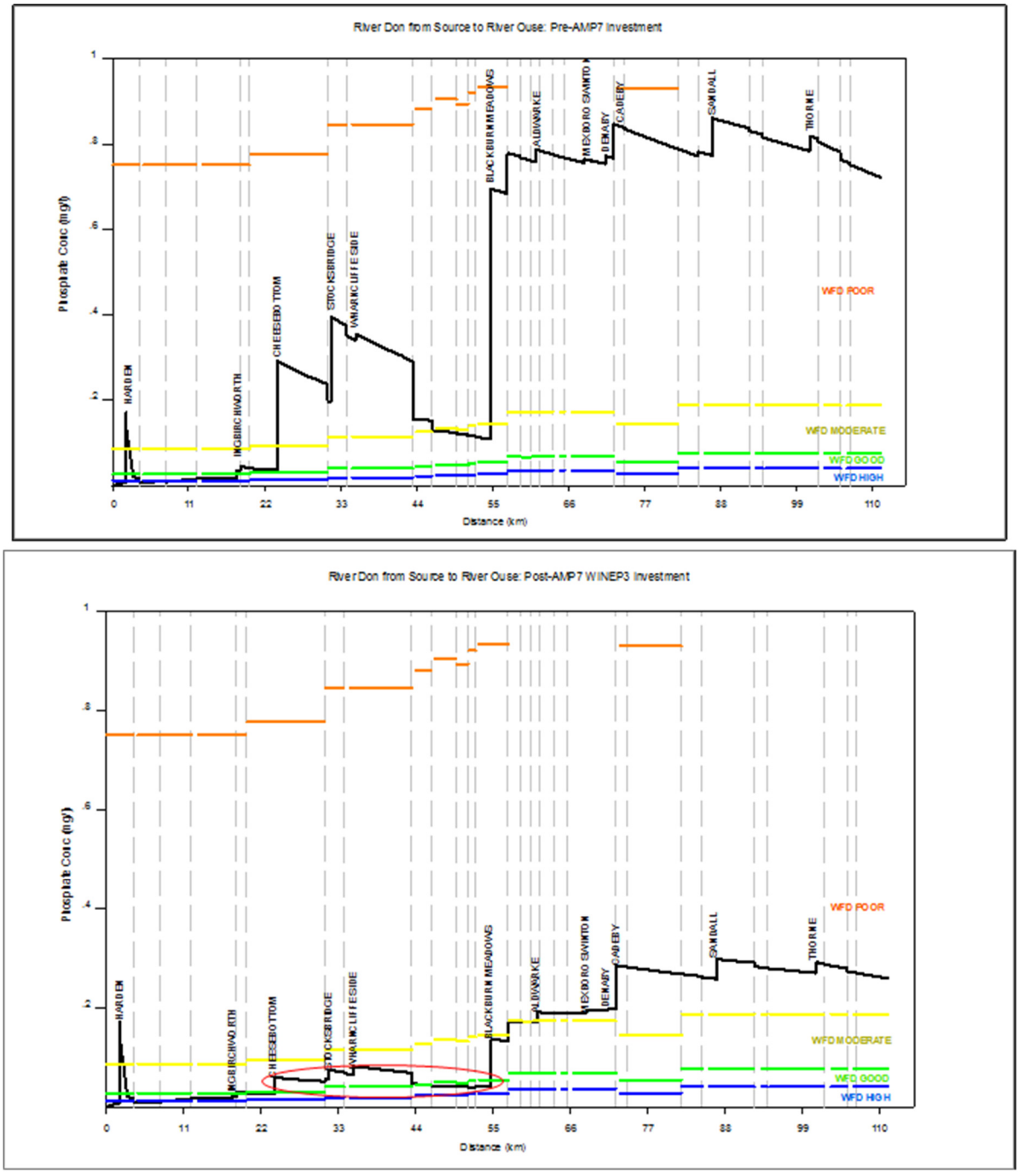


Figure 7.10 : River comparison of phosphorous concentrations pre- and post- WFD and UWWTD investment

Prior to AMP7, the upper reaches of the Rother are bad WFD ecological status for phosphorus until confluences with Rivers Hipper, Drone and Spittal Beck, which bring additional dilution into the waterbody. The Rother from Old Whittington to the confluence with the Don is poor WFD ecological status as shown in figure 7.11.

Post-AMP7: Investment at Danesmoor, Tupton and Dronfield improve the upper reaches of the Rother from bad to poor WFD ecological status. Investment at Old Whittington, Stockley, Bolsover, Staveley, Woodhouse Mill and Long Lane WwTWs retain poor ecological status.as shown in figure 7.11.

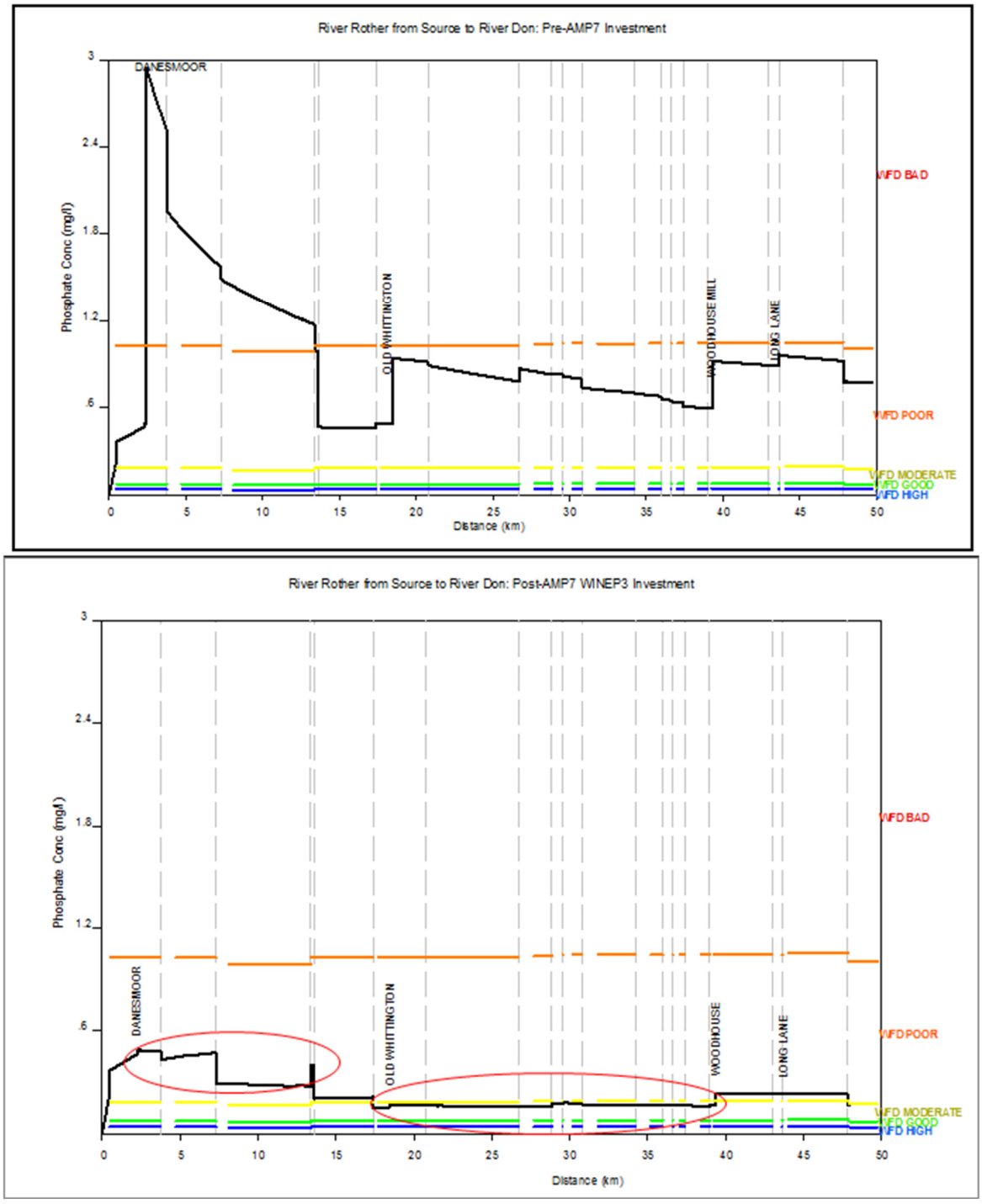


Figure 7.11: River Rother comparison of phosphorous concentrations in the River Rother pre- and post- WFD and UWWTD investment

Prior to AMP7 Dearne is poor WFD ecological status from Clayton West to Lundwood, where the in-river concentration deteriorates to bad WFD ecological status downstream to the confluence with the Don.

AMP7 investment has been identified for Clayton West, Hoylandswaine and Grimethorpe WwTWs in the Dearne catchment. The Clayton West investment retains the poor WFD ecological status, whilst the downstream section, improves with additional dilution from the catchment to borderline poor/moderate WFD ecological status. Darton to Lundwood remains poor WFD status. Whilst Lundwood to the confluence with the Don improves from bad to poor WFD ecological status.

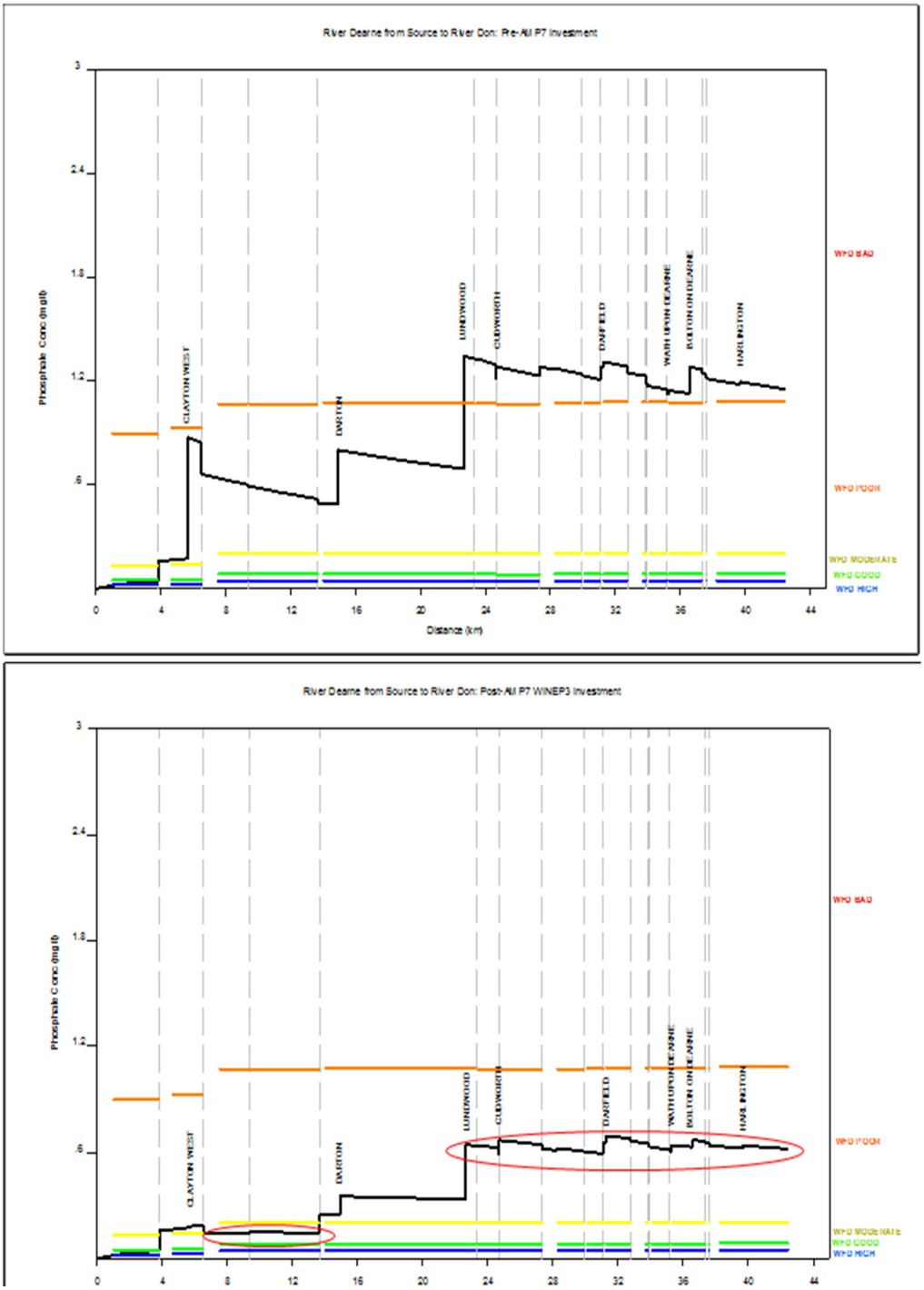


Figure 7.12 : River Dearne comparison of phosphorous concentrations in the River Dearne pre- and post- WFD and UWWTD investment

Interventions

The interventions for this measure all consist of the modification of existing biological processes and installation of tertiary treatment processes, where appropriate and assessed on a site by site basis. The basic blue print for P removal is chemical dosing and tertiatry solids capture. In a small number of cases, we propose either a biological process for p removal or to transfer the discharge. These approaches are detailed in full in section 8.

See appendix 1 for a full list of obligations in this measure.

Intervention costing

See section 8 for approach to treatment costing and quality assurance.

7.5 Water Framework Directive – Improvements in ammonia to moderate and good ecological status

WINEP 3 Measure Codes	WFD_IMP M, WFD_IMP G
WINEP3 measure summary	Schemes identified to deliver ammonia removal at WwTWs to achieve WFD moderate and good in the receiving waterbody. All schemes are assessed at the point of mixing. We have run the identified schemes through the nationally agreed SAGIS water quality model to produce the length of river improved in accordance with our method. These schemes were subject to cost-benefit assessment.
Total No.	3
Totex Cost (£m)	4.781

Summary

The Environment Agency has identified WwTWs that require ammonia removal to achieve good or moderate ecological status under the WFD.

Legislative drivers

The Water Framework Directive is the key legislation for protecting and improving the water environment. It seeks to achieve “Good Ecological Status” wherever possible in watercourses, subject to a set of feasibility and cost tests. It functions as three sets of six-

year planning cycles: River Basin Management Plans. We will enter the third cycle at the beginning of 2022.

Hazard identification and risk characterisation

The accepted national approach to identify investment is SIMCAT-SAGIS, a water quality modelling tool developed by the UK water industry in collaboration with the Agency to review WwTW impact on receiving waterbodies and plan investment in line with WFD objectives. There is a nationally accepted technical limit for ammonia removal that can be achieved: 3.0 mg/l.

The SIMCAT-SAGIS models were calibrated for the period 2010-12 by the Environment Agency. Sampled data is, generally, only collected by water companies at WwTWs where there is existing ammonia treatment. We currently have many WwTWs with ammonia treatment and the data from these WwTWs has been included in the 2010-12 baseline model calibration, where applicable. Investment post-2012 to March 2020 (end of AMP6) was incorporated into the model prior to AMP7 investment being identified.

The Environment Agency PR19 approach to identify ammonia investment under WFD was based on full permit limit to achieve waterbody specific WFD targets at the point of mixing. All outputs identified went forward for cost-benefit analysis. Only improvements that were both technically feasible and cost-beneficial were promoted for investment. The Environment Agency analysis was not repeated with the resuting technically feasible and cost-beneficial schemes to confirm the predicted WFD classifications

On receipt of WINEP from the EA, we put the regulatory obligations into the SIMCAT-SAGIS model. These results have been used to calculate the length of river improved performance commitments based solely on the obligations that achieved cost-benefit analysis for WFD drivers. Therefore our predictions differ to those of the Environment Agency.

Interventions

Interventions in this section include the modifcation and increased capacity of biological processes to meet the new requirements.

For a full list of interventions in this section are listed in Appendix 1.

Intervention costing

See section 8 for our approach to treatment costing and quality assurance.

7.6 Water Framework Directive – No deterioration

WINEP Measure code	WFD_ND
WINEP3 measure summary	Schemes identified to prevent the deterioration of waterbody status due to deterioration of works performance in relation to population growth with regards ammonia, biochemical oxygen demand and phosphorus.
Total no.	9
Cost (£m)	4.59

Summary

This part of the Water Framework Directive is concerned with safeguarding existing river water quality. This is distinct from other elements of the WFD, which are focused on improvements. The driver is specifically about preventing deterioration of receiving water quality that may have resulted under the first and second cycles of WFD River Basin Planning, up to 2021.

Legislative drivers

One the prime purposes of the Water Framework Directive (2000/60/EC) is the protection of receiving waters to prevent their deterioration, covered in Article 1 of the Directive. Section 2.1 of the WISER document sets out the Environment Agency and Natural England expectations under this driver. Detailed requirements are set out in the Environment Agency guidance. The associated Environment Agency driver reference is WFD_ND.

Hazard identification and risk characterisation

The Environment Agency's PR19 prevent deterioration in WFD status guidance sets out how requirements under this driver should be evaluated. The Environment Agency has identified sites under this driver based on whether deterioration in WFD class has been observed in the 2015 baseline year when compared to 2009. Any waterbody identified must receive investment to restore the waterbody back to the 2009 classification. Growth has also been assessed to understand where increase in flow and load to WwTWs may cause a

deterioration in WFD class. Certain or probable growth to 2021 and predicted certain growth to 2027 was assessed to understand the modelled impact on the receiving waterbody's classification. For sites where a permit concentration does not exist, discharge sample data was used by the Environment Agency. This in particular applies for phosphorus. In this case, the assessment only applies to the predicted increase in flows using available capacity at the waste water treatment works .
The process identified:

- 120 WFD_ND_Phosphorus.
- 90 WFD_ND_Ammonia.
- 49 WFD_ND_BOD.

In order to identify a robust list of WFD_ND schemes, water quality sample data was assessed to understand the risk of actual deterioration in WwTW performance. The serviceability data assessed sampled data over a five-year period 2010 to 2015, against half the current permit limit for the required parameter. This identified the risk of each WwTW nearing treatment capacity (headroom). Were the ratio is 0.4 or less, a scheme was included.

WwTW do not routinely remove phosphorus unless specific treatment is already provided. Where treatment was already provided, sampled data showed no deterioration in serviceability performance at these assets. At WwTW with no existing phosphorus removal, there is no deterioration in the treatment of the parameter, as there is no treatment.

In summary, following analysis and liaison with the Environment Agency, no prevent deterioration schemes for phosphorus have been put into WINEP. Five ammonia prevent deterioration schemes have been included in WINEP, and four for BOD.

At a number of sites, the prevent deterioration driver will require performance that is more stringent than the current technical limits for certain determinands. To address this, we will invest at those sites to achieve the current technical limits, but cannot guarantee performance beyond that. This approach has been agreed with the Environment Agency and is reflected in the WINEP limits.

When considering deterioration due to increases in Biological Oxygen Demand (BOD) loads, sites have only been taken forward under this driver if the increase in load was likely to lead to a deterioration in the dissolved oxygen status of the water body.

Intervention

Interventions in this section include the modifcation and increased capacity of biological processes to meet the new requirements. See Appendix 1 for the full list of schemes.

Intervention costing

See section 8 for approach to treatment costing and quality assurance.

8. Approach to treatment costing and quality assurance

8.1 Introduction

This section summarises our approach to costing and quality assurance of all our treatment intervention measures, including:

- UIMP1,2
- WFD_IMP M,G
- WFD_ND

A summary of the process is provided in Figure 8.1, followed by further detail and examples for each step. There is enhanced detail around P removal, as this accounts for >90% of our treatment cost in our business plan.

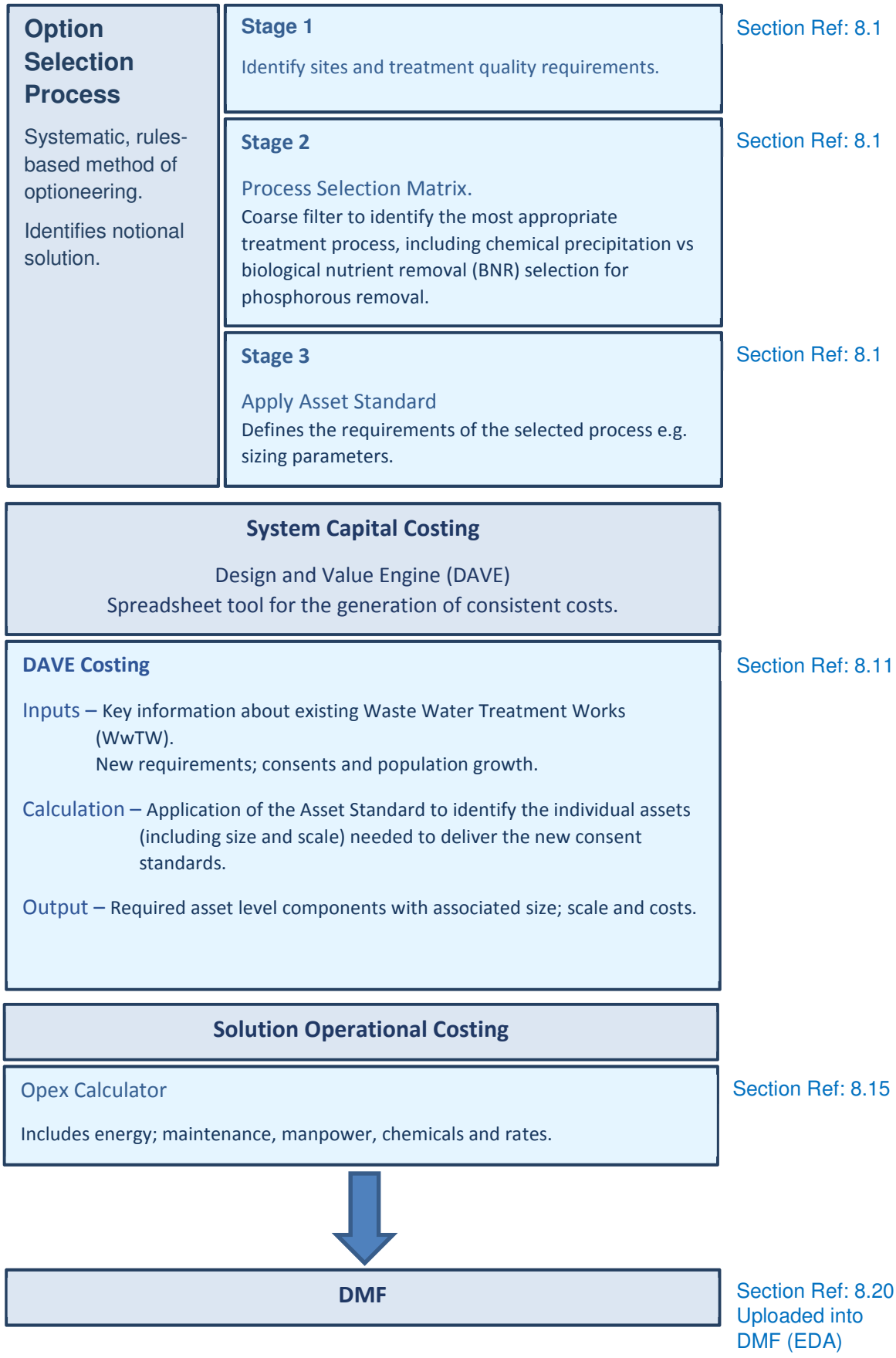


Figure 8.1: The Approach to Waste Water Treatment Costing

Option Selection Process

The first step is to to apply the Option Selection Process (OSP). This represents a systematic, rules-based method of optioneering, which identifies the notional solutions for inclusion in our Business Plan programme. The process is designed to ensure that the following objectives are met:

- Selection of the most appropriate technology to meet the objectives
- Technically feasible of the solution
- Solution meets Best Available Technology and can be delivered to meet the objectives efficiently
- The solution offers, where affordable, the best Whole Life Cost, thus minimising the cost to customers.

Stage 1 OSP

Stage 1 of the OSP is to obtain and list the locations and requirements of sites identified for investment in WINEP3.

Stage 2 OSP

Stage 2 is to apply the Process Section Matrix (PSM) for Treatment. This is based on our Asset Policy and Asset Standard principles and provides a coarse filter to identify the most appropriate treatment process. It ensures that the treatment process selected is robust, well understood, operable and maintainable. Our PSM assumes that we will retain the existing process on site where possible and enhance this process to achieve the required level of treatment. This ensures an efficient approach through maximisation of existing assets.

An example of our PSM for sites with existing biological filtration treatment is shown in table 8.1. The output from the PSM is a recommendation for changes or enhancements to the treatment process/es at each site. The full Process Selection Matrix is available on request.

	Population equivalent			
Effluent standard (95%ile)	<250	250-2000 Screens (to be considered for population equivalent > 1000 Primary tank	2000-10000 Screens > 5000 population equivalent grit removal Primary tank	> 10000 Screens Grit removal Primary tank
1mg/l P or 3mg/l Fe		2 point chemical dosing with 100% tertiary solids removal	2 point chemical dosing with 100% tertiary solids removal	2 point chemical dosing with 100% tertiary solids removal
Descriptive	**Existing**: Septic tank followed by	n/a	n/a	Na/

	trickling filter and humus tank **New works:** Package SAF			
≤10mg/l BOD	n/a	Tertiary solids removal process or side stream SAF or tertiary SAF with full tertiary solids removal or ASP with tertiary solids removal	Tertiary solids removal process or side stream SAF or tertiary SAF with full tertiary solids removal up to 5000 total PE or ASP with tertiary solids removal	Tertiary solids removal process or ASP with tertiary solids removal
11-20 mg/l BOD or < 20mg/l SS	n/a	Consider tertiary solids removal process or side stream SAF or tertiary SAD with full tertiary solids removal or ASP with tertiary solids removal	Consider tertiary solids removal process or side stream SAF or tertiary solids removal up to 5000 total PE or ASP with tertiary solids removal	Consider tertiary solids removal process or ASP with tertiary solids removal
20 mg/l BOD 3mg/l Amm	n/a	Tertiary nitrifying filters in ADF mode or tertiary SAF crude sewage oxidation ditch	Tertiary nitrifying filters in ADF mode or tertiary SAF crude sewage oxidation ditch up to 10000 PE or primary tanks and ASP	Tertiary nitrifying filters in ADF mode or primary tanks and ASP
20 mg/l BOD ≥ 5mg/l Amm	Additional trickling filter capacity (mineral media only) Primary tanks and SAF RBC shaft replacement (only on existing)	Additional trickling filter capacity (mineral media only) Primary tanks and SAF RBC shaft replacement (only on existing)	Additional trickling filter capacity	Additional trickling filter capacity

Table 8.1: Extract from the Process Selection Matrix for WwTW sites with existing Biological Filtration Plant.

OSP Stage 3: Asset Standard Principles

Following the identification of the most suitable process to deliver the required consent via the PSM, the next stage is to apply the appropriate Asset Standards - there is an Asset Standard documented for every process identified within the PSM. A check is also carried out to ensure that the selected process improvements are appropriate.

The Asset Standard dictates how the required process should be built, sized, and how any constraints should be handled to ensure operability; maintainability and saftey. Our Asset Standards are working documents and are subject to on-going review as new technologies emerge.

8.2 Phosphorous removal – Chemical Precipitation

Building on the sections above we provide further detail on how interventions for P removal are selected and costed. Using the principles above we discuss in this section how we approach our interventions, which account for over 90% of the treatment costs in our plan.

We have developed an asset standard for P removal which is based on the Synthesis Report produced from the UKWIR National Phosphorous trials work that was coordinated by Atkins in early AMP6. The report identified a series of assets considered to be a minimum requirement for P removal through Chemical Precipitation. These were:

- Chemical Dosing of Ferric Sulphate or Chloride in the primary sludge and secondary sludge (2 stages being applied where the P consent was below 1 mg/l.)
- Tertiary Solids Capture Unit – to capture the precipitated P in a tertiary stage which is then removed into the sludge and taken away for treatment in the Bio Resources business
- Alkalinity dosing - requirement to dose Caustic Soda to adjust the pH to a level that is suitable for effective precipitation of P in geographic areas where the water is soft and acidic.
- Instrumentation –Instrumentation for monitoring and control throughout the process:
    - Primary Stage Dosing only (Stage 1 dosing)
        - Ortho-phosphate (Ortho-P) monitor at the crude wastewater inlet point (to include returns) - the requirement for this monitor to be confirmed for each scheme
        - Turbidity monitor on the final effluent
        - pH monitor following ferric addition if required for alkalinity monitoring and control
    - Primary and Secondary stage dosing (Stage 1 & 2 dosing)
      Upstream of chemical addition and solids capture
        - Orthophosphate monitor
        - pH monitor following ferric dosing
        - Turbidity monitor
    - Downstream of chemical addition and solids capture
        - Total Phosphate monitor
        - pH monitor
        - Total Iron monitor
        - Turbidity monitor

8.3 Additional Assets

There are a range of additional assets that may be required to support delivery of P removal. These are either associated with current assets no longer considered 'fit for purpose' in the wider process chain and / or with projected population growth.

Additional asset requirements typically including large civils assets associated with primary and secondary sludge settlement, with associated high costs. However, as per RAG (see section below on Cost Apportionment) we would attribute all these costs to either capital maintenance (where we are replacing capacity) or growth where specifically driven by projected population changes i.e. not quality.

The core components of our Chemical Precipitation Asset Standard are shown in Table 8.2, showing, for clarity, how the investment purpose areas are coded. Note that different assessments are made depending on whether the standard is <1mg/l or >= 1mg/l.

Area	<1mg/l	=> 1mg/l	IC allocation (Base, Quality, Growth)
Chem Dosing	2 stages	1 stage	Q
Final Settlement	include	Exclude (unless driven by growth)	B / G
Scraped Radial Primary and Final Sludge Tanks	Include	Assessment	B / G
Alkalinity dosing	Include	Geographic assessment	Q
Tertiary Solids Capture	Include	Site assessment	Q
Instrumentation	Include	Site assessment	Q

Table 8.2 shows the key components of Chemical Precipitation Asset Standard, assessments made and investment purpose area coding.

8.4 Phosphorous Removal: Biological Nutrient Removal

Biological Nutrient Removal (BNR) is a process whereby P is absorbed biologically, under optimised aerated and non-aerated conditions. This enables both removal of P from the effluent discharged to the receiving watercourse and recovery from sludges. The process uses significantly less chemical to precipitate out the P, although there is a requirement for final polishing, operation in cold conditions or where low consents apply.

The overall operational costs and risks (for example associated with supply chain and chemical storage) are lower for BNR than for chemical precipitation, but construction costs tend to be higher. Therefore, assessing the impact on customer bills and the cost over a 40-year NPC period is key.

We determine if BNR is applicable on a site by site basis using 3 criteria;

1. Is there an existing ASP process ready to convert (because converting a biological filter plant to ASP and then to BNR would not be affordable / economic)?
2. Does the BNR have a better Whole Life Cost (NPC discount over 40 years)
3. Is the construction of BNR affordable within the 5-year period (in comparison to chemical precipitation)?

Our BNR process is based on a Blue Print provided by our construction partner which is outlined in Figure 8.2 and comprises of the following key features:

- Primary sludge fermenter and thickener to augment incoming sewage
- Modifications to the existing ASP to convert to BNR through additional baffles, mixers, recirculation pumps and pipework and aeration system modifications
- Additional ASP lanes and/or FSTs to provide additional capacity
- If necessary, tertiary solids capture through use of a sand filter complete with lift/feed pumping station
- If necessary ferric dosing and mixing tank
- Associated instrumentation and control software for the operation of the above items

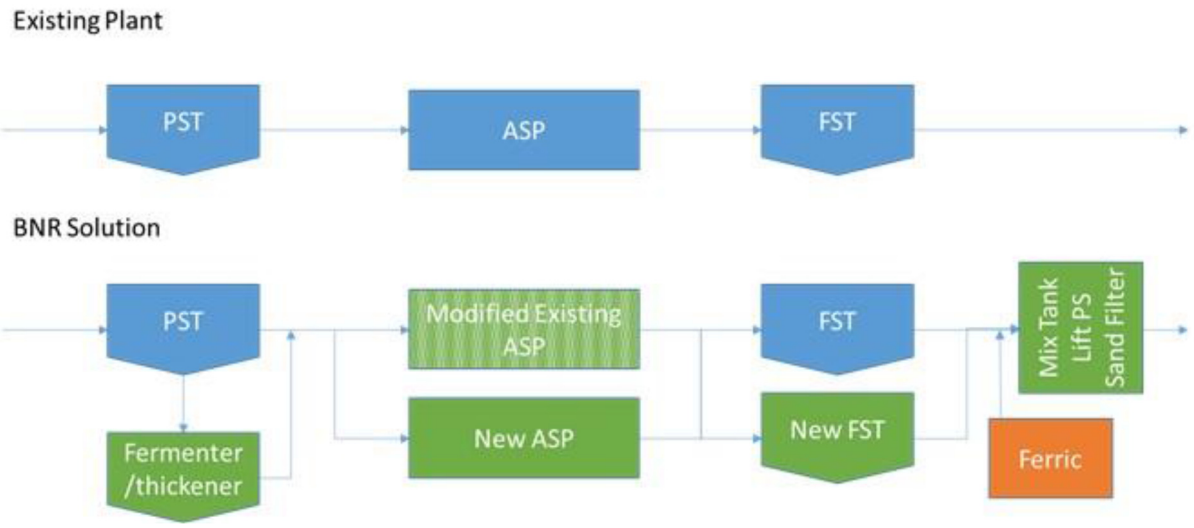


Figure 8.2 : BNR Blueprint Configuration

8.5 Primary Sludge Fermenter

Fermentation of the primary sludge is key to achieve the production of Volatile Fatty Acids (VFAs) needed for the removal of phosphorus. Sludge from the primary clarifiers is pumped to the fermenters (large enclosed tanks with a rotating stirring mechanism) where volatile fatty acids (VFAs) are produced. The VFA-rich liquid from the fermenter is pumped to the BNR bioreactor, where phosphorus removal occurs. After fermentation, the residual sludge and scum, is pumped to the sludge digesters for digestion. Foul air formed in the headspace of the fermenters is extracted through a blower and bubbled up through the bioreactors for odour scrubbing.

8.6 BNR Bioreactor

BNR conversion is planned to be carried out in the A_2O (Anaerobic-Anoxic- Oxic) configuration as shown in Figure 8.3). The proposed outline sizing is based on achieving a 21 days total sludge age, with an aerobic sldge age of 14 days to ensure full nitrification is maintained during cold weather. The hydraulic retention times of 1 hour for the anaerobic zone, 2 hours for the anoxic zone and 6 hours for the aerobic zone have been used to apportion the ASP volume. It is noted that the sludge age is the limiting design criterion.

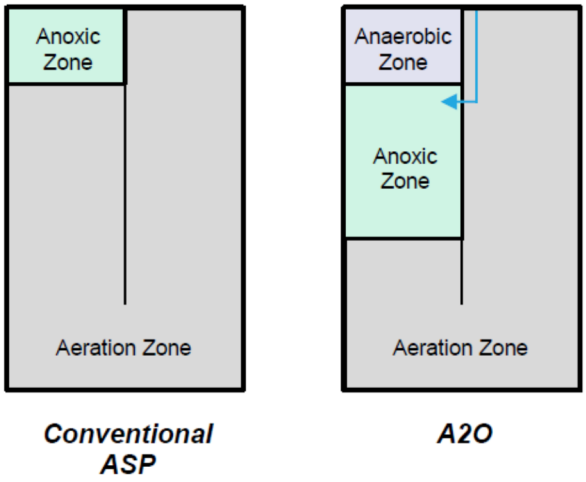


Figure 8.3: Show the creation of Anoxic zones within existing ASP

The existing anoxic zone will be reconfigured to operate as an anaerobic zone and additional anoxic volume will be created through the addition of three baffle walls per lane to create the anoxic and anaerobic zones required, and to ensure a serpentine flow within them. Additional mixing will be required within the anaerobic and anoxic zones whilst the diffusers will need to be re-tapered within the aeration zone.

Flows at the back end of the aeration zone will be returned to the front end of the anoxic zone by pumps and dedicated pipework. The geometry of the lanes (U shaped or straight) determines the requirement for internal recirculation pipework.

For the BNR process the sludge age in the ASP will need to be increased to enable sufficient process capacity to ensure phosphorus removal. This can be achieved by either:

- Increasing the overall volume and maintaining the mixed liquor concentration by adding new ASP lanes
- Increasing the mixed liquor concentration and adding new final settling tanks to match the increased solids loading in the ASP outlet

The preferred solution is to increase the volume of the ASP, to limit the increases in solids loading to the final settlement tanks (FST), ensuring an economical FST design and lower effluent solids with associated phosphorus load.

8.7 Tertiary Solids Capture Unit

Where the Phosphorus limit in the final effluent is below 1 mg/litre an additional solids removal process is required to ensure compliance with the effluent P standard. This is

used in both of the technologies we have costed. In most cases filtration through a sand filter will remove any residual solids containing Phosphorus, enabling tight P limits to be met consistently.

The Tertiary Solids Removal process is calculated based on the flow to full treatment in order to size the feed pumps in Kw, this determines the size of the pumping station required and the capacity of the wet well. The capital costs of the pumping station are calculated based on the total capacity of the pumps (Duty/Assist/Standby) in Kw. The cost of the pumping station is calculated using Unit Cost Database Models for pumping stations and wet wells. Costs include the civil costs of the pumping station, all pumps, access metalwork, access road, interconnecting pipework and instrumentation.

The size of sand filter required is calculated based on an upflow rate of 8 m/h at the maximum flowrate through the plant. This determines the area of sand filter required to treat the FFT in m3/d. The costs of the sand filter are calculated using a Unit Cost Database Model for sand filters. The capital costs include for the civil structure, media, air scour blowers, instrumentation and all other associated M&E items.

Tertiary sand filters normally require backwashing of the media to restore its capacity and to remove accumulated solids. This requires a set of Backwashing pumps to flush
out the solids from the filters and return the backwash water for settlement in the treatment plant,
upstream of the secondary treatment process. Costs include for Duty/Standby backwash pumps,
clean and dirty wet wells, instrumentation and other associated controls.

8.8 Chemical Dosing for process optimisation and operations in abnormal conditions

In order to remove any residual P from the effluent prior to discharge a chemical dosing facility is specified to be dosed into the feed to the sand filter to aid P removal in the filtration process. The ferric dosing equipment is sized in relation the flow to be dosed in m3/day using a Unit Cost Database Model for Ferric Dosing equipment. Storage Tanks for bulk chemicals are included in this cost model along with the necessary dosing pumps and delivery lines. Instrumentation is required to measure and control the amount of Ferric dosed into the flow and to monitor and control the pH (this is shown in Table 8.3).

Monitoring instrumentation	Unit	Description
Ferric dosing system	Flow to be dosed (m^3/d)	Including duty/standby dosing pumps, implementation and other items.
Ferric storage tank	m^3	Including loading points, instrumentation, and other items
Ferric mixing chamber	m^3	Including weirs, handrailing, decking and any integral pipework and fittings
Ferric rapid mixer	kW	Include any metalwork as required as part of installation and integration into existing
pH monitor	No	Instrumental, mechanical and electrical installation and integration into existing where applicable
Ferric monitor	No	Instrumental, mechanical and electrical installation and integration into existing where applicable
Turbidity monitor	No	Instrumental, mechanical and electrical installation and integration into existing where applicable

Table 8.3: Monitoring instrumentation in the phosphorus removal standard

8.9 Whole Life Cost Assessment for P removal – Chemical vs Biological

There are 80 sites in WINEP that have a new P removal requirement. For P removal, we have evaluated:

- Chemical Dosing and Tertiary Solids removal using Mecana media or Sand – this approach is applicable at most sites
- Biological Nutrient Removal – using and changing the configuration of existing Activated Sludge processes and fermenting the primary sludge
- Transferring the discharge downstream to mitigate the need for P removal in a specific location

The process below describes the NPC analysis undertaken between options for chemical precipitation and BNR but limited to where BNR was a candidate option using the criteria set out in the BNR section 8.3. Our initial assessment using the criteria was therefore undertaken against 18 candidate sites as shown in Table 8.4.

The methodology assumes that a periodic replacement capex is incurred every 15 years and is 40% of the value (£) of capex. Replacement capex is annuitised over a 40-year period using an annuity rate of 2.4% (the weighted average cost of capital). This reflects how much the company will pay back per year if it borrows money over 40 years at the borrowing cost of 2.4%, and the 40 years reflects the assumed asset life. The total present value of replacement capex is the discounted sum of the annuitised replacement capex over the rest of the 40-year analysis period, using the HM Treasury Green Book discount rate of 3.5% for the first 30 years, dropping to 3% for the next 10 years. Table 8.4 shows the initial results.

Site	WLC BNR /Chem Precipitation ratio	BNR selected
Aldwarke	85%	Y
Blackburn	94%	Y
Bradford	120%	N
Calder Vale	59%	Y
Castleford	96%	Y
Dewsbury	139%	N
Dronfield	89%	Y
Halifax	74%	Y
Harrogate South	107%	N
Knostrop	92%	Y
Lemonroyd	76%	Y
Lundwood	180%	N
Neiley	92%	Y
Old Whittington	193%	N
Sandall	87%	Y
South Elmsall	72%	Y
Woodhouse	65%	Y
Huddersfield	113%	N

Figure 8.4: WLC analysis of BNR vs Chemical Precipiation

The initial assessment shows that, of the 18 sites assessed, 12 sites are favourable for BNR (ie those with a column 2 value below 100%). However, we then undertook an affordability analysis for our customers within the 5 year period, (as opposed to the 40 year cost impact assessed in the step above). This criteria changes the outcome of the analysis, as shown in Table 8.5.

Site	WLC BNR/Chem Dosing %	BNR selected in WLC	Min Capex Process Choice	Min capex agrees with WLC
Aldwarke	85%	Y	BNR	Y
Blackburn	94%	Y	Chem	N
Bradford	120%	N	Chem	N
Calder Vale	59%	Y	BNR	Y
Castleford	96%	Y	Chem	N
Dewsbury	139%	N	Chem	N
Dronfield	89%	Y	BNR	Y
Halifax	74%	Y	Chem	N
Harrogate South	107%	N	Chem	N
Knostrop	92%	Y	Chem	N
Lemonroyd	76%	Y	Chem	N
Lundwood	180%	N	Chem	N
Neiley	92%	Y	BNR	Y
Old Whittington	193%	N	Chem	N
Sandall	87%	Y	BNR	Y
South Elmsall	72%	Y	BNR	Y
Woodhouse	65%	Y	BNR	Y
Huddersfield	113%	N	Chem	N

Figure 8.5: WLC analysis of BNR vs Chemical Precipitation with affordability

When the 5-year affordability analysis is complete, there are now 7 sites where BNR is applicable. With the remainder reverting to Chemical Precipitation. We believe this decision will reduce the cost of delivery by over £150m in the AMP7 plan with a resultant minimisation of bill impacts. We have therefore included 7 number BNR solutions in the Final Business Plan submission, with 3 transfer discharges (described in section 8.10) and the remaining 70 number being P removal through chemical precipitation.

It should be noted that whilst capex has been minimised in the 5 year period, the level of opex required to service the new treatment consents is very high from the point of full compliance. The values and risks around this are discussed in more detail below.

8.10 P removal – transfer discharge

Consideration has been given to site factors including size, configuration and proximety to nearby WwTWs. This has identified some opportunities to decommission smaller sites and transfer the flow to a nearby larger / newer WwTWs. We propose 3 such examples in our plan. These are summarised in Table 8.6, along with an overall cost savings, which are calculated against the notional cost of standard interventions proposed through application of the Option Selection Process. The lowest whole life cost solution was then identified for inclusion in the Business Plan.

Site	Transfer into	Cost saving (£m)
Bishop Wilton	Pockilington	1.7
Kirk Smeaton	Norton	3.1
Ingbirchworth	Cheesebottom	0.5
Total		5.3

Figure 8.6: Proposed discharge transfers

8.11 Solution Capital Costing

Once the design and optionerring has been completed, the next key step in our intervention and costing process is to cost the new solution through our Design and Value Engine (DAVE). This is an established part of our strategic planning capability and has been in use for over 10 years, recently revised to deal with P removal and used for all P consents. It was first constructed for use in planning for the Urban Waste Water Treatment Directive and Freshwater Fisheries Directive solutions in AMP4. Since then it has been regularly revised and updated and has been critically reviewed. It is a spreadsheet tool, considered to be amongst the best in the industry for generating consistent costs.

The Solution Costing Tool is applied by a technical specialist and has three key components:

- Inputs - relating to the existing works and required capabilities.
- Calculations and logic pathways.

- Outputs – individual asset elements.

The following description includes screenshots to illustrate the level of detail we have considered in developing the most appropriate solutions for each requirement.

8.12 Inputs

The key inputs comprise information about the existing WwTWs; the relevant consent values, flow parameters and population equivalent. These inputs establish the 'as is' position. This data is supplemented with information on the new requirements at the site i.e. new consents, predicted growth in population, or other pressures in the future. Figure 8.4 provides an example partial view of the input sheet for Bentley WwTW.

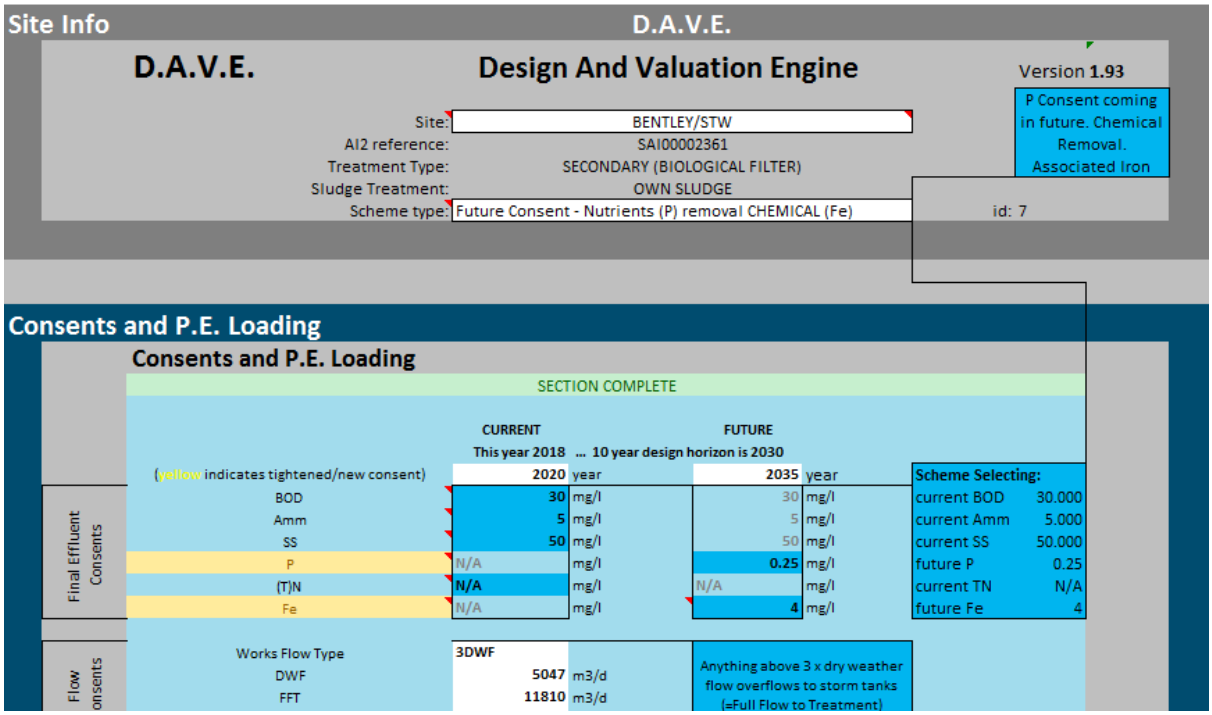


Figure 8.4: Partial screenshot of the Solution Costing Tool input sheet for Bentley STW.

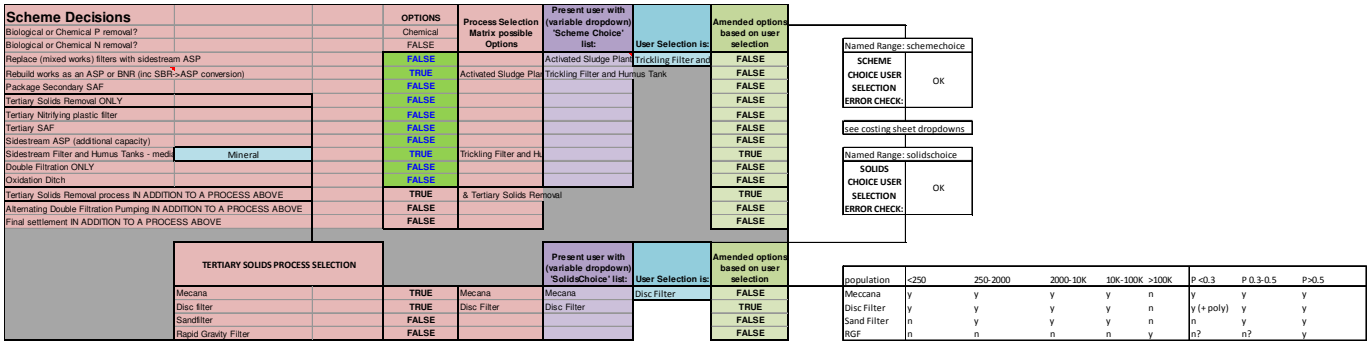
8.13 Calculation

The spreadsheet contains built in logic that applies the Asset Standard for a specific parameter. This identifies the individual assets needed to deliver the new consent level as well as calculating the required size and scale of these assets. It identifies the major civils, mechanical and electrical assets required together with ancillary assets such as instrumentation and SCADA. Application of the Asset Standard in this way ensures that the requirements are met and there is consistency between one solution and another.

8.14 Outputs

Based on the input values, the Solution Costing Tool generates an output which describes the recommended process to use and breaks down the asset level components required to solution element level, with associated size, scale and estimated costs. These solution elements have associated Unit Cost Model References which we can use to replicate the notional solution and its estimated costs in our corporate risk system (EDA).

Figure 8.5 and figure 8.6 show screen shots of the outputs from the Solution Costing Tool for the required enhancements at Bentley WwTW.



Scheme Decisions		OPTIONS	Process Selection Matrix possible Options	Present user with (variable dropdown) 'Scheme Choice' list:	User Selection is:	Amended options based on user selection
Biological or Chemical P removal?		Chemical				
Biological or Chemical N removal?		FALSE				
Replace (mixed works) filters with sidestream ASP		FALSE		Activated Sludge Plant	Trickling Filter and	FALSE
Rebuild works as an ASP or BNR (inc SBR->ASP conversion)		TRUE	Activated Sludge Pla	Trickling Filter and Humus Tank		FALSE
Package Secondary SAF		FALSE				FALSE
Tertiary Solids Removal ONLY		FALSE				FALSE
Tertiary Nitrifying plastic filter		FALSE				FALSE
Tertiary SAF		FALSE				FALSE
Sidestream ASP (additional capacity)		FALSE				FALSE
Sidestream Filter and Humus Tanks - medi	Mineral	TRUE	Trickling Filter and Hu			TRUE
Double Filtration ONLY		FALSE				FALSE
Oxidation Ditch		FALSE				FALSE
Tertiary Solids Removal process IN ADDITION TO A PROCESS ABOVE		TRUE	& Tertiary Solids Removal			TRUE
Alternating Double Filtration Pumping IN ADDITION TO A PROCESS ABOVE		FALSE				FALSE
Final settlement IN ADDITION TO A PROCESS ABOVE		FALSE				FALSE

Named Range: schemechoice — SCHEME CHOICE USER SELECTION ERROR CHECK: OK

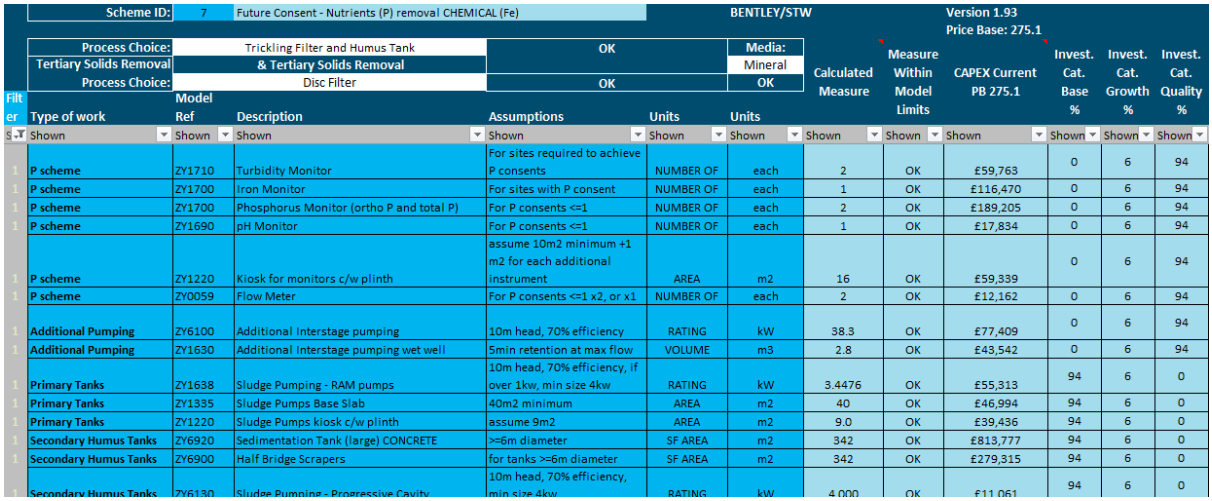
see costing sheet dropdowns

Named Range: solidschoice — SOLIDS CHOICE USER SELECTION ERROR CHECK: OK

TERTIARY SOLIDS PROCESS SELECTION			Present user with (variable dropdown) 'SolidsChoice' list:	User Selection is:	Amended options based on user selection
Mecana	TRUE	Mecana	Mecana	Disc Filter	FALSE
Disc filter	TRUE	Disc Filter	Disc Filter		TRUE
Sandfilter	FALSE				FALSE
Rapid Gravity Filter	FALSE				FALSE

population	<250	250-2000	2000-10K	10K-100K	>100K	P <0.3	P 0.3-0.5	P>0.5
Meccana	y	y	y	y	n	y	y	y
Disc Filter	y	y	y	y	n	y (+ poly)	y	y
Sand Filter	n	y	y	y	n	n	y	y
RGF	n	n	n	n	y	n?	n?	y

Figure 8.5: Screenshot of the Solution Costing Tool for Bentley STW showing the selected process.



Scheme ID:	7	Future Consent - Nutrients (P) removal CHEMICAL (Fe)		BENTLEY/STW		Version 1.93 Price Base: 275.1					
Process Choice:		Trickling Filter and Humus Tank		OK		Media:					
Tertiary Solids Removal		& Tertiary Solids Removal				Mineral					
Process Choice:		Disc Filter		OK		OK					
Filter	Type of work	Model Ref	Description	Assumptions	Units	Units	Calculated Measure	Measure Within Model Limits	CAPEX Current PB 275.1	Invest. Cat. Base %	Invest. Cat. Growth %	Invest. Cat. Quality %
1	P scheme	ZY1710	Turbidity Monitor	For sites required to achieve P consents	NUMBER OF	each	2	OK	£59,763	0	6	94
1	P scheme	ZY1700	Iron Monitor	For sites with P consent	NUMBER OF	each	1	OK	£116,470	0	6	94
1	P scheme	ZY1700	Phosphorus Monitor (ortho P and total P)	For P consents <=1	NUMBER OF	each	2	OK	£189,205	0	6	94
1	P scheme	ZY1690	pH Monitor	For P consents <=1	NUMBER OF	each	1	OK	£17,834	0	6	94
1	P scheme	ZY1220	Kiosk for monitors c/w plinth	assume 10m2 minimum +1 m2 for each additional instrument	AREA	m2	16	OK	£59,339	0	6	94
1	P scheme	ZY0059	Flow Meter	For P consents <=1 x2, or x1	NUMBER OF	each	2	OK	£12,162	0	6	94
1	Additional Pumping	ZY6100	Additional Interstage pumping	10m head, 70% efficiency	RATING	kW	38.3	OK	£77,409	0	6	94
1	Additional Pumping	ZY1630	Additional Interstage pumping wet well	5min retention at max flow	VOLUME	m3	2.8	OK	£43,542	0	6	94
1	Primary Tanks	ZY1638	Sludge Pumping - RAM pumps	10m head, 70% efficiency, if over 1kw, min size 4kw	RATING	kW	3.4476	OK	£55,313	94	6	0
1	Primary Tanks	ZY1335	Sludge Pumps Base Slab	40m2 minimum	AREA	m2	40	OK	£46,994	94	6	0
1	Primary Tanks	ZY1220	Sludge Pumps kiosk c/w plinth	assume 9m2	AREA	m2	9.0	OK	£39,436	94	6	0
1	Secondary Humus Tanks	ZY6920	Sedimentation Tank (large) CONCRETE	>=6m diameter	SF AREA	m2	342	OK	£813,777	94	6	0
1	Secondary Humus Tanks	ZY6900	Half Bridge Scrapers	for tanks >=6m diameter	SF AREA	m2	342	OK	£279,315	94	6	0
1	Secondary Humus Tanks	ZY6130	Sludge Pumping - Progressive Cavity	10m head, 70% efficiency, min size 4kw	RATING	kW	4.000	OK	£11,061	94	6	0

Figure 8.6: Screenshot of the Solution Costing Tool for Bentley WwTW, showing some of the solution elements identified as being required.

Figure 8.6 shows how the Solution Costing Tool identifies the cost elements (displayed as 'Model Ref' and 'Description') required to implement the recommended solution. It provides the units and measure values which are used in costing to populate the solution costs in DMF.

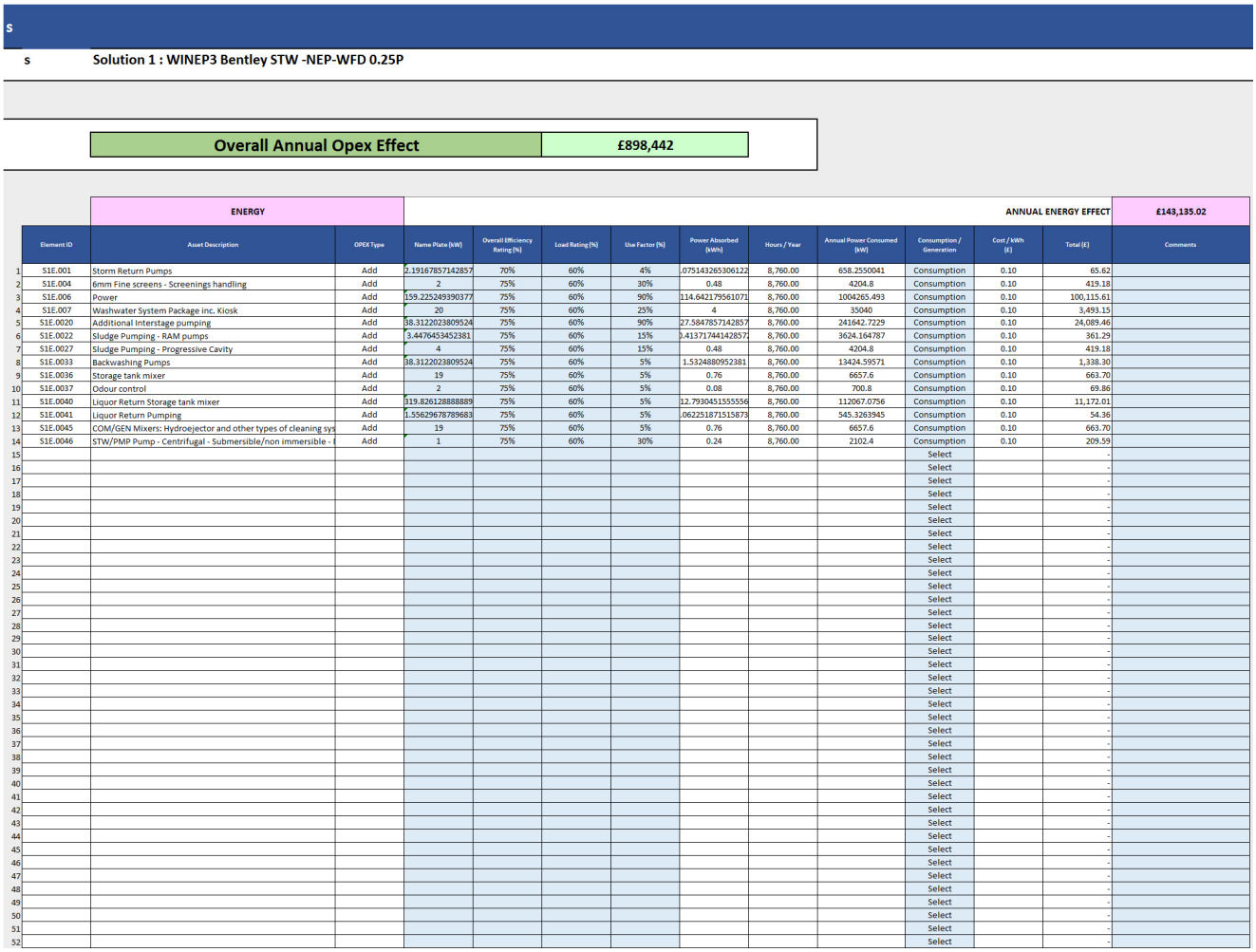
8.15 Operational Costs

Once capital costing has been completed, the new operating costs are calculated. This is done through our "opex costing tool". This is utilised in delivery of solutions in the current AMP to identify the best whole life cost solutions. It contains asset level models to assess the components that make up operational costs. The opex is calculated in the spreadsheet based costing tool a screenshot of which is in Figure 8.7 and shows the annual operating cost for Bentley WwTW.

When a solution is forecasted to deliver in a year we take half of the opex withoin that year and trhen the full year effect from the following year thereafter.

- Energy
  - Calculated from Nameplate KW rating* % Efficiency Rating*% Loading Rating* % usage rating to give number of KWh per year multiplied by unit cost for KWh

- Maintenance
  - Calculated as a fixed% of the Capital cost of each item of new equipment that requires Maintenance with different % rates depending on the type of maintenance required:
  - 2.44% for M&E equipment Maintenance
  - 16.66% for ICA Maintenance
  - 13.33% for Statutory Maintenance
- Manpower
  - Calculated as additional hours per year for an Operator at a fixed hourly rate depending on the skill level required
- Chemicals usage
  - Calculated as the annual quantity of chemical required to be dosed measured in tonnes multiplied by the unit cost for each chemical specified in £/Tonne. Yearly Tonnage is calculated from the product of Average Daily Flow multiplied by a dosing factor in Tonnes/m3 of sewage flow multiplied by 365 days.
- Rates. Calculated as follows:
  - Capital Cost of item at current COPI value/Q1 2008 COPI value*5%*0.492=Annual Rates charge



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s Solution 1 : WINEP3 Bentley STW -NEP-WFD 0.25P

Overall Annual Opex Effect	£898,442

ENERGY — ANNUAL ENERGY EFFECT £143,135.02

	Element ID	Asset Description	OPEX Type	Name Plate (kW)	Overall Efficiency Rating (%)	Load Rating (%)	Use Factor (%)	Power Absorbed (kWh)	Hours / Year	Annual Power Consumed (kW)	Consumption / Generation	Cost / kWh (£)	Total (£)	Comments
1	S1E.001	Storm Return Pumps	Add	2.19167857142857	70%	60%	4%	.075143265306122	8,760.00	658.2550041	Consumption	0.10	65.62	
2	S1E.004	6mm Fine screens - Screenings handling	Add	2	75%	60%	30%	0.48	8,760.00	4204.8	Consumption	0.10	419.18	
3	S1E.006	Power	Add	159.225249390377	75%	60%	90%	114.642179561071	8,760.00	1004265.493	Consumption	0.10	100,115.61	
4	S1E.007	Washwater System Package inc. Kiosk	Add	20	75%	60%	25%	4	8,760.00	35040	Consumption	0.10	3,493.15	
5	S1E.0020	Additional Interstage pumping	Add	38.3122023809524	75%	60%	90%	27.5847857142857	8,760.00	241642.7229	Consumption	0.10	24,089.46	
6	S1E.0022	Sludge Pumping - RAM pumps	Add	3.4476453452381	75%	60%	15%	0.41371744142857	8,760.00	3624.164787	Consumption	0.10	361.29	
7	S1E.0027	Sludge Pumping - Progressive Cavity	Add	4	75%	60%	15%	0.48	8,760.00	4204.8	Consumption	0.10	419.18	
8	S1E.0033	Backwashing Pumps	Add	38.3122023809524	75%	60%	5%	1.5324880952381	8,760.00	13424.59571	Consumption	0.10	1,338.30	
9	S1E.0036	Storage tank mixer	Add	19	75%	60%	5%	0.76	8,760.00	6657.6	Consumption	0.10	663.70	
10	S1E.0037	Odour control	Add	2	75%	60%	5%	0.08	8,760.00	700.8	Consumption	0.10	69.86	
11	S1E.0040	Liquor Return Storage tank mixer	Add	319.826128888889	75%	60%	5%	12.7930451555556	8,760.00	112067.0756	Consumption	0.10	11,172.01	
12	S1E.0041	Liquor Return Pumping	Add	1.55629678789683	75%	60%	5%	.062251871515873	8,760.00	545.3263945	Consumption	0.10	54.36	
13	S1E.0045	COM/GEN Mixers: Hydroejector and other types of cleaning sys	Add	19	75%	60%	5%	0.76	8,760.00	6657.6	Consumption	0.10	663.70	
14	S1E.0046	STW/PMP Pump - Centrifugal - Submersible/non immersible -	Add	1	75%	60%	30%	0.24	8,760.00	2102.4	Consumption	0.10	209.59	
15											Select		-	
16											Select		-	
17											Select		-	
18											Select		-	
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48											Select		-	
49											Select		-	
50											Select		-	
51											Select		-	
52											Select		-	

Figure 8.7: Screenshot of the Opex calculator used to establish Operational costs

8.16 Quality assurance

Following the generation of a preferred costed solution, validation of the output is undertaken in two ways.

- Firstly we validated the option selection process with a separate process engineer (who hadn't designed / costed the original scheme)
- Secondly we employed our engineering Strategic Planning Partner, Stantec for capex and T&T for opex to perform some additional quality assurance.

The primary purpose of the process engineer review was to ensure that the PSM and asset standard have been correctly applied, and that the notional solution is suitable and is the best option.

8.17 Validating the Option Selection Process

A summary of options is shown and then some examples are provided to illustrate the process. These examples are for illustration only and are not a representation of final quality assured costs.

Level 1

- Removal through chemical precipitation
- Removal through biological processes
- Transfer the discharge

Level 2

- Secondary treatment options of Bioloigcial Filtration, Activated Sludge and Submerged Aerated Filtration.
- Tertiary treatment options of Mecana Media, Disc or Sand Filters.
- Any combination of the above.

We provide examples illustrating the process for the three schemes listed below. Each of these examples has been chosen to test a different decision point within the *Option Selection Process:*

1. **Huddersfield -** examines an alternative option made available at stage 2 of the OSP.
2. **Keighley -** examines an alternative option made available at stage 4 of the OSP.
3. **Bishop Wilton and Pocklington** – examines a combined solution vs separate site solutions

1. **Huddersfield-** testing stage 2 of the OSP.

The first optioneering example relates to the Huddersfield treatment complex. This is a complex treatment works with separate processes located across five different but inter-connected sites: Deighton, Colne Bridge; Heaton Lodge, Upper and Lower Brighouse. At this works the PSM generated two options, with the rejected option introducing significant re-configuration of the site and abandoning the operational assets at Colne Bridge.

Table 8.7 confirms that the solution we have selected for our Business Plan (Option1) is the more cost effective of the two alternatives, having a lower Capex, Opex, and Whole Life Cost than the rejected alternative solution.

Huddersfield:		Costs (£m's)		
		CAPEX	OPEX	WLC (40 yr NPV)
Option 1 Proposed	Expansion of ASP by 20% with primary tanks to improve the consent from a 5 to 4mg/l of Ammonia in accordance with the Process Selection Matrix.	57.698	2.519	115.192
DDOption 2 Rejected	New sidestream sewage works. Consisting of mineral filters with humus tanks to settle, together with tertiary nitrifying filter in ADF mode. This option removes Colne Bridge and the Filter works at Heaton Lodge (Negative opex effect), rationalising the Huddersfield complex.	80.202	2.453	136.879

Table 8.7: Optioneering example 1: Huddersfield*.

*These examples are for illustration only and are not a representation of final quality assured costs.

2 **Keighley -** testing stage 4 of the OSP.

The second optioneering example compares our proposed solution of upgrading the WwTW at Keighley to include a Tertiary Sandfilter (building on the existing filtration) with a new Biological Nutrient Removal (BNR) process.

Our OSP follows the Asset Standard principle that it is not effective to mix-and-match treatment processes. This would create unnecessary complexity in terms of operational and maintenance activity, introducing unnecessary risk. Instead it advocates the use of "more of the same" types of technology where possible. This example tests how well this principle stands up from the position of Whole Life Cost.

Table 8.8 confirms that the solution that we have proposed (Option 1) in our business plan is the more cost effective of the two options, having a lower Capex, Opex, and Whole Life Cost.

Keighley:		Costs (£m's)		
		CAPEX	OPEX	WLC (40 yr NPV)
Option 1 proposed	2 stage chemical dosing with tertiary solids removal, Tertiary Sandfilter Rapid Gravity	21.521	1.265	50.179
Option 2 rejected	Biological Nutrient Removal (BNR) option Installation of an ASP together with BNR add-ons, tertiary sandfilter.	43.547	1.685	82.148

Figure 8.8: Optioneering example 2: Keighley*.

*These examples are for illustration only and are not a representation of final quality assured costs.

3. Bishop Wilton and Pocklington

This example demonstrates a comparison using our OSP between two individual treatment solutions and a combined solution. It shows we can use the tool to ensure the lowest whole life cost can be identified by considering catchment level solutions rather than single site schemes.

Cheesebottom Ingbirchworth:			Costs (£m)		
			CAPEX	OPEX	WLC (40 YR NPV)
Option 1 Proposed	Decommission Bishop Wilton. Transfer untreated sewage to Pocklington STW. Enhance treatment facilities at Pocklington to accommodate Bishop Wilton's flows and meet 0.25 P limit	Sewer out to Pocklington	13.879	0.441	20.164
Option 2 Rejected	Separate improvements at Bishop Wilton and Pocklington STWs to meet new limits of 1.0 mg/l Pand 0.25 mg/l P respectively	Bishop Wilton	**4.264**	**0.199**	
		Pocklington	**15.774**	**0.497**	
		Total	20.038	0.696	**36.041**

Figure 8.9: Optioneering example 3: Bishop Wilton-Pocklington*.

*These examples are for illustration only and are not a representation of final quality assured costs

We believe that the results of these comparisons justify and validate our OSP. It follows that the systematic application of this Optioneering methodology is justified, and will arrive at the appropriate notional solution options that provide the least whole Llfe cost.

8.18 Strategic Planning Partner review - capex

We employed Stantec, our Strategic Planning Partner at Yorkshire Water to undertake a high level business plan scoping and cost estimating exercise for 8 sites for the addition of chemical phosphorous removal and tertiary solids separation for meeting new phosphorous consents, including the following asset types;

- 1 No. ASP sites with a relaxed final effluent phosphorous consent (1mg/l)
- 1 No. ASP sites with a tight final effluent phosphorous consent (0.5mg/l)
- 1 No. ASP sites with a tight final effluent phosphorous consent (0.4mg/l)
- 1 No. ASP sites with a tight final effluent phosphorous consent (0.25mg/l)
- 2 No. Trickling Filter sites with a relaxed final effluent phosphorous consent (1mg/l)
- 2 No. Trickling Filter sites with a tight final effluent phosphorous consent (0.25mg/l)

Scope

The scope of the review was as below;

Prepare cost sstimates for eight sites with chemical phosphorous precipitation and tertiary solids removal:

- Review historical data to identify the design basis for each site.
- Liaise with Hydrok to provide site data, obtain budget quotes and understand Mecana inclusions / exclusions.
- Identify the scope for the full project solution at each site – noting any assumptions.
- Liaise with Yorkshire Water's estimating team to understand and input relevant data requirements for the estimating tool and the inclusions / exclusions for each item.
- Provide unit size calculations or estimates for all supporting process, mechanical and all other ancillary equipment.
- Produce a technical note summarising the findings.

A full copy of the report can be made available on request.

Conclusions

The conclusions of the exercise were that the largest two works in the review were difficult to cost as they are an atypical size in the industry. A further scope refine,ent was recommended with particular focus on aspects of tertiary solids capture unit throughput. We did not adjust any of our costs further as a result of this exercise but will continue to work with Stantec to refine our scopes.

8.19 Phosphorous removal future operating cost risk

The phosphorous removal will generate a significant amount of new operational costs once the full programme is delivered and commissioned for the following reasons:

- We propose 70 no of works that will require ferric sulphate dosing
- These works range from 808,819 PE (Knostrop STW) to 188 PE (Clifton STW).
- Table 8.10 shows some indicative ferric storage and useage values.

Site	Ferric Storage Vol (m3)	Ferric usage (weekly) m3	Tonnes /week	Tanker Loads/week
Large STWs (8 sites)	4246	2123	3375.6	112.5
Medium STWs (19 sites)	1330	665	1057.4	35.25
Small STWs (50 sites)	804	402	639.2	21.3
Indicative Totals	6380	3190	5072	169

Table 8.10: shows some indiciative values for ferric sulphate usage

Dosing ferric sulphate leads to an increased sludge production, this is expected to be in the region of an additional 9,500 TDS in the 5yr period. Ferric dosing locks in the phosphorous meaning it cannot easily be recovered.

Supply chain risk

Our current framework supplier of Ferric Sulphate is ICL who are very aware of the potential volume impact of future P-Removal requirements across the water industry. They supply approximately 70% of the UK market. There has recently been a 25% price hike on prices due to supply of raw material in Europe and therefore the market is volatile.

We have taken the step to raise the supply of Ferric Sulphate as a strategic risk to be managed by our Executive Management Team due to a threat to supply last year when 30% of the European market of the key raw material, Copperas, disappeared due to a fire at the Huntsman Titanium Dioxide plant in Pori.

Strategic Planning Partner review - Opex

For Opex we have employed T&T to review our opex of capex calculations to ensure consistency in our assumptions and input. The review found that of a sample size of 10 number solutions, we had applied the rules and process consistently. We therefore have confidence in our requirement of new operating costs.

8.20 Upload into DMF (EDA)

All of our solutions are uploaded into the Decision Making Framework (DMF) for inclusion in the business plan. We score our needs and solutions against our service mesasure framework so that we can analyse the costs and benefits associated with each scheme.

The Decision Making Framework allows us to assess cost benefit and service impact consistently with the rest of our plan to ensure we maximise the benefit we deliver to customers within our service, compliance and affordability constraints.

The Decision Making Framework is described in more detain in Chapter 10 of our “Decision Efficiency” and in our Wholesale Cost Appendicies.

8.21 Bioresources impacts - sludge capacity

Driver	Sludge: Water Framework Directive, Urban Waste Water Treatment Directive
Measure summary	It has been estimated that an additional 19619 tonnes of dry solids (TDS) of capacity will be required as a direct result of WINEP developments across 84 new consents. The proposed solutions detailed in the Bioresources cost claim and narrative will handle the additional volume of generated sludge by a range of market based and in-house solutions.
Total no.	See Bioresources Cost Claim documentation
Cost (£m)	60.35

Summary

Sludge production across our wastewater treatment works will increase in the 2020-25 period for those works with a designated tighter consent under the WINEP. This is particularly relevant to P which drives 79% of additional sludge treatment capacity needs and over 95% of the needs from WINEP3 – the rest being from population growth. (see Bioresource cost claim and narrative). Our capacity to handle increased volumes of sludge will need to increase accordingly.

Legislative drivers

The Legislative Drivers are indirect for this business case. As a result of addressing the legislative drivers and measures under WFD and UWWTD, we will generate greater volumes of sludge.

Hazard identification and risk characterisation

In delivering the required levels of treatment to meet the WINEP objectives, additional sludge will be generated. Non disposal of this would result in a build up of hazardous sludge material, and is not an option. The additional volumes of sludge being generated at each site resulting from WINEP investment is detailed in the Bioresources documentation. The total increase in sludge production once all these implementations have been commissioned is 19,619 Tonnes of Dry Solids (TDS).

In addition to this, our supply demand business case estimates that a further 5,000 TDS per annum will be added to the regional sludge production figures by the end of 2020-25 as a result of population growth. A range of market based and in house interventions have been identified to address both causes of increased sludge generation.

In considering the appropriate intervention for the increased volumes of sludges as a result of tighter consents driven through the WINEP and population growth, we have considered the need in the wider context of the sludge strategy.

Intervention

The impacts of WINEP will increase sludge production by 24,619 TDS, an additional 15,760 TDS over and above our previous plan, which will create a shortfall of 14,048 TDS relative to our existing declared capacity (of 163,310 TDS). On this basis we cannot avoid the need for significant and atypical investment in the 2020-25 period if we are to meet these requirements. Full details of how we have costed an efficient method of treating the new sludge's as a result of WINEP can be found in the Bioresource Cost Adjustment Claim appendix 8m.

8.22 Water Framework Directive: Chemicals Investigation Programme

WINEP 3 Measure Coes	WFD_INV_CHEM1, WFD_INV_CHEM2, WFD_INV_CHEM3, WFD_INV_CHEM4, WFD_INV_CHEM5, WFD_INV_CHEM6, WFD_INV_CHEM7, WFD_INV_CHEM8, WFD_INV_CHEM9, WFD_INV_CHEM10, WFD_INV_CHEM11, WFD_INV_CHEM12, WFD_INV_CHEM14, WFD_MON_CHEM
WINEP3 Measure summary	The Agency has concerns about the impact on the environment of chemicals in intermittent and continuous discharges from wastewater collection and treatment. These drivers comprise Yorkshire Water's delivery of the Chemicals Investigation Programme phase 3 (CIP3) in asset management period 7 (AMP7). The drivers have been derived by the CIP2 steering group, including Agency representatives, as a response to the outcomes of CIP2 in AMP6.
Total No.	43
Totex Cost (£m)	2.256

Summary

Part of the Water Framework Directive requires us to understand the risks from the most potentially polluting chemicals, and develop and implement strategies to address such risks.

Over the last ten years, as part of a national programme, we have been investigating the ability of different sewage treatment processes to reduce or remove such substances. Other related studies set out to identify all sources of such substances in identified catchments, both from consented sources and the rest of the sewerage infrastructure. In the current asset management period (AMP6), the programme will investigate the impact of chemicals in the final effluent of the 600 wastewater treatment works (nationally) with least dilution by receiving watercourses. There are also five further river catchment studies.

The results of that work led to the identification of further work that is required, both regionally and nationally. The work will deliver an ambitious but necessary programme of work:

- More detailed analysis of existing data.
- Investigation and management of risk to groundwater.
- Assessment of domestic discharge of chemicals.
- Quantification of chemical discharges to transitional and coastal waters (TraCs).
- Investigation of innovative methods for control of chemicals entering sewer networks.
- Quantification of chemicals in (WwTWs) sludge.
- Quantification of chemicals discharging to surface waters.
- Monitoring for continuing trends of specific chemicals' reduction in the sewer network.
- Monitoring the performance of chemical removal by technologies installed in AMP6.
- Quantification of new and emerging chemicals of potential concern.
- Investigations into microplastics and antimicrobial resistance (AMR) in wastewater treatment.

Legislative drivers

Article 16 of the Water Framework Directive (2000/60/EC) deals with strategies against the pollution of water, in particular by 'priority substances'. Further, the Environmental Quality Standards Directive (2013/39/EU) sets the detail of the controls. Expectations under this driver are set out in section 2.9 of the WISER document. Detailed requirements are set out

in the Environment Agency guidance. There are 16 associated Environment Agency drivers; all include the code WFD ... CHEM.

Hazard Identification and risk characterisation

An original request from the Environment Agency was the imposition of permit limits for certain substances at particular sites. However, through discussions about certainty of data and reduced societal use, we were able to agree that we should monitor and quantify those substances rather than invest in treatment that might not be needed.

For the sites and determinands identified, sampling, analysis and reporting is required of WwTW influent and effluent quality and receiving watercourse or groundwater quality at some sites. Where novel hazards such as microplastics and antimicrobial resistance (AMR) are being addressed, nationwide research into their presence, reduction and potential increase in sewer networks and WwTWs will be delivered.

Intervention

At the sites listed in Appendix 1, screening of effluents will be carried out to establish the presence or otherwise of a number of priority hazardous substances, priority substances and specific pollutants, as identified by the national Chemicals Investigation Programme Steering Group. In addition, for the sites identified, effluent screening and process investigations will be carried out for a number of emerging substances.

Intervention costing

The following summarises the approach to costing of interventions in the plan.

WFD_INV_CHEM1 Chemicals (CIP2 extensions) Barrie Howe (Agency Senior Advisor Water Quality) agreed with Water UK SWQWPG Chemicals TaF Group members on 3rd November 2017 a £15,000 allowance per company for wider data mining from CIP data which have already been collected, and a desk based CSO study using existing CIP data, with possibility of some sediment monitoring.
WFD_INV_CHEM1 CIP3 for groundwater activities: GW CIP Effluent and groundwater monitoring at seven sites. Our Water Quality Sampling & Analysis Manager supplied analysis estimates, our Technical Specialist: Hydrogeology supplied borehole drilling estimates based upon recent work and our framework provider supplied sampling estimates.

WFD_INV_CHEM1 EA Area Catchment Investigations Monitoring needed of effluent and sewer catchment at two WWTW. Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_INV_CHEM2 Chemicals (CIP3) - TRAC waters Monitoring needed of effluent only at three WWTW. Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_INV_CHEM3 Chemicals (CIP3) – AMR Barrie Howe (Agency Senior Advisor Water Quality) agreed with Water UK SWQWPG Chemicals TaF Group members on 3rd November 2017 a £2 million programme of investigations into changes in abundance of antimicrobial resistance (AMR) genes through wastewater and sludge treatment processes. To be divided between companies according to UKWIR formula.

WFD_INV_CHEM4 Chemicals (CIP3) - Innovative pathway control Barrie Howe (t Agency Senior Advisor Water Quality) agreed scope with Matt Hill, who estimated monitoring, engagement and impact assessment costs from potential contractors.

WFD_INV_CHEM5 Chemicals (CIP3) - Microplastics Barrie Howe (Agency Senior Advisor Water Quality) agreed with Water UK SWQWPG Chemicals TaF Group members on 3rd November 2017 a £1 million programme of investigations into changes in abundance of microplastics through wastewater and sludge treatment processes. To be divided between companies according to UKWIR formula.

WFD_INV_CHEM6 Chemicals (CIP3) - Sewer catchment studies Barrie Howe (Agency Senior Advisor Water Quality) agreed with Water UK SWQWPG Chemicals TaF Group members on 3rd November 2017 cost estimates per river and sewer catchment survey.

WFD_INV_CHEM7 Chemicals (CIP3) - Sludge Analysis At the Water UK SWQWPG Chemicals TaF Group meeting on 11th October 2017, Mat Davis (Agency Technical Advisor: Soil Protection and Materials to Land) agreed sampling at the same 11 sites as for sludge in CIP2. Our framework provider supplied sampling and analysis estimates.

WFD_INV_CHEM8 Chemicals (CIP3) - PM investigation costs At the Water UK Strategic Water Quality and Waste Planning Group (SWQWPG) Chemicals Task and Finish (TaF) Group meeting on 11th October 2017, members agreed to include the same costs project management costs as for CIP2. The total CIP2 project management forecast is: Internal costs (Salaries) – 135,270 External – 752,567, therefore total is £887,837.

WFD_INV_CHEM9 Maintaining standstill limits for chemicals Monitoring needed of effluent and some watercourses too at four wastewater treatment works (WWTW). Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_INV_CHEM10 Effluent monitoring for TBT, DEHP and Triclosan. Monthly monitoring of effluent for 18 months to confirm if reductions in these substances seen

between CIP1 and 2 are continuing as predicted. Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_INV_CHEM11 Optimisation of new technologies Monthly monitoring at three sites for 18 months with associated process management to optimise performance of Mecana units installed in different processes. Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_INV_CHEM12 Monitoring of installed technologies Monthly monitoring at two sites for 20 months with associated process management to optimise performance of Tertiary Nitrifying Trickling Filter (TNTF) units. Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_INV_CHEM14 Monitoring of emerging substances. 12 samples per year for 12-18 months at three sites. Effluent, upstream and downstream sampling for new and emerging substances. Our Water Quality Sampling & Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

WFD_MON_CHEM Chemicals (CIP3 Programme) Monitoring of five discharges per company, including one TraC and one from CIP1 and/or CIP2. Influent and effluent sampling. Our Water Quality Sampling and Analysis Manager supplied analysis estimates and our framework provider supplied sampling estimates.

8.23 Water Framework Directive: Chemicals no deterioration

WINEP 3 Measure Codes	WFD_NDLS_CHEM1, WFD_NDLS_CHEM2
WINEP3 Measure Summary	The Chemicals Investigation Programme phase 2 (CIP2) in asset management period 6 (AMP6) identified 5 wastewater treatment works (WwTWs) contributing more than 20% to an environmental quality standard (EQS) failure downstream of their final effluent discharge. The Agency has set standstill limits at these WwTWs, and to manage the risk of these new limits Yorkshire Water must invest in new treatment and monitor performance.
Total No.	7
Totex Cost (£m)	12.240

Summary

Part of the Water Framework Directive requires Yorkshire Water to implement strategies to address the risks from the most potentially polluting chemicals. In the current asset management period (AMP6), the Chemicals Investigation Programme phase 2 (CIP2) has so far investigated the impact of chemicals in the final effluent of around 300 of the 600 wastewater treatment works (WwTWs) with least dilution by receiving watercourses. The results of that work have led to the identification five WwTWs where standstill limits for dissolved copper, nickel and/or lead are needed. Yorkshire Water has designed and costed a strategy to comply with these standstill limits.

Legislative drivers

The Water Framework Directive (2000/60/EC) has as one of its prime purposes the protection of receiving waters to prevent their deterioration, and is covered in Article 1 of that Directive. Section 2.1 of the WISER document sets out the EA/Natural England expectations under this driver. Detailed requirements are set out in the EA Guidance. The associated EA driver references are WFD_NDLS_CHEM1 & WFD_NDLS_CHEM2.

Hazard risk and identification

As part of the chemicals investigation programme phase 2 (CIP2) funded by the UK Water and Sewerage Companies (WaSCs) and steered in partnership with the Environment Agency, Natural England and Cyfoeth Naturiol Cymru / Natural Resources Wales, around 600 wastewater treatment works (WWTWs) were selected for monitoring of priority hazardous substances (PHS), hazardous substances (HS), specific pollutants (SP) and other substances of concern during asset management period 6 (AMP6). The steering group selected those WwTWs with the lowest dilution of final effluent by their receiving watercourses. Each WwTW's final effluent and receiving watercourse upstream and downstream of the final effluent discharge point was sampled and analysed for the designated substances over the course of 18 months. Of the 300 or so WwTWs whose monitoring was complete in time for them to be included in the PR19 WINEP, five WwTWs in Yorkshire were set standstill limits for dissolved copper, nickel and/or zinc to prevent the receiving watercourses' ecology deteriorating. Each WwTW set a standstill limit contributed more than 20% of each substance's environmental quality standard (EQS) where the water quality downstream of its discharge constituted a high confidence EQS non-compliance.

Intervention

As these are new limits they represent increased risk of non-compliance at each WwTW. Therefore, a technology review was carried out to identify potential removal processes. This review found no technology exists to provide certainty of removal to the concentrations defined by the new standstill limits without excessive cost. A new strategy was reviewed, of identifying trade effluents containing the relevant standstill substances. This review guided us to settle upon the strategy of tankering trade effluent from targeted traders and treating it separately from the general wastewater using membrane filtration at a central location before discharging it to the sewer network.

See appendix 1 for details on this scheme.

Intervention costing

We compiled costs for sampling and analysis at WwTWs and traders' sites, installation of effluent storage tanks at traders' sites, tankering effluent from traders to the membrane filtration plant, installation and operation of the membrane filtration plant.

8.24 Water Framework Directive Investigations

WINEP measure code	WFD_INV
WINEP3 Measure Summary	Investigations to understand the impact of our assets on failing waterbodies
Total no.	10
Totex cost (£m)	8.018

Summary

As part of understanding progress towards meeting the WFD, the Environmnet Agency, has been carrying out routine monitoring of each water body. They have then used that information to understand which water bodies are meeting their targets, where improvements are needed, and to which sector(s) those improvements relate.

While there is clear evidence for some water bodies of failures that have occurred and what they are attributable to, in other cases the degree of information and/or understanding is currently insufficient to allow such conclusions to be drawn.

Where a failure is being attributed to our assets but the evidence is not yet sufficient to base investment decisions on, it is proposed to carry out further investigations and sampling, analysis, modelling and interpretation to address this shortfall. We will be working in partnership with the Agency's own investigations into failing water bodies.

Legislative drivers

Article four of the Water Framework Directive (2000/60/EC) deals with the setting of environmental objectives and the development of actions to meet or move towards those objectives.

Hazard identification and risk characterisation

The work identified is generated from the Environment Agency weight of evidence database, whenever it has been identified that the WFD is not met for that water body, and the attributable cause is 'water industry'. Where the reasons for failure identified by the Environment Agency relate to intermittent discharges only, the associated studies have

been scoped in accordance with the Urban Pollution Management manual. Where studies relate to miscellaneous impacts regarding continuous discharges these studies have been scoped using Environment Agency guidance and our integrated catchment management procedure.

The studies will investigate the potential impact of our assets on the receiving waterbody against the relevant WFD water quality targets and identify potential investment for AMP8 where required. Scopes will be developed and agreed with the Agency upfront in order to ensure a robust study based on scientific evidence..

Intervention

See appendix 1 for the full list of investigations.

Intervention costing

Costs for the WFD investigations were developed using known costs from the AMP6 investigations.

Costs include:

- Sampling and monitoring for an appropriate number of monitoring locations and types of monitors specific to each study, for both river and waste water network surveys. Types of monitors include flow, water quality sondes and auto-samplers and rain gauges.
- Contractor costs to deliver the sampling and monitoring programme inclusive of data quality assurance, event triggering of auto-samplers and routine installation, maintenance, calibration and decommissioning.
- Laboratory analysis for 2-storm (wet) events, 3-dry events plus 1-spare event in the event of technical fault of the sampler or time adjustment to capture full river response from a storm event for each sampler.
- Network modelling consultants for waste water network flow and water quality model build, calibration and validation, where applicable.
- River flow modelling consultants for river flow model build, calibration and validation, where applicable.
- River water quality modelling consultants for river water quality model build, calibration and validation, where applicable. This also includes water quality assessment and solution scenarios, if applicable.

- Licence fees payable to the registered landowner for the selected monitoring locations.
- Ad hoc sampling and monitoring such as sediment oxygen demand has been included for Costa Beck and Holderness Drain in line with the requirements of WINEP.

9. Water quality drivers – measures for sewerage

9.1 Introduction

In this section we discuss the modelling, interventions and costs for measures related to our sewerage. These include:

8.0 Frequently operating overflows

9.0 Urban Pollution Management

9.2 Urban Waste Water Treatment Directive: Frequently operating overflows

WINEP measure code	U_INV
WINEP3 Measure Summary	UWWTR spill frequency reduction investigation and cost benefit appraisal.
Total no.	158
Totex cost (£m)	35.899

Summary

As part of the industry-wide initiative, 21st Century Drainage, all water companies have agreed to monitor and investigate their most frequently spilling combined sewer overflows (CSOs). By the end of the 2015-20 period, Event Duration Monitors (EDMs) will have been installed on all of our CSOs. We have analysed the EDM data we already hold and have identified 158 assets that need to be investigated under the U_INV driver for frequently operating overflows.

Legislative Drivers

The Urban Wastewater Treatment Directive requires the UK to maintain its sewerage system and limit any releases without secondary treatment to those that occur due to non-normal local climatic conditions. To meet this and other ambitions, the water industry instigated the 21st Century Drainage initiative which operates a number of programme

streams dealing with different aspects of urban drainage. One of the streams deals specifically with frequently operating overflows – Workstream 4 – CSOs. The U_INV driver is the implementation of the Storm Overflow Assessment Framework (SOAF) that has been developed by this 21st Century Drainage workstream. The SOAF was developed jointly with the Environment Agency and has become the official guide to investigating these types of asset. The full document is hosted on the Water UK website: https://www.water.org.uk/policy/improving-resilience/21st-century-drainage/long-term-planning

The Environmnet Agency and Natural England's expectations under this driver are set out in Section 2.7 of WISER.

Hazard Identification and Risk Characterisation

We have undertaken analysis of all our CSOs that have EDM data – either collected through the 2015-20 programme to date or any historic data that was held from previous monitoring. We compared the results to the appropriate spill number as outlined in SOAF in table 9.1.

Number of years' EDM data	Investigation spill trigger number
1	>60
2	>50
3	>40

Table 9.1: Investigation triggers for EDM

Where average annual spills were greater than the investigation spill trigger numbers, they have been included in WINEP.

Intervention

The SOAF involves determining the reason for an overflow exceeding the trigger number. Was it weather conditions, operational reasons or lack of capacity? Only if the investigation discovers that it is a capacity issue does the investigation continue to the environmental and societal impact assessment. At this point, there is a further test for ecological impact. If the assessment shows an impact or the assessment cannot be undertaken because of physical constraints (e.g. culverted watercourse), then an environmental model will be necessary. We will need to build (or use/modify existing) models of the sewer network and the river, including a rainfall run-off model.

An economic assessment will be performed on the outcome of the environmental and societal impact assessment. Note that this assessment is required even when there is no environmental impact. This is to satisfy the BTKNEEC (Best Technology Known Not Entailing Excessive Cost) test of the UWWTD.

158 discharges have been identified as exceeding the investigation spill trigger numbers. These are listed for investigation in Appendix 1.

Based on geographical location, we estimate we will have to undertake 75 environmental modeling (UPM) studies, but the full 158 sites will require environmental and societal impact assessments.

Intervention costing

The 2020-25 period expenditure was costed by developing a costing process based on the Storm Overflows Assessment Framework (SOAF), developed by the Environment Agency and the water industry. Stage 1 requires desktop investigations and will require funding of a full-time internal or consultant resource. Stage 2 questions whether the storm overflow causes an environmental impact. The framework is separated in to three sections:

- Aesthetic impact including amenity and public complaint.
- Invertebrate (biological) impact.
- Water quality impact.

A cost matrix was developed based on assumed costs or historic costs. This matrix was then used to estimate the required expenditure to carry out the necessary investigations within the 2020-25 period.

As part of WINEP2 a list of 158 sites was submitted by us to the Environment Agency in August 2017, this list was then used to assign the different costs for stages 1 and 2 of the SOAF process.

9.3 Defined/assumed costs

- Aesthetics - surveys of this type are not currently carried out by us, but a similar survey, as part of the pollution assessment work, is completed by Aecom on our behalf. This has therefore been used as a basis for an aesthetic survey, as it includes similar survey techniques and sample requirements

- Invertebrate - Macro-invertebrate surveys are something we already carry out so the defined costs for these were provided. These require a spring and autumn sample to take place therefore this extra cost has been captured.

- Water quality – historic UPM costs were obtained and have been used to provide an average cost for required water quality surveys.

The additional operational costs were also considered as part of this costing process and, although the final costs were to be confirmed by the environmental regulation and modelling team, the requirement for the initial assessment work has been included.

9.4 Assumptions

If an outfall was located within the same drainage area zone (DAZ) and discharged to the same waterbody then it was assumed that these sites could be included within the same water quality investigation, if required.

Site Name	Name of Waterbody	Waterbody ID	DAZ	No of CSO's in same DAZ	No of CSO's in same DAZ entering same waterbody	UPM Study	Age of UPM	Water Quality Study	DAP	Date of DAP	Macro-invertebrate Survey	Asethetics Survey	UPM Survey Cost
CROW NEST BRIDGE/CSO	River Calder	GB104027062630	241	4	3				No	-	£ 4,480.00	£1,750.00	£ 472,486.38
FIELDING STREET/CSO	River Calder	GB104027062630	241	4	3				No	-	£ 4,480.00	£1,750.00	Not Required
PRINCESS BRIDGE/NO 2 CSO	River Calder	GB104027062630	241	4	3				No	-	£ 4,480.00	£1,750.00	Not Required
SALEM CRICKET GROUND/CSO	Hebden Water	GB104027062790	241	4	1				No	-	£ 4,480.00	£1,750.00	£ 472,486.38

Table 9.2: Example cost matrix

This example of the costing matrix shows how the geographical assumption has been applied to the data. Sites within the same DAZ which also discharge to the same waterbody will only have a single UPM cost associated. Whereas, if it discharges to a different waterbody within the same DAZ it will require separate water quality modelling.

The approach to cost the framework methodology for stage 2 means an assumption was made around how many sites would need to be included throughout the different stages. Without carrying out a sample assessment on several sites it was not feasible to estimate the number of sites which would be removed from the process due to operational and weather issues. Therefore, the costs were calculated to include all 158 sites.

9.5 Process risk

An outstanding risk from this process, is the benefit analysis method developed by the Environment Agency and the water industry (based on BTKNEEC). This approach has not

yet been costed in terms of the practitioner carrying out the process, therefore there is a potential unknown amount of work to take place before developing solutions for the identified sites.

10. Water Framework Directive: Urban pollution management

WINEP measure code	WFD_IMP
WINEP3 Measure Summary	In 2015-20 UPM studies were undertaken to sample, model, predict and interpret potential water quality impacts from our intermittent storm overflows. As a result, a number of discharges require improvements such as additional storm storage to reduce the frequency and magnitude of wet weather, intermittent storm discharges impacting on the receiving waterbody. Storm storage construction and/or outfall relocation, as appropriate and identified during solution identification modelling. All solutions are tested to ensure improvement to water quality WFD standards are achieved.
Total No.	19
Totex Cost (£m)	60.901

10.1 Summary

In the 2015-20 reporing period, we investigated the impact in a number of catchments in Yorkshire, following the urban pollution management procedure. The outcome of those investigations was to identify Combined Sewer Overflows (CSO's) that require improvement in order to move towards and achieve Good status water bodies under the Water Framework Directive.

Legislative drivers

Article 4 of the Water Framework Directive (2000/60/EC) deals with the setting of environmental objectives and the development of actions to meet or move towards those objectives.
Section 2.1 of the WISER document sets out the Environment Agency and Natural England's expectations under this driver.

The Agency has previously established environmental standards for the performance of intermittent discharges that provide appropriate protection under the WFD, and these are included in the latest version (3rd edition) of the urban pollution management manual.

Hazard identification and risk characterisation

In 2015-20 reporting period we undertook a series of UPM investigations to understand the impacts of our assets on the receiving watercourse. The waterbodies requiring investigation were identified by the Environment Agency using their reason for failure database during the 2014 periodic review.

Each waterbody was subject to 12-months sampling and monitoring to understand storm asset performance and the resultant water quality. Both dry weather and storm conditions were surveyed. Flow and water quality models were developed and calibrated using the observed data from the sampling programme. Under the UPM manual (3rd edition), one year is not sufficient on which to invest as the one year surveyed could be a particularly wet or dry year. Following model build and calibration, a 10-year rainfall record is used to predict the operation of the waste water network in response to storm events and how this would impact the receiving water. The results are assessed using WFD intermittent water quality standards that are protective of good status, as identified in the Environment Agency report "Review of urban pollution management standards against WFD requirements" (Environment Agency, October 2012).

The outcome of the modelling results are listed in Table 10.1. Models which predicted an impact on the receiving water quality during the 10-year rainfall series modelling have identified interventions at assets to achieve WFD good against the intermittent standards. The solutions were subject to cost-benefit assessment by the Environment Agency.

Table 10.1: Urban pollution management – catchment study summary

UPM study	Outcome
Wyke Beck	Pass; no interventions required
Spen Beck	Pass; no interventions required
Costa Beck	Pass; no interventions required
River Dearne 2 – Lundwood to River Dove	Pass; no interventions required
Went Beck	Pass; no interventions required
Pudsey Beck	Interventions for: Pudsey Smalewell/CSO; Dick Lane/CSO; Dale Farm/CSO; Hough Side Works/CSO; Kent Road/CSO; Farnley Ringroad/CSO
Ea Beck	Interventions for: South Elmsall WwTW storm overflow; South Elmsall WwTW settled storm Ooverflow
Little Don	Intervention for: Hunshelf Road/CSO
River Dearne 1 – Clayton West to Cawthawne Dike	Interventions for: Clayton West WwTW settled storm overflow; Clayton West WwTW final effluent; West Bretton WwTW; Innfold Farm 1/CSO; Innfold Farm 2/CSO; Innfold Farm 3/No. 2 CSO; Innfold Farm 4/CSO
Bentley Mill Stream	Interventions for: Bentley Mill Rise/SPS; Bentley/WwTW final effluent, settled storm and storm overflow.
Holme Brook	Pass; No interventions required

Note that due to the complex nature of the UPM studies, the final findings from a number of these studies are still under review at the time of documentation.

Intervention

The interventions for the above schemes has been costed based on traditional storm storage solutions. While many of the obligations will be delivered in this way, in accordance with our intention to deliver sustainable solutions, we will be investingating alternative ways of meeting the requirements. This could be through ecological means or through sustainable urban drainage (SUDs) approaches.

See appendix 1 for full schedule of UPM interventions

Intervention costing

In AMP6, we investigated the impact of Combined Sewer Overflows (CSO's) identified to be causing an impact to the water body and required improvement in order to move towards and achieve Good Status water bodies under the Water Framework Directive (WFD).

Working with our consultants and the Environment Agency these overflows were modelled to determine their impact on the water body and propose an outline solution. These proposed solutions were modelled to prove the benefits to the water body.

The Environment Agency were consulted on these costed solutions, they ran a cost benefit analysis on these solutions and selected those they considered beneficial.

The Environment Agency beneficial solutions are shown in Table 10.2:

River Reach	£m (post efficiency)	Environment Agency ref.
Pudsey Beck	25.4	7YW300058, 7YW300066, 7YW300067, 7YW300068, 7YW300069, 7YW300070, 7YW200641
Little Don	6.4	7YW200640
Clayton West (Dearne)	16.3	7YW200638, 7YW300061
Bretton Brook	3.4	7YW300062, 7YW300060
Bentley Mill Stream	3.8	7YW300059, 7YW200637, 7YW300636
Ea Beck	4.7	7YW200635, 7YW300057

Table 10.2 : Environment Agency beneficial solutions

These schemes are to reduce spill frequency at their respective overflows/outlets. To this end these were modelled and designed with storage capacity on the network where during an event flows will be contained within the network for longer before entering the watercourse.

Three sites (Clayton West, Bretton brook and Bentley Mill stream) when modelled were unable to pass water quality with any volume of storage. These designs were changed to collect and relocate, via a transfer sewer, the outfalls to a suitable location whereby the river reach passes water quality requirements.

These solutions were costed using our cost models, which are based on historic delivery costs of similar assets.

10.2 Investment

To deliver these schemes we are expecting it to cost £60.0m, and will deliver 24.44km of river length improved (Environment Agency modelled length).

10.3 Efficiency

To ensure these costs are as low as possible, solutions have been reviewed and where possible savings have been proposed. For example, the schemes for outfall relocation for Clayton West and West Bretton have been redesigned to now use the same outfall, saving £3.2m.

Appendices

Appendix 1 – Schedule of schemes

Drinking Water Protected Area

WINEP ID	Regulatory Date	WINEP Obligation Title
7YW200001	22/12/2024	Armthorpe
7YW200002	22/12/2024	Littleworth
7YW200003	22/12/2024	Highfield Lane
7YW200004	31/03/2022	Nutwell
7YW300055	31/03/2022	Highfield Lane
7YW200077	22/12/2024	Bridlington safeguard zone catchment engagment scheme
7YW200078	22/12/2024	Haisthorpe safeguard zone catchment engagement scheme
7YW200079	22/12/2024	Burton Agnes safeguard zone catchment engagement scheme
7YW200080	22/12/2024	Cranswick safeguard zone catchment engagement scheme
7YW200081	22/12/2024	Elmswell Wold safeguard zone catchment engagement scheme
7YW200082	22/12/2024	Etton safeguard zone catchment engagement scheme
7YW200084	22/12/2024	Hull saline Intrusion Scheme
7YW200095	22/12/2024	Loxley - Agden Bradfield Moors
7YW200096	31/03/2022	Loxley - Dale Dike
7YW200097	22/12/2024	Loxley - Strines Reservoir Moors
7YW200098	22/12/2024	Oldfield - Keighly Moor Res catchment
7YW200099	22/12/2024	Oldfield - Water Sheddles Res
7YW200101	31/03/2022	DrWPA feeding Graincliffe WTW
7YW200106	22/12/2024	Chellow Heights - Scar House and Angram reservoirs including Nidd aquaduct catchment
7YW200108	22/12/2024	Chelker & Grimwith reservoirs - Chellow Heights
7YW200109	22/12/2024	Barden Upper
7YW200114	22/12/2024	Thornton Moor & Stubden Reservoirs
7YW200116	31/03/2022	DrWPA feeding Eccup WTW
7YW200119	22/12/2024	Harlow Hill - Leighton & Roundhill reservoirs
7YW200120	31/03/2022	Harlow Hill - Lumley Moor & Scargill reservoirs
7YW200122	22/12/2024	Thornton Steward - Wensleydale River Ure
7YW200123	22/12/2024	Langsett & Midhope reservoirs
7YW200124	22/12/2024	Ewden - Broomhead
7YW200126	31/03/2022	Ruswarp - Esk catchment
7YW200127	22/12/2024	Rivelin - Derwent pumped intake
7YW200129	31/03/2022	Deerhill Res and Blackmoorfoot res - Blackmoorfoot WTW
7YW200130	31/03/2022	Ramsden & Brownhill Reservoirs
7YW200131	22/12/2024	Yateholme & Riding Wood & Dingley reservoirs - Holmbridge WTW

7YW200134	22/12/2024	Embsay catchment
7YW200135	22/12/2024	Butterley, Blakely, Wessenden Old Reservoirs - Longwood WTW
7YW200137	22/12/2024	Scammonden Water and Deanhead Res - Longwood WTW
7YW200139	31/03/2022	DrWPA feeding Albert WTW
7YW200140	**22/12/2024**	**CSF officers Yorkshire wide all parameters**
7YW200141	22/12/2024	Catchment Partnership support
7YW200142	22/12/2024	Roll out of targetted product substitution trial (Irton metaldehyde) into new targetted hot spot areas in SUNO, Esk and Hull catchments.
7YW200143	22/12/2024	Innovative equipment hire
7YW300080	31/03/2022	Goosehouse Pesticide Investigation
7YW300081	31/03/2022	Carlton Mill Lane Pesticide Investigation

Heavily Modified Water Body schemes - Sediment schemes

WINEP ID	Regulatory Date	Obligation Title
7YW200060	22/12/2024	Grimwith Sediment Scheme
7YW200062	22/12/2024	Beaver Dyke Sediment Scheme

Heavily Modified Water Body schemes - Flow schemes

WINEP ID	Regulatory Date	Obligation Title
7YW100089	22/12/2024	Little Don Catchment Scheme
7YW100091	22/12/2024	Winscar Catchment Scheme
7YW100094	22/12/2024	Embsay Compensation Release Scheme
7YW100098	22/12/2024	River Burn Catchment Scheme
7YW100097	22/12/2024	Dale Dike Formalisation Scheme
7YW100087	22/12/2024	SCAMMONDEN INTAKES AND CATCHWATER IN COLNE S/C
7YW100088	31/03/2025	RIVER OUSE - YORK
7YW100089	31/03/2022	Little Don Catchment Scheme (Midhope & Underbank Reservoir)
7YW100090	31/03/2022	Scout dike Reservoir Control rule and Compensation Release Scheme
7YW200076	31/03/2022	West Beck Scheme
7YW100083	31/03/2022	Bellerby Licence Change
7YW100100	31/03/2025	Flow Adaptive Management Scheme
7YW100093	22/12/2024	Agden River Restoration Scheme

Fish Passage schemes

WINEP ID	Regulatory Date	Obligation Title
7YW100098	22/12/2024	River Burn Catchment Scheme
7YW200063	22/12/2024	Airebank Mills Fish Passage

WINEP ID	Regulatory Date	Obligation Title
7YW200064	22/12/2024	Cheesebottom Weir Fish Passage
7YW200069	31/03/2022	Springhead Weir Fish Passage Investigation
7YW200070	22/12/2024	Cononley Weir Fish Passage
7YW200071	22/12/2024	Farnley Beck Fish Passage
7YW200072	22/12/2024	Schole Hill Fish Passage
7YW200073	22/12/2024	Watson Mill Fish Passage
7YW200074	31/03/2025	Fish Pass Adaptive Management

Non native invasive species

WINEP ID	Regulatory Date	Obligation Title
7YW100104	31/03/2022	Bioresource INNS pathway biosecurity investigations, incorporating options appraisal
7YW200045	31/03/2025	Research and investigation into new mitigation measures to prevent spread of INNS within the raw water transfer network for inclusion in AMP8/9 implementation plans
7YW200046	31/03/2022	Water Transfer pathways investigation, incorporation risk assessments, and pathways options appraisal - Harrogate & Dales WRAP zone
7YW200047	31/03/2022	Water Transfer pathways investigation, incorporation risk assessments, and pathways options appraisal - North Dales WRAP zone
7YW200048	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways options appraisal - East - Malton and Coast WRAP zone
7YW200049	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways options appraisal - East - Hull and Wolds WRAP zone
7YW200050	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways options appraisal - North Central WRAP zone
7YW200051	31/03/2022	Water Transfer pathways investigation, incorporation risk assessments, and pathways options appraisal - North West Rural WRAP zone
7YW200052	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways options appraisal - North West Central WRAP zone
7YW200053	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways appraisal - South West (West) WRAP zone
7YW200054	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways options appraisal - South West WRAP zone

WINEP ID	Regulatory Date	Obligation Title
7YW200055	31/03/2022	Water Transfers pathways investigation, incorporating risk assessments, and pathways options appraisal - South Pennines WRAP zone
7YW200056	31/03/2022	Water Transfer pathways investigation, incorporating risk assessments, and pathways options appraisal - GRID network interconnections
7YW200058	31/03/2025	Investigation into the development of INNS focused DNA monitoring techniques and integration within Yorkshire Water operations
7YW200059	31/03/2025	Support into control measures for priority species (funding and/or trial sites for biocontrol)
7YW201468	31/03/2025	Investigation and trialling of mitigation options relevant to INNS related sediment inputs in the Derwent Catchment
7YW100104	31/03/2022	Bioresource INNS pathway biosecurity investigations, incorporating options appraisal
7YW200045	31/03/2025	Research and investigation into new mitigation measures to prevent spread of INNS within the raw water transfer network for inclusion in AMP8/9 implementation plans
7YW200046	31/03/2022	Water Transfer pathways investigation, incorporation risk assessments, and pathways options appraisal - Harrogate & Dales WRAP zone
7YW200047	31/03/2022	Water Transfer pathways investigation, incorporation risk assessments, and pathways options appraisal - North Dales WRAP zone

Invasive Non Native Species – No Deterioration Driver:

WINEP ID	Regulatory Date	Obligation Title
7YW100105	31/03/2025	Stakeholder/partnership scheme to reduce the risks of spread of INNS and improve regional biosecurity practice.
7YW100106	31/03/2025	Biosecurity implementation on YW estate and operations
7YW200057	31/03/2025	Moor Monkton - Eccup-Headingley Zebra Mussel biosecurity and mitigation scheme
7YW201461	31/03/2025	Gouthwaite Reservoir SSSI address impact of non-native species (Also driven by SSSI_IMP Driver).

NERC – Investigation Driver

WINEP ID	Regulatory Date	Obligation Title
7YW100114	31/03/2025	Baseline ecological surveys of NERC S.41 habitats on the Yorkshire Water Estate, to enable safeguarding of S.41 habitats and provide the evidence base to aim towards a net biodiversity gain ambition, incorporating development of suitable strategy to value and protect biodiversity.
7YW200087	31/03/2025	Investigations into impacts of YW operations on River Esk Freshwater Pearl Mussel population.

NERC – Implementation Driver

WINEP ID	Regulatory Date	Obligation Title
7YW100108	31/03/2025	Biodiversity Enhancement Programme, delivering projects within the Yorkshire Water operational area that align with government policy, the NERC Act and key regional and national strategies, incorporating measure enabling Catchment Partnership based delivery.
7YW100109	31/03/2025	Habitat management on YW land deemed high value for nature by Natural England mapping and Local Wildlife Status to help stop net S.41 habitat biodiversity loss
7YW200086	31/03/2025	Catchment scale NERC Section 41 Fish and Lamprey resilience programme, to unlock benefits achieved through improved water quality and fish passage.
7YW200090	31/03/2025	NERC Section 41 Species conservation projects (focused on Greater Water Parsnip, Arctic Char and White Clawed Crayfish).
7YW200092	31/03/2025	White Clawed Crayfish River Conservation Project

Sites of Special Scientific Interest

WINEP ID	Regulatory Date	Obligation Title
7YW201462	31/03/2025	SSSIs (Yorkshire Water Land) upland SSSI recovery including Dark Peak, West Nidderdale, Barden and Blubberhouses Moors, South Pennine Moors.

Habitats Directive

WINEP ID	Regulatory Date	Obligation Title
7YW100085	31/03/2022	Habitats Directive Lower Derwent Investigation

Groundwater Water Framework Directive Interventions

WINEP ID	Regulatory Date	Obligation Title
7YW100001	31/03/2022	Armthorpe – 3 boreholes. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Austerfield. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Finningley. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Finningley. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Highfield Lane. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Rossington Bridge. Part of Doncaster Wellfield Water Resources Investigation.

7YW100003	31/03/2022	Rossington Bridge. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Austerfield. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Austerfield. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Finningley. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Hatfield. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Highfield Lane. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Highfield Lane. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Nutwell. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Nutwell. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Rossington Bridge. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Thornham. Part of Doncaster Wellfield Water Resources Investigation.
7YW100003	31/03/2022	Thornham. Part of Doncaster Wellfield Water Resources Investigation.
7YW100043	31/03/2022	Hatfield Woodhouse. Part of Doncaster Wellfield Water Resources Investigation.
7YW100043	31/03/2022	Hatfield Woodhouse. Part of Doncaster Wellfield Water Resources Investigation.
7YW100047	31/03/2022	Boston Park (1,2,3). Part of Doncaster Wellfield Water Resources Investigation.
7YW100047	31/03/2022	Boston Park (1,2,3). Part of Doncaster Wellfield Water Resources Investigation.
7YW100059	31/03/2022	Littleworth. Part of Doncaster Wellfield Water Resources Investigation.
7YW100059	31/03/2022	Littleworth. Part of Doncaster Wellfield Water Resources Investigation.
7YW100059	31/03/2022	Littleworth. Part of Doncaster Wellfield Water Resources Investigation.
7YW100070	31/03/2022	Borehole 1 - Sherwood Sandstone – Carlton. Part of Selby Wellfield Water Resources Investigation.
7YW100076	31/03/2022	Boreholes - Sherwood Sandstone - Carlton Hanger Lane. Part of Selby Wellfield Water Resources Investigation.
7YW100077	31/03/2022	Borehole 1 - Sherwood Sandstone - Cowick. Part of Selby Wellfield Water Resources Investigation.
7YW100078	31/03/2022	Borehole 1 - Sherwood Sandstone - Great Heck. Part of Selby Wellfield Water Resources Investigation.
7YW100079	31/03/2022	Borehole 1 - Sherwood Sandstone - Pollington. Part of Selby Wellfield Water Resources Investigation.
7YW100080	31/03/2022	Borehole 1 - Sherwood Sandstone - Carlton Mill Lane. Part of Selby Wellfield Water Resources Investigation.
7YW100082	31/03/2022	Sherwood Sandstone - Brayton. Part of Selby Wellfield Water Resources Investigation.
7YW200075	31/03/2022	Sherwood Sandstone - Brayton. Part of Selby Wellfield Water Resources Investigation.

Measaures under UIMP_1

WINEP ID	Regulatory Date	Obligation Title
7YW200149	31/03/2025	MELTON COLLEGE/STW
7YW201458	31/03/2025	Linton-on-Ouse STW

Meaures for WW flow and storm tanks – U_MON3 Sites EDM to Storm Tanks

WINEP ID	Regulatory Date	Obligation Title
7YW300156	31/03/2022	ABERFORD/STW
7YW300158	31/03/2022	ACKWORTH/STW
7YW300160	31/03/2022	ADWICK/NO 2 STW
7YW300162	31/03/2022	AIREDALE/STW
7YW300164	31/03/2022	AIRMYN/STW
7YW300166	31/03/2022	ALDWARKE/STW
7YW300168	31/03/2022	AMPLEFORTH VILLAGE/STW
7YW300170	31/03/2022	APPLETON WISKE/STW
7YW300172	31/03/2022	ASKHAM BRYAN/STW
7YW300174	31/03/2022	ASKRIGG/STW
7YW300176	31/03/2022	BAGBY/STW
7YW300178	31/03/2022	BAINBRIDGE/STW
7YW300180	31/03/2022	BALBY/STW
7YW300182	31/03/2022	BARLBY/STW
7YW300184	31/03/2022	BARLOW/STW
7YW300186	31/03/2022	BARWICK IN ELMET/STW
7YW300188	31/03/2022	BEAMSLEY/STW
7YW300190	31/03/2022	BEDALE/STW
7YW300192	31/03/2022	BEEFORD/STW
7YW300194	31/03/2022	BELLERBY/STW
7YW300196	31/03/2022	BEN RHYDDING/STW
7YW300198	31/03/2022	BENTLEY/STW
7YW300200	31/03/2022	BEVERLEY/STW
7YW300202	31/03/2022	BISHOP MONKTON/NO 2 STW
7YW300204	31/03/2022	BISHOP WILTON/STW
7YW300206	31/03/2022	BLACKBURN MEADOWS/STW
7YW300208	31/03/2022	BOLSOVER/STW
7YW300210	31/03/2022	BOLTON ON DEARNE/STW
7YW300212	31/03/2022	BOROUGHBRIDGE/NO 2 STW
7YW300214	31/03/2022	BRADFORD ESHOLT/NO 2 STW
7YW300216	31/03/2022	BRIDLINGTON/STW
7YW300218	31/03/2022	BURLEY IN WHARFEDALE/STW
7YW300220	31/03/2022	BURN/STW
7YW300222	31/03/2022	BURNSALL/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300224	31/03/2022	BURTON FLEMING/STW
7YW300226	31/03/2022	BURTON PIDSEA/STW
7YW300228	31/03/2022	CALDER VALE/STW
7YW300230	31/03/2022	CARLETON/NO 2 STW
7YW300232	31/03/2022	CASTLEFORD/STW
7YW300234	31/03/2022	CATTERICK VILLAGE/STW
7YW300236	31/03/2022	CAWTHORNE/STW
7YW300238	31/03/2022	CHEESEBOTTOM/STW
7YW300240	31/03/2022	CHERRY BURTON/STW
7YW300242	31/03/2022	CLAYTON WEST/STW
7YW300244	31/03/2022	COLBURN/STW
7YW300246	31/03/2022	COLD HIENDLEY/STW
7YW300248	31/03/2022	CRAKEHALL/STW
7YW300250	31/03/2022	CRANE MOOR/STW
7YW300252	31/03/2022	CROFTON/STW
7YW300254	31/03/2022	CROW EDGE/STW
7YW300256	31/03/2022	CUDWORTH/NO 2 STW
7YW300258	31/03/2022	DANBY/STW
7YW300260	31/03/2022	DANESMOOR/STW
7YW300262	31/03/2022	DARFIELD/NO 2 STW
7YW300264	31/03/2022	DARLEY/STW
7YW300266	31/03/2022	DARTON/STW
7YW300268	31/03/2022	DENABY/NO 2 STW
7YW300270	31/03/2022	DENHOLME/NO 2 STW
7YW300272	31/03/2022	DEWSBURY/STW
7YW300274	31/03/2022	DEWSBURY/STW
7YW300276	31/03/2023	DOWLEY GAP/STW
7YW300278	31/03/2023	DRONFIELD/STW
7YW300280	31/03/2023	EARBY/STW
7YW300282	31/03/2023	EASINGTON/STW
7YW300284	31/03/2023	EASINGWOLD/STW
7YW300286	31/03/2023	EASTWOOD/STW
7YW300288	31/03/2023	EGGBOROUGH/STW
7YW300290	31/03/2023	EGTON BRIDGE/STW
7YW300292	31/03/2023	ELLERKER/NO 2 STW

WINEP ID	Regulatory Date	Obligation Title
7YW300294	31/03/2023	ELVINGTON/STW
7YW300296	31/03/2023	EMBSAY/STW
7YW300298	31/03/2023	FILEY/STW
7YW300300	31/03/2023	FLAMBOROUGH VILLAGE/STW
7YW300302	31/03/2023	FLAXTON/STW
7YW300304	31/03/2023	FOLKTON/STW
7YW300306	31/03/2023	FOLKTON/STW
7YW300308	31/03/2023	GARFORTH/STW
7YW300310	31/03/2023	GILBERDYKE/STW
7YW300312	31/03/2023	GILLING WEST/STW
7YW300314	31/03/2023	GLAISDALE/STW
7YW300316	31/03/2023	GOATHLAND/NO 3 STW
7YW300318	31/03/2023	GOOLE RAWCLIFFE/STW
7YW300320	31/03/2023	GOOLE/STW
7YW300322	31/03/2023	GRASSINGTON/STW
7YW300324	31/03/2023	GRIMETHORPE/STW
7YW300326	31/03/2023	GROSMONT/STW
7YW300328	31/03/2023	HALIFAX COPLEY/STW
7YW300330	31/03/2023	HALIFAX COPLEY/STW
7YW300332	31/03/2023	HARLEY/STW
7YW300334	31/03/2023	HARLINGTON/STW
7YW300336	31/03/2023	HAROME/STW
7YW300338	31/03/2023	HARROGATE NORTH/STW
7YW300340	31/03/2023	HARROGATE SOUTH/STW
7YW300342	31/03/2023	HATFIELD WOODHOUSE/STW
7YW300344	31/03/2023	HAWES/STW
7YW300346	31/03/2023	HAXBY WALBUTTS/STW
7YW300348	31/03/2023	HAXBY WALBUTTS/STW
7YW300350	31/03/2023	HEBDEN/STW
7YW300352	31/03/2023	HEDON/STW
7YW300354	31/03/2023	HELMSLEY/STW
7YW300356	31/03/2023	HELPERBY/STW
7YW300358	31/03/2023	HEMINGBROUGH/NO 2 STW
7YW300360	31/03/2023	HETTON/STW
7YW300362	31/03/2023	HIGH ROYD/NO 2 STW

WINEP ID	Regulatory Date	Obligation Title
7YW300366	31/03/2023	HOLME ON SPALDING MR/STW
7YW300368	31/03/2023	HOLMESFIELD/STW
7YW300364	31/03/2023	HOOK/STW
7YW300370	31/03/2023	HORBURY/STW
7YW300372	31/03/2023	HORNSEA/STW
7YW300374	31/03/2023	HOVINGHAM/STW
7YW300376	31/03/2023	HOWDEN/STW
7YW300378	31/03/2023	HOYLANDSWAINE/STW
7YW300380	31/03/2023	HUDDERSFIELD/STW
7YW300382	31/03/2023	HUDDERSFIELD/STW
7YW300384	31/03/2023	HULL/STW
7YW300386	31/03/2023	HUNMANBY/STW
7YW300388	31/03/2023	HUNTON/STW
7YW300390	31/03/2023	HUSTHWAITE/STW
7YW300392	31/03/2023	ILKLEY/STW
7YW300394	31/03/2023	INGBIRCHWORTH/NO 2 STW
7YW300396	31/03/2024	KEARBY/STW
7YW300398	31/03/2024	KEIGHLEY MARLEY/STW
7YW300400	31/03/2024	KELFIELD/STW
7YW300402	31/03/2024	KETTLEWELL/STW
7YW300404	31/03/2024	KILHAM/STW
7YW300406	31/03/2024	KIRK HAMMERTON/STW
7YW300408	31/03/2024	KIRK SMEATON/STW
7YW300410	31/03/2024	KIRKBY MALZEARD/STW
7YW300412	31/03/2024	KIRKBYMOORSIDE/STW
7YW300414	31/03/2024	KNARESBOROUGH/STW
7YW300416	31/03/2024	KNOSTROP/STW
7YW300418	31/03/2024	KNOSTROP/STW
7YW300420	31/03/2024	LEALHOLM/STW
7YW300422	31/03/2024	LEEMING BAR/STW
7YW300424	31/03/2024	LEMONROYD/STW
7YW300426	31/03/2024	LEVEN/STW
7YW300428	31/03/2024	LEYBURN/STW
7YW300430	31/03/2024	LOCKINGTON/STW
7YW300432	31/03/2024	LONG LANE/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300434	31/03/2024	LONG MARSTON/STW
7YW300436	31/03/2024	LONG RISTON NORTH/STW
7YW300438	31/03/2024	LUNDWOOD/STW
7YW300440	31/03/2024	MALHAM/NO 2 STW
7YW300442	31/03/2024	MALTON/STW
7YW300444	31/03/2024	MARKET WEIGHTON/NO 2 STW
7YW300446	31/03/2024	MARKINGTON/STW
7YW300448	31/03/2024	MASHAM/STW
7YW300450	31/03/2024	MELBOURNE/STW
7YW300452	31/03/2024	MELBOURNE/STW
7YW300454	31/03/2024	MELTHAM/STW
7YW300456	31/03/2024	MELTON/STW
7YW300458	31/03/2024	MEXBORO SWINTON/STW
7YW300460	31/03/2024	MICKLEFIELD/NO 2 STW
7YW300462	31/03/2024	MIDDLETON TYAS/NO 2 STW
7YW300464	31/03/2024	MORTON ON SWALE/STW
7YW300466	31/03/2024	NAFFERTON/STW
7YW300468	31/03/2024	NEILEY/NO 2 STW
7YW300470	31/03/2024	NEWTON LE WILLOWS/STW
7YW300472	31/03/2024	NORMANTON/STW
7YW300474	31/03/2024	NORTH COWTON/STW
7YW300476	31/03/2024	NORTH DEIGHTON/STW
7YW300478	31/03/2024	NORTH FERRIBY/STW
7YW300480	31/03/2024	NORTH STAINLEY/STW
7YW300482	31/03/2024	NORTHALLERTON/STW
7YW300484	31/03/2024	NORTON/NO 2 STW
7YW300486	31/03/2024	NOTTON VILLAGE/STW
7YW300488	31/03/2024	NUN MONKTON/STW
7YW300490	31/03/2024	OLD WHITTINGTON/STW
7YW300492	31/03/2024	OTLEY/STW
7YW300494	31/03/2024	OTTRINGHAM/STW
7YW300496	31/03/2024	OXENHOPE/NO 2 STW
7YW300498	31/03/2024	PATELEY BRIDGE/STW
7YW300500	31/03/2024	PATRINGTON/STW
7YW300502	31/03/2024	PICKERING/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300504	31/03/2024	POCKLINGTON/STW
7YW300506	31/03/2024	POOL/STW
7YW300508	31/03/2024	RAWCLIFFE YORK/STW
7YW300510	31/03/2024	REDACRE/NO 2 STW
7YW300512	31/03/2024	RENISHAW/STW
7YW300514	31/03/2024	RICHMOND/STW
7YW300516	31/03/2025	RILLINGTON/STW
7YW300518	31/03/2025	RIPON/STW
7YW300520	31/03/2025	RIPPONDEN/STW
7YW300522	31/03/2025	RUFFORTH/STW
7YW300524	31/03/2025	SANDALL/STW
7YW300526	31/03/2025	SCARBOROUGH/STW
7YW300528	31/03/2025	SEAMER/STW
7YW300530	31/03/2025	SELBY/NO 2 STW
7YW300532	31/03/2025	SETTRINGTON/STW
7YW300534	31/03/2025	SHAW MILLS/STW
7YW300536	31/03/2025	SHERBURN IN ELMET/STW
7YW300538	31/03/2025	SHERBURN/STW
7YW300540	31/03/2025	SHERIFF HUTTON/STW
7YW300542	31/03/2025	SHIPTON/NO 2 STW
7YW300544	31/03/2025	SILKSTONE/STW
7YW300546	31/03/2025	SINDERBY/STW
7YW300548	31/03/2025	SINNINGTON/STW
7YW300550	31/03/2025	SKELTON/STW
7YW300552	31/03/2025	SKIDBY/STW
7YW300554	31/03/2025	SKIPTON/STW
7YW300556	31/03/2025	SLINGSBY/NO 2 STW
7YW300558	31/03/2025	SNAITH/STW
7YW300560	31/03/2025	SNAPE/STW
7YW300562	31/03/2025	SOUTH ELMSALL/STW
7YW300564	31/03/2025	STANLEY/STW
7YW300566	31/03/2025	STAVELEY/STW
7YW300568	31/03/2025	STOCKLEY/STW
7YW300570	31/03/2025	STOCKSBRIDGE/STW
7YW300572	31/03/2025	SUTTON ON THE FOREST/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300574	31/03/2025	SUTTON/STW
7YW300576	31/03/2025	TADCASTER/DOMEST STW
7YW300578	31/03/2025	TANKERSLEY/STW
7YW300580	31/03/2025	TEMPLE NORMANTON/STW
7YW300582	31/03/2025	THIRSK/STW
7YW300584	31/03/2025	THORNE/STW
7YW300586	31/03/2025	THORNTON LE DALE/STW
7YW300588	31/03/2025	THORP ARCH/STW
7YW300590	31/03/2025	TOCKWITH/STW
7YW300592	31/03/2025	TOLLERTON/STW
7YW300594	31/03/2025	TUPTON/STW
7YW300596	31/03/2025	UPTON WRANGBROOK/STW
7YW300598	31/03/2025	WATH ON DEARNE/STW
7YW300600	31/03/2025	WATH RIPON/STW
7YW300602	31/03/2025	WATTON/STW
7YW300604	31/03/2025	WEETON/STW
7YW300606	31/03/2025	WEST BRETTON/NO 2 STW
7YW300608	31/03/2025	WETHERBY/STW
7YW300610	31/03/2025	WHARNCLIFFE SIDE/STW
7YW300612	31/03/2025	WHELDRAKE/STW
7YW300614	31/03/2025	WHITBY/STW
7YW300616	31/03/2025	WHITBY/STW
7YW300618	31/03/2025	WILLIAMTHORPE/STW
7YW300620	31/03/2025	WISTOW/STW
7YW300622	31/03/2025	WITHERNSEA/NO 2 STW
7YW300624	31/03/2025	WOMBWELL/STW
7YW300626	31/03/2025	WOODHOUSE MILL/NO 2 STW
7YW300628	31/03/2025	WOOLLEY VILLAGE/STW
7YW300630	31/03/2025	WORSBROUGH/STW
7YW300632	31/03/2025	YORK NABURN/STW
7YW300634	31/03/2025	YORK NABURN/STW

Meaures for WW flow and storm tanks – U_MON4 Sites FFT Flow Monitoring

WINEP ID	Regulatory Date	Obligation Title
7YW300164	31/03/2022	AIRMYN/STW
7YW300166	31/03/2022	ALDWARKE/STW
7YW300168	31/03/2022	AMPLEFORTH VILLAGE/STW
7YW300172	31/03/2022	ASKHAM BRYAN/STW
7YW300178	31/03/2022	BAINBRIDGE/STW
7YW300184	31/03/2022	BARLOW/STW
7YW300186	31/03/2022	BARWICK IN ELMET/STW
7YW300190	31/03/2022	BEDALE/STW
7YW300192	31/03/2022	BEEFORD/STW
7YW300194	31/03/2022	BELLERBY/STW
7YW300196	31/03/2022	BEN RHYDDING/STW
7YW300200	31/03/2022	BEVERLEY/STW
7YW300204	31/03/2022	BISHOP WILTON/STW
7YW300212	31/03/2022	BOROUGHBRIDGE/NO 2 STW
7YW300216	31/03/2022	BRIDLINGTON/STW
7YW300218	31/03/2022	BURLEY IN WHARFEDALE/STW
7YW300222	31/03/2022	BURNSALL/STW
7YW300224	31/03/2022	BURTON FLEMING/STW
7YW300226	31/03/2022	BURTON PIDSEA/STW
7YW300230	31/03/2022	CARLETON/NO 2 STW
7YW300232	31/03/2022	CASTLEFORD/STW
7YW300234	31/03/2022	CATTERICK VILLAGE/STW
7YW300236	31/03/2022	CAWTHORNE/STW
7YW300238	31/03/2022	CHEESEBOTTOM/STW
7YW300240	31/03/2022	CHERRY BURTON/STW
7YW300246	31/03/2022	COLD HIENDLEY/STW
7YW300248	31/03/2022	CRAKEHALL/STW
7YW300250	31/03/2022	CRANE MOOR/STW
7YW300252	31/03/2022	CROFTON/STW
7YW300254	31/03/2022	CROW EDGE/STW
7YW300258	31/03/2022	DANBY/STW
7YW300264	31/03/2022	DARLEY/STW
7YW300266	31/03/2022	DARTON/STW
7YW300270	31/03/2022	DENHOLME/NO 2 STW

WINEP ID	Regulatory Date	Obligation Title
7YW300272	31/03/2022	DEWSBURY/STW
7YW300274	31/03/2022	DEWSBURY/STW
7YW300276	31/03/2023	DOWLEY GAP/STW
7YW300280	31/03/2023	EARBY/STW
7YW300282	31/03/2023	EASINGTON/STW
7YW300286	31/03/2023	EASTWOOD/STW
7YW300288	31/03/2023	EGGBOROUGH/STW
7YW300298	31/03/2023	FILEY/STW
7YW300300	31/03/2023	FLAMBOROUGH VILLAGE/STW
7YW300302	31/03/2023	FLAXTON/STW
7YW300304	31/03/2023	FOLKTON/STW
7YW300306	31/03/2023	FOLKTON/STW
7YW300308	31/03/2023	GARFORTH/STW
7YW300310	31/03/2023	GILBERDYKE/STW
7YW300314	31/03/2023	GLAISDALE/STW
7YW300316	31/03/2023	GOATHLAND/NO 3 STW
7YW300318	31/03/2023	GOOLE RAWCLIFFE/STW
7YW300320	31/03/2023	GOOLE/STW
7YW300324	31/03/2023	GRIMETHORPE/STW
7YW300328	31/03/2023	HALIFAX COPLEY/STW
7YW300330	31/03/2023	HALIFAX COPLEY/STW
7YW300332	31/03/2023	HARLEY/STW
7YW300334	31/03/2023	HARLINGTON/STW
7YW300342	31/03/2023	HATFIELD WOODHOUSE/STW
7YW300346	31/03/2023	HAXBY WALBUTTS/STW
7YW300348	31/03/2023	HAXBY WALBUTTS/STW
7YW300356	31/03/2023	HELPERBY/STW
7YW300360	31/03/2023	HETTON/STW
7YW300362	31/03/2023	HIGH ROYD/NO 2 STW
7YW300368	31/03/2023	HOLMESFIELD/STW
7YW300364	31/03/2023	HOOK/STW
7YW300374	31/03/2023	HOVINGHAM/STW
7YW300378	31/03/2023	HOYLANDSWAINE/STW
7YW300380	31/03/2023	HUDDERSFIELD/STW
7YW300382	31/03/2023	HUDDERSFIELD/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300386	31/03/2023	HUNMANBY/STW
7YW300388	31/03/2023	HUNTON/STW
7YW300390	31/03/2023	HUSTHWAITE/STW
7YW300396	31/03/2024	KEARBY/STW
7YW300402	31/03/2024	KETTLEWELL/STW
7YW300404	31/03/2024	KILHAM/STW
7YW300422	31/03/2024	LEEMING BAR/STW
7YW300424	31/03/2024	LEMONROYD/STW
7YW300426	31/03/2024	LEVEN/STW
7YW300428	31/03/2024	LEYBURN/STW
7YW300434	31/03/2024	LONG MARSTON/STW
7YW300436	31/03/2024	LONG RISTON NORTH/STW
7YW300448	31/03/2024	MASHAM/STW
7YW300450	31/03/2024	MELBOURNE/STW
7YW300452	31/03/2024	MELBOURNE/STW
7YW300454	31/03/2024	MELTHAM/STW
7YW300456	31/03/2024	MELTON/STW
7YW300458	31/03/2024	MEXBORO SWINTON/STW
7YW300462	31/03/2024	MIDDLETON TYAS/NO 2 STW
7YW300464	31/03/2024	MORTON ON SWALE/STW
7YW300466	31/03/2024	NAFFERTON/STW
7YW300468	31/03/2024	NEILEY/NO 2 STW
7YW300470	31/03/2024	NEWTON LE WILLOWS/STW
7YW300474	31/03/2024	NORTH COWTON/STW
7YW300480	31/03/2024	NORTH STAINLEY/STW
7YW300482	31/03/2024	NORTHALLERTON/STW
7YW300484	31/03/2024	NORTON/NO 2 STW
7YW300486	31/03/2024	NOTTON VILLAGE/STW
7YW300492	31/03/2024	OTLEY/STW
7YW300494	31/03/2024	OTTRINGHAM/STW
7YW300496	31/03/2024	OXENHOPE/NO 2 STW
7YW300500	31/03/2024	PATRINGTON/STW
7YW300504	31/03/2024	POCKLINGTON/STW
7YW300508	31/03/2024	RAWCLIFFE YORK/STW
7YW300510	31/03/2024	REDACRE/NO 2 STW

WINEP ID	Regulatory Date	Obligation Title
7YW300512	31/03/2024	RENISHAW/STW
7YW300514	31/03/2024	RICHMOND/STW
7YW300516	31/03/2025	RILLINGTON/STW
7YW300522	31/03/2025	RUFFORTH/STW
7YW300528	31/03/2025	SEAMER/STW
7YW300532	31/03/2025	SETTRINGTON/STW
7YW300534	31/03/2025	SHAW MILLS/STW
7YW300538	31/03/2025	SHERBURN/STW
7YW300540	31/03/2025	SHERIFF HUTTON/STW
7YW300542	31/03/2025	SHIPTON/NO 2 STW
7YW300546	31/03/2025	SINDERBY/STW
7YW300550	31/03/2025	SKELTON/STW
7YW300552	31/03/2025	SKIDBY/STW
7YW300560	31/03/2025	SNAPE/STW
7YW300562	31/03/2025	SOUTH ELMSALL/STW
7YW300564	31/03/2025	STANLEY/STW
7YW300566	31/03/2025	STAVELEY/STW
7YW300574	31/03/2025	SUTTON/STW
7YW300576	31/03/2025	TADCASTER/DOMEST STW
7YW300578	31/03/2025	TANKERSLEY/STW
7YW300580	31/03/2025	TEMPLE NORMANTON/STW
7YW300582	31/03/2025	THIRSK/STW
7YW300586	31/03/2025	THORNTON LE DALE/STW
7YW300590	31/03/2025	TOCKWITH/STW
7YW300592	31/03/2025	TOLLERTON/STW
7YW300598	31/03/2025	WATH ON DEARNE/STW
7YW300600	31/03/2025	WATH RIPON/STW
7YW300604	31/03/2025	WEETON/STW
7YW300606	31/03/2025	WEST BRETTON/NO 2 STW
7YW300610	31/03/2025	WHARNCLIFFE SIDE/STW
7YW300614	31/03/2025	WHITBY/STW
7YW300616	31/03/2025	WHITBY/STW
7YW300618	31/03/2025	WILLIAMTHORPE/STW
7YW300622	31/03/2025	WITHERNSEA/NO 2 STW
7YW300624	31/03/2025	WOMBWELL/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300628	31/03/2025	WOOLLEY VILLAGE/STW
7YW300630	31/03/2025	WORSBROUGH/STW
7YW300632	31/03/2025	YORK NABURN/STW
7YW300634	31/03/2025	YORK NABURN/STW

Meaures for WW flow and storm tanks – U_MON5 Sites First Time Flow Monitoring

WINEP ID	Regulatory Date	Obligation Title
7YW200151	31/03/2023	BECKWITHSHAW/STW
7YW200152	31/03/2025	RAVENFIELD/STW
7YW200153	31/03/2024	INGLEBY ARNCLIFFE/STW
7YW200154	31/03/2023	GILLING EAST/STW
7YW200155	31/03/2023	HUDSWELL/STW
7YW200156	31/03/2025	WENTWORTH CASTLE/STW
7YW200157	31/03/2024	MELTON COLLEGE/STW

Meaures for WW flow and storm tanks – U_INV2 Sites PFF Measurement Investigations

WINEP ID	Regulatory Date	Obligation Title
7YW300156	31/03/2022	ABERFORD/STW
7YW300158	31/03/2022	ACKWORTH/STW
7YW300160	31/03/2022	ADWICK/NO 2 STW
7YW300162	31/03/2022	AIREDALE/STW
7YW300170	31/03/2022	APPLETON WISKE/STW
7YW300174	31/03/2022	ASKRIGG/STW
7YW300176	31/03/2022	BAGBY/STW
7YW300180	31/03/2022	BALBY/STW
7YW300182	31/03/2022	BARLBY/STW
7YW300188	31/03/2022	BEAMSLEY/STW
7YW300198	31/03/2022	BENTLEY/STW
7YW300202	31/03/2022	BISHOP MONKTON/NO 2 STW
7YW300206	31/03/2022	BLACKBURN MEADOWS/STW
7YW300208	31/03/2022	BOLSOVER/STW
7YW300210	31/03/2022	BOLTON ON DEARNE/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300214	31/03/2022	BRADFORD ESHOLT/NO 2 STW
7YW300220	31/03/2022	BURN/STW
7YW300228	31/03/2022	CALDER VALE/STW
7YW300242	31/03/2022	CLAYTON WEST/STW
7YW300244	31/03/2022	COLBURN/STW
7YW300256	31/03/2022	CUDWORTH/NO 2 STW
7YW300260	31/03/2022	DANESMOOR/STW
7YW300262	31/03/2022	DARFIELD/NO 2 STW
7YW300268	31/03/2022	DENABY/NO 2 STW
7YW300278	31/03/2023	DRONFIELD/STW
7YW300284	31/03/2023	EASINGWOLD/STW
7YW300290	31/03/2023	EGTON BRIDGE/STW
7YW300292	31/03/2023	ELLERKER/NO 2 STW
7YW300294	31/03/2023	ELVINGTON/STW
7YW300296	31/03/2023	EMBSAY/STW
7YW300312	31/03/2023	GILLING WEST/STW
7YW300322	31/03/2023	GRASSINGTON/STW
7YW300326	31/03/2023	GROSMONT/STW
7YW300336	31/03/2023	HAROME/STW
7YW300338	31/03/2023	HARROGATE NORTH/STW
7YW300340	31/03/2023	HARROGATE SOUTH/STW
7YW300344	31/03/2023	HAWES/STW
7YW300350	31/03/2023	HEBDEN/STW
7YW300352	31/03/2023	HEDON/STW
7YW300354	31/03/2023	HELMSLEY/STW
7YW300358	31/03/2023	HEMINGBROUGH/NO 2 STW
7YW300366	31/03/2023	HOLME ON SPALDING MR/STW
7YW300370	31/03/2023	HORBURY/STW
7YW300372	31/03/2023	HORNSEA/STW
7YW300376	31/03/2023	HOWDEN/STW
7YW300384	31/03/2023	HULL/STW
7YW300392	31/03/2023	ILKLEY/STW
7YW300394	31/03/2023	INGBIRCHWORTH/NO 2 STW
7YW300398	31/03/2024	KEIGHLEY MARLEY/STW
7YW300400	31/03/2024	KELFIELD/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300406	31/03/2024	KIRK HAMMERTON/STW
7YW300408	31/03/2024	KIRK SMEATON/STW
7YW300410	31/03/2024	KIRKBY MALZEARD/STW
7YW300412	31/03/2024	KIRKBYMOORSIDE/STW
7YW300414	31/03/2024	KNARESBOROUGH/STW
7YW300416	31/03/2024	KNOSTROP/STW
7YW300418	31/03/2024	KNOSTROP/STW
7YW300420	31/03/2024	LEALHOLM/STW
7YW300430	31/03/2024	LOCKINGTON/STW
7YW300432	31/03/2024	LONG LANE/STW
7YW300438	31/03/2024	LUNDWOOD/STW
7YW300440	31/03/2024	MALHAM/NO 2 STW
7YW300442	31/03/2024	MALTON/STW
7YW300444	31/03/2024	MARKET WEIGHTON/NO 2 STW
7YW300446	31/03/2024	MARKINGTON/STW
7YW300460	31/03/2024	MICKLEFIELD/NO 2 STW
7YW300472	31/03/2024	NORMANTON/STW
7YW300476	31/03/2024	NORTH DEIGHTON/STW
7YW300478	31/03/2024	NORTH FERRIBY/STW
7YW300488	31/03/2024	NUN MONKTON/STW
7YW300490	31/03/2024	OLD WHITTINGTON/STW
7YW300498	31/03/2024	PATELEY BRIDGE/STW
7YW300502	31/03/2024	PICKERING/STW
7YW300506	31/03/2024	POOL/STW
7YW300518	31/03/2025	RIPON/STW
7YW300520	31/03/2025	RIPPONDEN/STW
7YW300524	31/03/2025	SANDALL/STW
7YW300526	31/03/2025	SCARBOROUGH/STW
7YW300530	31/03/2025	SELBY/NO 2 STW
7YW300536	31/03/2025	SHERBURN IN ELMET/STW
7YW300544	31/03/2025	SILKSTONE/STW
7YW300548	31/03/2025	SINNINGTON/STW
7YW300554	31/03/2025	SKIPTON/STW
7YW300556	31/03/2025	SLINGSBY/NO 2 STW
7YW300558	31/03/2025	SNAITH/STW

WINEP ID	Regulatory Date	Obligation Title
7YW300568	31/03/2025	STOCKLEY/STW
7YW300570	31/03/2025	STOCKSBRIDGE/STW
7YW300572	31/03/2025	SUTTON ON THE FOREST/STW
7YW300584	31/03/2025	THORNE/STW
7YW300588	31/03/2025	THORP ARCH/STW
7YW300594	31/03/2025	TUPTON/STW
7YW300596	31/03/2025	UPTON WRANGBROOK/STW
7YW300602	31/03/2025	WATTON/STW
7YW300608	31/03/2025	WETHERBY/STW
7YW300612	31/03/2025	WHELDRAKE/STW
7YW300620	31/03/2025	WISTOW/STW
7YW300626	31/03/2025	WOODHOUSE MILL/NO 2 STW

Meaures for WW flow and storm tanks – U_IMP5 Sites Increased FFT

WINEP ID	Regulatory Date	Obligation Title
7YW200959	31/03/2023	CAWTHORNE/STW
7YW200967	31/03/2023	HETTON/STW
7YW300154	31/03/2024	HOLME ON SPALDING MR/STW
7YW200980	31/03/2024	MEXBORO SWINTON/STW
7YW201021	31/03/2025	RIPON/STW
7YW201119	31/03/2025	RIPPONDEN/STW

Meaures for WW flow and storm tanks – U_IMP6 Sites Increased Storm Tank Capacity

WINEP ID	Regulatory Date	Obligation Title
7YW201182	31/03/2023	ACKWORTH/STW
7YW201228	31/03/2023	BARLBY/STW
7YW201216	31/03/2023	BEDALE/STW
7YW201213	31/03/2023	BOROUGHBRIDGE/NO 2 STW
7YW201272	31/03/2023	BRADFORD ESHOLT/NO 2 STW
7YW201247	31/03/2023	BURLEY IN WHARFEDALE/STW
7YW201266	31/03/2023	BURTON PIDSEA/STW
7YW201181	31/03/2023	CARLETON/NO 2 STW

WINEP ID	Regulatory Date	Obligation Title
7YW201201	31/03/2023	CATTERICK VILLAGE/STW
7YW201264	31/03/2023	CHERRY BURTON/STW
7YW201183	31/03/2023	COLD HIENDLEY/STW
7YW201198	31/03/2023	CUDWORTH/NO 2 STW
7YW201250	31/03/2023	DARFIELD/NO 2 STW
7YW201193	31/03/2023	DENHOLME/NO 2 STW
7YW201246	31/03/2023	DEWSBURY/STW
7YW201222	31/03/2023	EASINGWOLD/STW
7YW201187	31/03/2023	EGGBOROUGH/STW
7YW201192	31/03/2023	GRIMETHORPE/STW
7YW201252	31/03/2023	HARLEY/STW
7YW201232	31/03/2023	HELMSLEY/STW
7YW201218	31/03/2023	HELPERBY/STW
7YW201186	31/03/2024	HETTON/STW
7YW201265	31/03/2024	HOLME ON SPALDING MR/STW
7YW201233	31/03/2024	HOVINGHAM/STW
7YW201202	31/03/2024	ILKLEY/STW
7YW201276	31/03/2024	INGBIRCHWORTH/NO 2 STW
7YW201225	31/03/2024	KELFIELD/STW
7YW201208	31/03/2024	KIRK HAMMERTON/STW
7YW201211	31/03/2024	KIRKBY MALZEARD/STW
7YW201231	31/03/2024	KIRKBYMOORSIDE/STW
7YW201271	31/03/2024	KNOSTROP/STW
7YW201273	31/03/2024	LEMONROYD/STW
7YW201275	31/03/2024	LEVEN/STW
7YW201260	31/03/2024	LONG MARSTON/STW
7YW201274	31/03/2024	LONG RISTON NORTH/STW
7YW201224	31/03/2024	MICKLEFIELD/NO 2 STW
7YW201217	31/03/2024	NORTH COWTON/STW
7YW201241	31/03/2024	NORTON/NO 2 STW
7YW201237	31/03/2024	POCKLINGTON/STW
7YW201205	31/03/2024	POOL/STW
7YW201220	31/03/2024	RAWCLIFFE YORK/STW
7YW201196	31/03/2024	RENISHAW/STW
7YW201219	31/03/2025	RICHMOND/STW

WINEP ID	Regulatory Date	Obligation Title
7YW201235	31/03/2025	RILLINGTON/STW
7YW201238	31/03/2025	SANDALL/STW
7YW201207	31/03/2025	SHAW MILLS/STW
7YW201236	31/03/2025	SHERBURN/STW
7YW201229	31/03/2025	SHERIFF HUTTON/STW
7YW201223	31/03/2025	SHIPTON/NO 2 STW
7YW201195	31/03/2025	SILKSTONE/STW
7YW201189	31/03/2025	SNAITH/STW
7YW201269	31/03/2025	STAVELEY/STW
7YW201249	31/03/2025	STOCKLEY/STW
7YW201221	31/03/2025	SUTTON ON THE FOREST/STW
7YW201206	31/03/2025	TADCASTER/DOMEST STW
7YW201204	31/03/2025	THORP ARCH/STW
7YW201209	31/03/2025	TOCKWITH/STW
7YW201227	31/03/2025	TOLLERTON/STW
7YW201239	31/03/2025	TUPTON/STW
7YW201199	31/03/2025	WATTON/STW
7YW201203	31/03/2025	WETHERBY/STW
7YW201200	31/03/2025	WILLIAMTHORPE/STW
7YW201226	31/03/2025	WISTOW/STW

Measures under Urban Waste Water Treatment Sensitive Area (Eutrophication) Designations

WINEP ID	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200917	Caldervale WwTW	Aire-Calder	1	31/03/2025
7YW200918	Castleford WwTW	Aire-Calder	2	31/03/2025
7YW200923	Dewsbury (Mitchell Laithes) WwTW	Aire-Calder	1	31/03/2025
7YW200924	Dowley Gap (Bingley) WwTW	Aire-Calder	2	31/03/2025
7YW200951	Eastwood WwTW	Aire-Calder	2	31/03/2025
7YW200916	Esholt WwTW	Aire-Calder	1	31/03/2025
7YW200952	Halifax WwTW	Aire-Calder	1	31/03/2025
7YW200950	High Royd WwTW	Aire-Calder	2	31/03/2025

WINEP ID	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200929	Horbury (Dudfleet) WwTW	Aire-Calder	2	31/03/2025
7YW200954	Huddersfield STW Colne Bridge	Aire-Calder	2	31/03/2025
7YW200930	Huddersfield STW Cooper Bridge	Aire-Calder	1	31/03/2025
7YW200955	Keighley (Marley) WwTW	Aire-Calder	2	31/03/2025
7YW200931	Knostrop WwTW	Aire-Calder	1	31/03/2025
7YW200932	Lemonroyd WwTW	Aire-Calder	2	31/03/2025
7YW200953	Neiley WwTW	Aire-Calder	2	31/03/2025
7YW200935	Normanton (Mill Lane) WwTW	Aire-Calder	2	31/03/2025
7YW200926	Owlwood (Garforth) SWwTW	Aire-Calder	2	31/03/2025
7YW200942	Smalley Bight (Stanley) WwTW	Aire-Calder	2	31/03/2025
7YW200940	Snaith WwTW	Aire-Calder	2	31/03/2025
7YW201465	Snaygill (Skipton) WwTW	Aire-Calder	2	31/03/2025
7YW200945	Sutton WwTW	Aire-Calder	2	31/03/2025
7YW200910	Adwick Le Street WwTW	Don-Rother	2	31/03/2025
7YW200911	Aldwarke WwTW	Don-Rother	1	31/03/2025
7YW200912	Bentley WwTW	Don-Rother	2	31/03/2025
7YW200913	Blackburn Meadows WwTW	Don-Rother	1	31/03/2025
7YW200914	Bolsover WwTW	Don-Rother	2	31/03/2025
7YW200915	Bolton On Dearne WwTW	Don-Rother	2	31/03/2025
7YW200919	Cheesebottom WwTW	Don-Rother	2	31/03/2025
7YW200920	Clayton West WwTW	Don-Rother	2	31/03/2025
7YW200921	Darton WwTW	Don-Rother	2	31/03/2025
7YW200922	Denaby WwTW	Don-Rother	2	31/03/2025
7YW200925	Dronfield WwTW	Don-Rother	2	31/03/2025
7YW200927	Grimethorpe WwTW	Don-Rother	2	31/03/2025
7YW200933	Long Lane WwTW	Don-Rother	2	31/03/2025
7YW200934	Lundwood WwTW	Don-Rother	2	31/03/2025
7YW200957	Mexboro Swinton WwTW	Don-Rother	2	31/03/2025
7YW200936	Norton (Askern) WwTW	Don-Rother	2	31/03/2025
7YW200937	Old Whittington WwTW	Don-Rother	1	31/03/2025
7YW200938	Sandall WwTW	Don-Rother	2	31/03/2025

WINEP ID	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200941	South Elmsall WwTW	Don-Rother	2	31/03/2025
7YW200943	Staveley WwTW	Don-Rother	2	31/03/2025
7YW200944	Stocksbridge WwTW	Don-Rother	2	31/03/2025
7YW200958	Thorne WwTW	Don-Rother	2	31/03/2025
7YW200946	Tupton WwTW	Don-Rother	2	31/03/2025
7YW200956	Wath Upon Dearne WwTW	Don-Rother	2	31/03/2025
7YW200947	Wombwell WwTW	Don-Rother	2	31/03/2025
7YW200948	Woodhouse Mill WwTW	Don-Rother	1	31/03/2025
7YW200949	Worsborough WwTW	Don-Rother	2	31/03/2025
7YW200928	Harrogate South WwTW	SUNO	2	31/03/2025
7YW200939	Sherburn In Elmet WwTW	Wharfe and Lower Ouse	2	31/03/2025

Measures to improve to WFD moderate and good ecological status for phosphorous removal

WINEP ID	NEP Driver	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200818	WFD_IMPg	ESHOLT STW(Bradford)	Aire-Calder	0.5	22/12/2024
7YW200819	WFD_IMPg	KNOSTROP WWTW	Aire-Calder	0.4	22/12/2024
7YW200820	WFD_IMPg	LEMONROYD STW	Aire-Calder	2	22/12/2024
7YW100125	WFD_IMPm	OWLWOOD (GARFORTH) STW	Aire-Calder	0.25	22/12/2024
7YW200822	WFD_IMPg	WHELDALE (CASTLEFORD	Aire-Calder	3	22/12/2024
7YW200823	WFD_IMPg	SUTTON WWTW	Aire-Calder	1	22/12/2024
7YW100124	WFD_IMPg	Oxenhope WwTW	Aire-Calder	0.3	22/12/2021
7YW200816	WFD_IMPg	KEIGHLEY MARLEY/STW	Aire-Calder	0.5	22/12/2024

WINEP ID	NEP Driver	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200817	WFD_IMPg	DOWLEY GAP (BINGLEY)	Aire-Calder	0.25	22/12/2024
7YW200810	WFD_IMPg	EMBSAY/STW	Aire-Calder	0.25	22/12/2024
7YW200811	WFD_IMPg	EAST MARTON	Aire-Calder	4	22/12/2024
7YW200793	WFD_IMPg	CROFTON/STW	Aire-Calder	0.2	22/12/2024
7YW200801	WFD_IMPg	Huddersfield STW Colne Bridge	Aire-Calder	0.25	22/12/2024
7YW200802	WFD_IMPg	HUDDERSFIELD STW Cooper Bridge	Aire-Calder	0.25	22/12/2024
7YW200803	WFD_IMPg	MITCHELL LAITHES WWT	Aire-Calder	0.5	22/12/2024
7YW200804	WFD_IMPg	HORBURY (DUDFLEET) STW	Aire-Calder	0.5	22/12/2024
7YW200805	WFD_IMPg	CALDER VALE/STW	Aire-Calder	0.6	22/12/2024
7YW200806	WFD_IMPg	SMALLEY BIGHT (STANL	Aire-Calder	1	22/12/2024
7YW200807	WFD_IMPg	NORMANTON/STW (Mill Lane)	Aire-Calder	0.8	22/12/2024
7YW200796	WFD_IMPg	RIPPONDEN WOOD STW	Aire-Calder	0.5	22/12/2024
7YW200798	WFD_IMPg	REDACRE STW	Aire-Calder	0.5	22/12/2024
7YW200799	WFD_IMPg	HIGH ROYD NO 2 STW	Aire-Calder	0.5	22/12/2024
7YW200800	WFD_IMPg	HALIFAX COPLEY STW	Aire-Calder	0.3	22/12/2024
7YW200797	WFD_IMPg	EASTWOOD/STW	Aire-Calder	0.5	22/12/2024
7YW200794	WFD_IMPg	MELTHAM/STW	Aire-Calder	0.4	22/12/2024
7YW200795	WFD_IMPg	NEILEY NO 2 STW	Aire-Calder	0.4	22/12/2024

WINEP ID	NEP Driver	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200790	WFD_IMPg	BISHOP WILTON WPC WO	Derwent (Yorkshire)	1	22/12/2024
7YW200791	WFD_IMPg	POCKLINGTON/STW	Derwent (Yorkshire)	0.25	22/12/2024
7YW200784	WFD_IMPg	HAROME/STW	Derwent (Yorkshire)	0.25	22/12/2024
7YW200830	WFD_IMPm	GRIMETHORPE/STW	Don-Rother	0.25	22/12/2024
7YW200831	WFD_IMPg	CLAYTON WEST/STW	Don-Rother	0.25	22/12/2024
7YW200832	WFD_IMPg	HOYLANDS WAINE/STW	Don-Rother	0.4	22/12/2024
7YW200825	WFD_IMPm	SOUTH ELMSALL/STW	Don-Rother	0.3	22/12/2024
7YW200826	WFD_IMPg	WRANGBROOK STW	Don-Rother	0.5	22/12/2024
7YW200827	WFD_IMPm	Adwick Le Street	Don-Rother	0.3	22/12/2024
7YW200867	WFD_IMPg	BENTLEY/STW P removal for WFD	Don-Rother	0.25	22/12/2024
7YW100131	WFD_IMPg	ACKWORTH/STW	Don-Rother	0.5	22/12/2024
7YW100132	WFD_IMPm	CARLETON/NO 2 STW	Don-Rother	0.25	22/12/2024
7YW200872	WFD_IMPg	KIRK SMEATON/STW	Don-Rother	0.5	22/12/2024
7YW100133	WFD_IMPg	NORTON (ASKERN) WwTW	Don-Rother	0.25	22/12/2024
7YW200850	WFD_IMPg	BLACKBURN MEADOWS/STW	Don-Rother	0.3	22/12/2024
7YW200863	WFD_IMPg	ALDWARKE/STW	Don-Rother	0.7	22/12/2024
7YW200864	WFD_IMPg	MEXBORO SWINTON/STW	Don-Rother	1	22/12/2024
7YW200865	WFD_IMPg	DENABY WTW	Don-Rother	0.6	22/12/2024
7YW200846	WFD_IMPg	INGBIRCHWORTH STW	Don-Rother	1	22/12/2024

WINEP ID	NEP Driver	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200847	WFD_IMPm	CHEESEBOTTOM STW	Don-Rother	0.5	22/12/2024
7YW200848	WFD_IMPm	STOCKSBRIDGE/STW	Don-Rother	0.5	22/12/2024
7YW200866	WFD_IMPg	Clifton STW	Don-Rother	4	22/12/2024
7YW100126	WFD_IMPm	DRONFIELD/STW	Don-Rother	0.3	22/12/2024
7YW100128	WFD_IMPm	DANESMOOR/STW	Don-Rother	0.4	22/12/2024
7YW100129	WFD_IMPm	TUPTON/STW	Don-Rother	0.2	22/12/2024
7YW200857	WFD_IMPg	Old Whittington (Chesterfield) STW	Don-Rother	0.25	22/12/2024
7YW200858	WFD_IMPg	STOCKLEY/STW	Don-Rother	0.5	22/12/2024
7YW200859	WFD_IMPg	BOLSOVER/STW	Don-Rother	0.3	22/12/2024
7YW200860	WFD_IMPg	STAVELEY/STW	Don-Rother	0.25	22/12/2024
7YW200861	WFD_IMPg	WOODHOUSE MILL WwTW	Don-Rother	0.9	22/12/2024
7YW200862	WFD_IMPg	LONG LANE/STW	Don-Rother	0.5	22/12/2024
7YW100122	WFD_IMPg	STILLINGTON STW	Ouse (SUNO)	1.5	22/12/2021
7YW100123	WFD_IMPg	SHERIFF HUTTON/STW	Ouse (SUNO)	1	22/12/2021
7YW200756	WFD_IMPg	KILLINGHALL STW	Ouse (SUNO)	0.5	22/12/2024
7YW200737	WFD_IMPg	CARTHORPE WPC WORKS	Ouse (SUNO)	0.5	22/12/2024
7YW200757	WFD_IMPg	SHAW MILLS/STW	Ouse (SUNO)	1	22/12/2024
7YW100121	WFD_IMPm	HARROGATE SOUTH/STW	Ouse (SUNO)	0.4	22/12/2024
7YW100120	WFD_IMPg	SUTTON ON THE FOREST/STW	Ouse (SUNO)	0.7	22/12/2021
7YW200748	WFD_IMPg	Rainton STW	Ouse (SUNO)	3	22/12/2024

WINEP ID	NEP Driver	Obligation Title	WFD Management Catchment	Standard (mg/l annual average)	Regulatory Date
7YW200749	WFD_IMPg	DISHFORTH WPC WORKS	Ouse (SUNO)	0.5	22/12/2024
7YW200750	WFD_IMPg	KIRKBY MALZEARD/STW	Ouse (SUNO)	1.5	22/12/2024
7YW200743	WFD_IMPg	THORNTON LE BEANS	Ouse (SUNO)	1.5	22/12/2024
7YW200005	WFD_IMPg	BALBY (STW)	Trent	0.25	22/12/2024
7YW200006	WFD_IMPg	HATFIELD WOODHOUSE (STW)	Trent	0.3	22/12/2024
7YW200777	WFD_IMPg	DRAUGHTON WPC WORKS	Wharfe & Lower Ouse	0.25	22/12/2024
7YW200782	WFD_IMPm	SHERBURN IN ELMET/STW	Wharfe & Lower Ouse	0.5	22/12/2024

Measures in WFD to improve ammonia

WINEP ID	WINEP Driver	Obligation Title	WFD Management Catchment	Standard (mg/l 95th percentile (Upper Tier))	Regulatory Date
7YW200719	WFD_IMPg	SHERBURN IN ELMET/STW	Wharfe & Lower Ouse	1.3 (12)	21/12/2024
7YW200731	WFD_IMPg	BOLSOVER/STW	Don-Rother	1 (12)	21/12/2024
7YW200007	WFD_IMPg	HATFIELD WOODHOUSE/STW	Trent	2 (12)	21/12/2024

Measures in WFD to prevent no deterioiration of the water course

WINEP ID	WINEP Driver	Obligation Title	Standard (mg/l) (95th percentile (Upper Tier))	Regulatory Date
7YW200642	BOD	WENTWORTH/STW	9 (47)	31/03/2025
7YW200643	BOD	BELLERBY/STW	16 (51)	31/03/2025
7YW200646	BOD	WORSBROUGH/STW	7 (44)	31/03/2025
7YW200647	BOD	DRAUGHTON/STW	12 (48)	31/03/2025
7YW200648	Ammonia	BOLSOVER/STW	7 (27)	31/03/2025
7YW200644	Ammonia	BARWICK IN ELMET/STW	6 (23)	31/03/2025
7YW200649	Ammonia	WORSBROUGH/STW	3 (12)	31/03/2025
7YW200650	Ammonia	HAXBY WALBUTTS/STW	3 (12)	31/03/2025
7YW300071	Ammonia	OXENHOPE/STW	8 (30)	31/03/2025

Investigations under the WFD Chemicals Driver

WINEP ID	Obligation Title	WINEP Driver	Regulatory Date
7YW300001, 7YW300002	Adwick Le Street STW (CIP1)	WFD_INV_CHEM10WFD_INV_CHEM9	30/09/2021
7YW300003	Aldwarke STW (CIP2 T2)	WFD_NDLS_CHEM1	22/12/2022
7YW300004	Bentley WwTW	WFD_INV_CHEM6	30/09/2021
7YW300005	Beverley STW	WFD_INV_CHEM2	30/09/2021
7YW300008	Burton Fleming STW	WFD_INV_CHEM1	30/09/2021
7YW300009, 7YW300010, 7YW300011	Cherry Burton STW (CIP2 T2)	WFD_INV_CHEM10, WFD_MON_CHEM, WFD_INV_CHEM6	30/09/2021 31/03/2025 30/09/2021
7YW300014	Darley WwTW	WFD_INV_CHEM4	30/09/2021
7YW300015	Dewsbury/STW	WFD_INV_CHEM1	30/09/2021
7YW300016	Esholt (Bradford) STW	WFD_INV_CHEM1	30/09/2021
7YW300017	Garforth WwTW	WFD_INV_CHEM6	30/09/2021
7YW300018, 7YW200023	Grimethorpe STW (CIP1)	WFD_INV_CHEM9, WFD_NDLS_Chem2	30/09/2021 22/12/2022
7YW300006, 7YW300007	Huddersfield STW	WFD_MON_CHEM, WFD_INV_CHEM14	31/03/2025

WINEP ID	Obligation Title	WINEP Driver	Regulatory Date
			30/09/2021
7YW300019, 7YW300020, 7YW300021	Hull WwTW	WFD_INV_CHEM2, WFD_MON_CHEM, WFD_INV_CHEM14	30/09/2021 31/03/2025 30/09/2021
7YW200038, 7YW300022, 7YW300023	Knostrop STW (CIP2 T1)	WFD_NDLS_Chem2, WFD_INV_CHEM1, WFD_INV_CHEM14	22/12/2022 30/09/2021 30/09/2021
7YW300025	Middleton on the Wolds STW	WFD_INV_CHEM1	30/09/2021
7YW300026	Naburn	WFD_INV_CHEM7	30/09/2021
7YW300027	North Dalton STW	WFD_INV_CHEM1	30/09/2021
7YW300028	Otley WwTW	WFD_INV_CHEM11	30/09/2021
7YW300029	Pateley Bridge WwTW	WFD_INV_CHEM4	30/09/2021
7YW200040, 7YW200041, 7YW200042	Pocklington STW (CIP2 T1)	WFD_NDLS_Chem2, WFD_NDLS_Chem2, WFD_NDLS_Chem2	22/12/2022 22/12/2022 22/12/2022
7YW300031, 7YW300032	Renishaw WWTW (CIP2 T1)	WFD_INV_CHEM10, WFD_INV_CHEM9	30/09/2021 30/09/2021
7YW300034	Scarborough	WFD_MON_CHEM	31/03/2025
7YW200043, 7YW300035, 7YW300036	Sherburn in Elmet STW (CIP2 T1)	WFD_NDLS_Chem2, WFD_INV_CHEM10, WFD_INV_CHEM9	22/12/2022 30/09/2021 30/09/2021
7YW300037	Skipton WwTW	WFD_INV_CHEM11	30/09/2021
7YW300038	Thorne	WFD_INV_CHEM2	30/09/2021
7YW300039	Thorp Arch WwTW	WFD_INV_CHEM11	30/09/2021
7YW300040	Tibthorpe STW	WFD_INV_CHEM1	30/09/2021
7YW300041	Weaverthorpe STW	WFD_INV_CHEM1	30/09/2021
7YW300042	West Lutton STW	WFD_INV_CHEM1	30/09/2021
7YW300043	Wetwang STW	WFD_INV_CHEM1	30/09/2021
7YW300044	York Naburn	WFD_MON_CHEM	30/03/2025
7YW300012	CIP Anti Microbial Resistance Investigations	WFD_INV_CHEM3	30/09/2021
7YW300013	CIP Microplastics Investigations	WFD_INV_CHEM5	30/09/2021
7YW300024	Mechanisms of chemical removal	WFD_INV_CHEM12	30/09/2021
7YW300033	Risk-based extension to CIP Investigations	WFD_INV_CHEM1	30/09/2021
7YW300030	Project Management	WFD_INV_CHEM8	30/09/2021

WFD Chemicals Driver - schemes under the No Deterioiration Chemicals Driver

WINEP ID	Obligation Title	Regulatory Date
7YW300003	Aldwarke STW (CIP2 T2)	22/12/22
7YW200023	Grimethorpe STW (CIP1)	22/12/22
7YW200038	Knostrop STW (CIP2 T1)	22/12/22
7YW200040	Pocklington STW (CIP2 T1)	22/12/22
7YW200041	Pocklington STW (CIP2 T1)	22/12/22
7YW200042	Pocklington STW (CIP2 T1)	22/12/22
7YW200043	Sherburn in Elmet STW (CIP2 T1)	22/12/22

WFD Investigations

WINEP ID	Obligation Title	Regulatory Date
7YW200906	Oakenshaw Beck UPM	30/09/2021
7YW200907	Choke Churl Beck UPM	30/09/2021
7YW200903	Rother 1 (Source to Redleadmill Brook) UPM	30/09/2021
7YW200902	Rother 2 (Spital Brook to River Doe Lea) UPM	30/09/2021
7YW200904	Holgate Beck UPM	30/09/2021
7YW300073	Hookstone Beck UPM	30/09/2021
7YW201460	Costa Beck SOD Miscellaneous Study	30/09/2021
7YW200898	Holderness Drain Miscellaneous Study: Phosphorus; Ammonia; BOD/DO	30/09/2021
7YW201457	Bradford Beck UPM	30/09/2021
7YW300074	Bradford Beck Catchment Investigation	30/09/2021

Measures under UWWTD Frequently Operating Overflows

WINEP ID	Regulatory Date	Obligation Title
7YW201297	31/03/2023	TRAFALGAR STREET/CSO
7YW201298	31/03/2024	THORPE ROAD/CSO
7YW201299	31/03/2024	ABBEYDALE MOUNT/CSO
7YW201300	31/03/2024	WIDE LANE WOODLANDS/2 CSO
7YW201301	31/03/2025	HASTILAR ROAD SOUTH/CSO
7YW201302	31/03/2022	FOULRIDGE/CSO
7YW201303	31/03/2024	DENBY DALE ROAD/CSO
7YW201304	31/03/2022	SADDLEWORTH ROAD/CSO
7YW201305	31/03/2022	WEST VALE/CSO

WINEP ID	Regulatory Date	Obligation Title
7YW201306	31/03/2022	WYVIL CRESCENT/CSO
7YW201307	31/03/2022	DRAUGHTON PRIORS LANE/CSO
7YW201308	31/03/2024	TADCASTER WEST/CSO
7YW201309	31/03/2024	TADCASTER EAST/CSO
7YW201310	31/03/2023	BIRSTWITH/NO 2 CSO
7YW201311	31/03/2023	SKIPTON ROAD 109/CSO
7YW201312	31/03/2023	ST MARYS WALK112/CSO
7YW201313	31/03/2023	MILLGATE MASHAM/CSO
7YW201314	31/03/2023	SKELDERGATE BRIDGE/CSO
7YW201315	31/03/2023	FISHERGATE/CSO
7YW201316	31/03/2023	TERRY AVENUE/CSO
7YW201317	31/03/2023	LAYERTHORPE BRIDGE/CSO
7YW201318	31/03/2023	GROSVENOR TERRACE/CSO
7YW201319	31/03/2023	KITCHENER STREET/CSO
7YW201320	31/03/2023	RIVERSIDE GARDENS/CSO
7YW201321	31/03/2023	SPORTSFIELD/NO 2 CSO
7YW201322	31/03/2023	KIRKBY MOORSIDE/NO 2 CSO
7YW201323	31/03/2023	WHEELGATE/CSO
7YW201324	31/03/2023	CARRHOUSE LN CAYTON/2 CSO
7YW201325	31/03/2023	YORKERSGATE/CSO
7YW201326	31/03/2023	ESPLANADE WHITBY/CSO
7YW201327	31/03/2023	RUNSWICK BECK/CSO
7YW201328	31/03/2022	BUCK MILL LANE/CSO
7YW201329	31/03/2022	THURGOLAND/CSO
7YW201330	31/03/2022	RIVADALE VIEW/CSO
7YW201331	31/03/2023	SUMMERBRIDGE/CSO
7YW201332	31/03/2025	BROMPTON ROAD/CSO
7YW201333	31/03/2022	CUCKSTOOL BOTTOM/CSO
7YW201334	31/03/2025	CARLISLE STREET/CSO
7YW201335	31/03/2023	GREAT OUSEBURN EAST/CSO
7YW201336	31/03/2024	FOUNDRY LANE/NO 2 CSO
7YW201337	31/03/2025	GREASBROUGH/CSO
7YW201338	31/03/2022	DOCK LANE/CSO
7YW201339	31/03/2022	THURNSCOE/CSO
7YW201340	31/03/2023	LEBBERSTON TANK/CSO

WINEP ID	Regulatory Date	Obligation Title
7YW201341	31/03/2022	GRANGE MOOR/CSO
7YW201342	31/03/2022	PARK ROAD/CSO
7YW201343	31/03/2024	HOUGH SIDE WORKS/CSO
7YW201344	31/03/2023	JUBILEE TERRACE/CSO
7YW201345	31/03/2022	LEE LANE/STW
7YW201346	31/03/2025	166 BROADWAY/CSO
7YW201347	31/03/2023	STONEBRIDGEGATE FIRE STN/CSO
7YW201348	31/03/2022	BOG GREEN LANE/CSO
7YW201349	31/03/2025	HARROWDEN ROAD/CSO
7YW201350	31/03/2024	DEWSBURY ROAD 51/NO 2 CSO
7YW201351	31/03/2022	HARROGATE ROAD 297/2 CSO
7YW201352	31/03/2025	HIGH ST SWALLOWNEST/CSO
7YW201353	31/03/2022	HARDINGS LANE/CSO
7YW201354	31/03/2022	EASTWOOD/NO 2 CSO
7YW201355	31/03/2023	LOW MILL ROAD/CSO
7YW201356	31/03/2023	VILLAGE GREEN/CSO
7YW201357	31/03/2025	ADWICK ROAD/CSO
7YW201358	31/03/2025	RUSKIN AVENUE/CSO
7YW201359	31/03/2024	EBOR WAY/CSO
7YW201360	31/03/2022	BEMPTON/CSO
7YW201361	31/03/2024	PARK HILL FARM/CSO
7YW201362	31/03/2025	RIVELIN VALLEY 3/CSO
7YW201363	31/03/2023	SEASIDE RD EASINGTON/CSO
7YW201364	31/03/2023	TOLLERTON GARAGE/CSO
7YW201365	31/03/2022	THE BATTS/CSO
7YW201366	31/03/2023	BILLAMS HILL/CSO
7YW201367	31/03/2023	BRANDSBY ROAD/NO 2 CSO
7YW201368	31/03/2022	BROCKHOLES LANE/CSO
7YW201369	31/03/2022	CROW NEST BRIDGE/CSO
7YW201370	31/03/2022	FIELDING STREET/CSO
7YW201371	31/03/2025	HANGINGWATER ROAD/CSO
7YW201372	31/03/2022	KEIGHLEY MARLEY/STW
7YW201373	31/03/2022	DARK LANE WORSBORO/CSO
7YW201374	31/03/2023	BAGLEY BECK RODLEY/CSO
7YW201375	31/03/2023	MOSS BRIDGE ROAD/CSO

WINEP ID	Regulatory Date	Obligation Title
7YW201376	31/03/2022	OUTGANG DRIFFIELD/CSO
7YW201377	31/03/2024	BUCKSTONE ROAD/3 CSO
7YW201378	31/03/2022	SPA MILLS BRIDGE ST/CSO
7YW201379	31/03/2022	GORDON TERRACE/CSO
7YW201380	31/03/2022	CAUSEWAY SIDE 12/CSO
7YW201381	31/03/2022	RAMSDEN MILL/CSO
7YW201382	31/03/2025	FRASER DRIVE/CSO
7YW201383	31/03/2022	BARBER ROW/NO 2 CSO
7YW201384	31/03/2025	GOOLE EAST PARADE/CSO
7YW201385	31/03/2024	ABBEYDALE ROAD SOUTH/CSO
7YW201386	31/03/2025	ABBEY LANE SHEFFIELD/CSO
7YW201387	31/03/2024	ABBEYDALE ROAD 46/CSO
7YW201388	31/03/2025	GRAFTON BRIDGE/CSO
7YW201389	31/03/2022	SANDYBRIDGE LANE/NO 3 CSO
7YW201390	31/03/2024	HAIGH PARK ROAD/CSO
7YW201391	31/03/2022	CLAY HALL/CSO
7YW201392	31/03/2024	HARROGATE ROAD 135/CSO
7YW201393	31/03/2025	RETFORD RD REC GND/2 CSO
7YW201394	31/03/2024	KING EDWARD STREET/NO 2 CSO
7YW201395	31/03/2025	BOBBINMILL LANE/CSO
7YW201396	31/03/2024	ST PAULS STREET/CSO
7YW201397	31/03/2022	SOUTH STREET KEIGHLEY/CSO
7YW201398	31/03/2024	VICKERS ROAD/CSO
7YW201399	31/03/2022	HEBBLE LANE/CSO
7YW201400	31/03/2024	ROUNDHAY MOUNT/NO 2 CSO
7YW201401	31/03/2024	HAREHILLS LANE/NO 2 CSO
7YW201402	31/03/2025	SICEY AVENUE/CSO
7YW201403	31/03/2022	STEETON/CSO
7YW201404	31/03/2024	WHELDON ROAD/CSO
7YW201405	31/03/2025	WOODLANDS DONC ROAD/CSO
7YW201406	31/03/2022	LIDGET BRIDGE/CSO
7YW201407	31/03/2022	HECKMONDWIKE/NO 2 CSO
7YW201408	31/03/2025	HERRIES ROAD/NO 2 CSO
7YW201409	31/03/2024	STANBRIDGE LANE/NO 2 CSO
7YW201410	31/03/2022	SALEM CRICKET GROUND/CSO

WINEP ID	Regulatory Date	Obligation Title
7YW201411	31/03/2022	DALTON ICI NORTH/NO 2 CSO
7YW201412	31/03/2022	WATERLOO ROAD/NO 2 CSO
7YW201413	31/03/2022	WYKE OLD LANE/CSO
7YW201414	31/03/2022	ALEGER STREET/CSO
7YW201415	31/03/2022	THORNHILL/CSO
7YW201416	31/03/2022	NEW INN WEST STREET/CSO
7YW201417	31/03/2022	LONGLANDS ROAD/NO 2 CSO
7YW201418	31/03/2025	MAIN ROAD FARM/CSO
7YW201419	31/03/2025	BRIMINGHAM ROAD/CSO
7YW201420	31/03/2022	COACH ROAD/CSO
7YW201421	31/03/2022	PRINCESS BRIDGE/NO 2 CSO
7YW201422	31/03/2024	BROADFIELD ROAD/CSO
7YW201423	31/03/2025	MANCHESTER ROAD WEIR/CSO
7YW201424	31/03/2024	MEADOW ROAD/CSO
7YW201425	31/03/2024	BURLEY LODGE ROAD/CSO
7YW201426	31/03/2022	COLNE ROAD/CSO
7YW201427	31/03/2025	BRITAIN STREET/CSO
7YW201428	31/03/2022	HUDDERSFIELD RD 106/CSO
7YW201429	31/03/2022	QUEENS MILL ROAD/CSO
7YW201430	31/03/2022	DOG KENNEL BANK/CSO
7YW201431	31/03/2024	VILLAGE PLACE/NO 2 CSO
7YW201432	31/03/2025	EASTWOOD IND ESTATE/CSO
7YW201433	31/03/2022	MILNSBRIDGE/CSO
7YW201434	31/03/2024	LEDGARD WAY/CSO
7YW201435	31/03/2025	DERBY ROAD N242/CSO
7YW201436	31/03/2024	BAPTISTS LANE/CSO
7YW201437	31/03/2024	STAIRFOOT LANE/CSO
7YW201438	31/03/2022	ROOLEY AVENUE/CSO
7YW201439	31/03/2022	SMITH AVENUE/CSO
7YW201440	31/03/2024	NEWMILLERDAM/CSO
7YW201441	31/03/2025	CROW LANE MEMORIAL/CSO
7YW201442	31/03/2025	ALPORT ROAD/CSO
7YW201443	31/03/2022	WEST STREET/CSO
7YW201444	31/03/2022	RIVERSIDE CLOSE/CSO
7YW201445	31/03/2022	SPRING WOOD/CSO

WINEP ID	Regulatory Date	Obligation Title
7YW201446	31/03/2024	DRIVER TERRACE/CSO
7YW201447	31/03/2022	FARNHAM ROAD/CSO
7YW201448	31/03/2022	LONGROYD MANCH ROAD/CSO
7YW201449	31/03/2022	FARTOWN GREEN ROAD/CSO
7YW201450	31/03/2022	QUEENS SQUARE/CSO
7YW201451	31/03/2025	BARROWFIELD ROAD/CSO
7YW201452	31/03/2022	LUMB CLOUGH/CSO
7YW201453	31/03/2022	CARLETON RD SKIPTON/CSO
7YW201454	31/03/2025	PONTEFRACT RD BRAMPTON/CSO

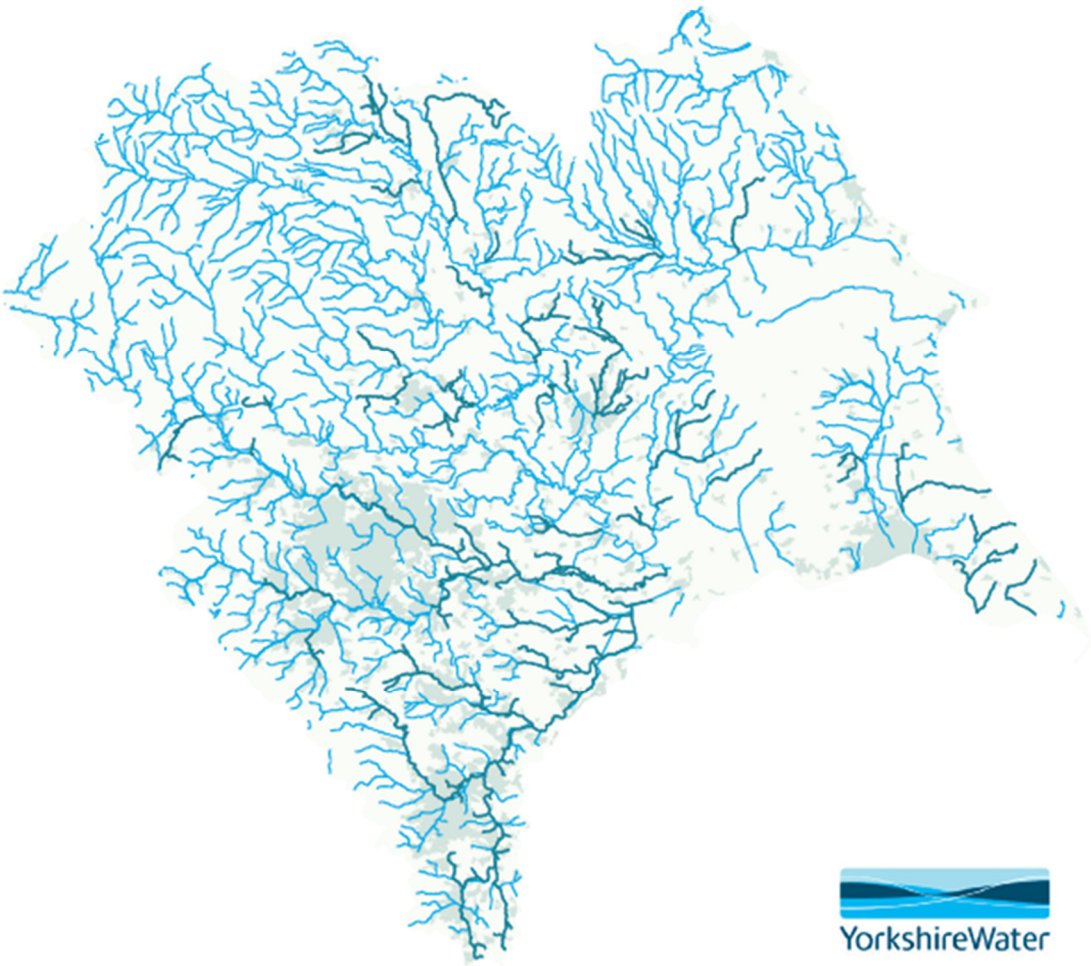
Investigations under WFD Urban Pollution Monitor

WINEP ID	Obligation Title	Regulatory Date
7YW300058/7YW300070	Pudsey Smalewell	22/12/2024
7YW300066	Dick Lane	22/12/2024
7YW300067	Dale Farm SPS/CSO	22/12/2024
7YW300068	Hough Side Works CSO	22/12/2024
7YW300069	Kent Road CSO	22/12/2024
7YW200641	Farnley Ringroad CSO	22/12/2024
7YW200640	c.Hunshelf Road CSO	22/12/2024
7YW200638	Clayton West STW 3x	22/12/2024
7YW300061	Clayton West STW FE	22/12/2024
7YW300062	West Bretton STW FE	22/12/2024
7YW300060	West Bretton STW Settled Storm	22/12/2024
Not in WINEP	Innfold Farm 1 CSO	22/12/2024
Not in WINEP	Innfold Farm 2 CSO	22/12/2024
Not in WINEP	Innfold Farm 3 No.2 CSO	22/12/2024
Not in WINEP	Innfold Farm 4 CSO	22/12/2024
7YW300059	Bentley Mill Rise SPS	22/12/2024
7YW200637	Bentley STW/FE	22/12/2024
7YW300636	Bentley STW/Intermittents	22/12/2024
7YW300057	South Elmsall STW 3x	22/12/2024
7YW200635	South Elmsall STW 6x	22/12/2024

Appendix 2 : Catchment Sense

Yorkshire Water
Catchment sense

An affordable alternative approach that delivers better benefits for the environment and our customers



YorkshireWater


Such a scale of alternative solutions has not been taken forward previously in the UK. Our proposed approach will maximise benefits for catchment ecosystems and communities whilst keeping this affordable for our customers.

Introduction

In this document we set out an ambitious alternative approach to delivering the Water Industry National Environment Programme for Yorkshire. It is deliverable, affordable, and exceeds the current targets.

Yorkshire's rivers have seen huge improvements in the last 30 years through major investment in wastewater treatment to improve river water quality. The Aire and Don, once biologically dead along many stretches, now host iconic species in former industrial areas. People are connecting with their rivers once again.

Our challenge and opportunity is to find the most cost-effective way to continue and expand that improvement, broadening our focus to the whole catchment ecosytem and the health, wellbeing and resilience of communities. The current Water Industry National Environment Programme (WINEP) for Yorkshire increases costs for our customers without delivering significant environmental and community benefits.

Our alternative plan - based on detailed supporting evidence and analysis - will deliver the current targets and more, at a cost that would keep the WINEP affordable, and will set us on course towards our long-term vision for Yorkshire.

We know that our approach is new and ambitious. To plan and deliver this programme we will need to be innovative and we will need to work with others, building capacity and support through constructive long-term partnerships. Having examined the alternatives, we believe that this is the right approach. Right for the environment, right for customers and communities, and right for Yorkshire.

40%

of the UK's new nationally 'sensitive' areas are within Yorkshire

£16/yr

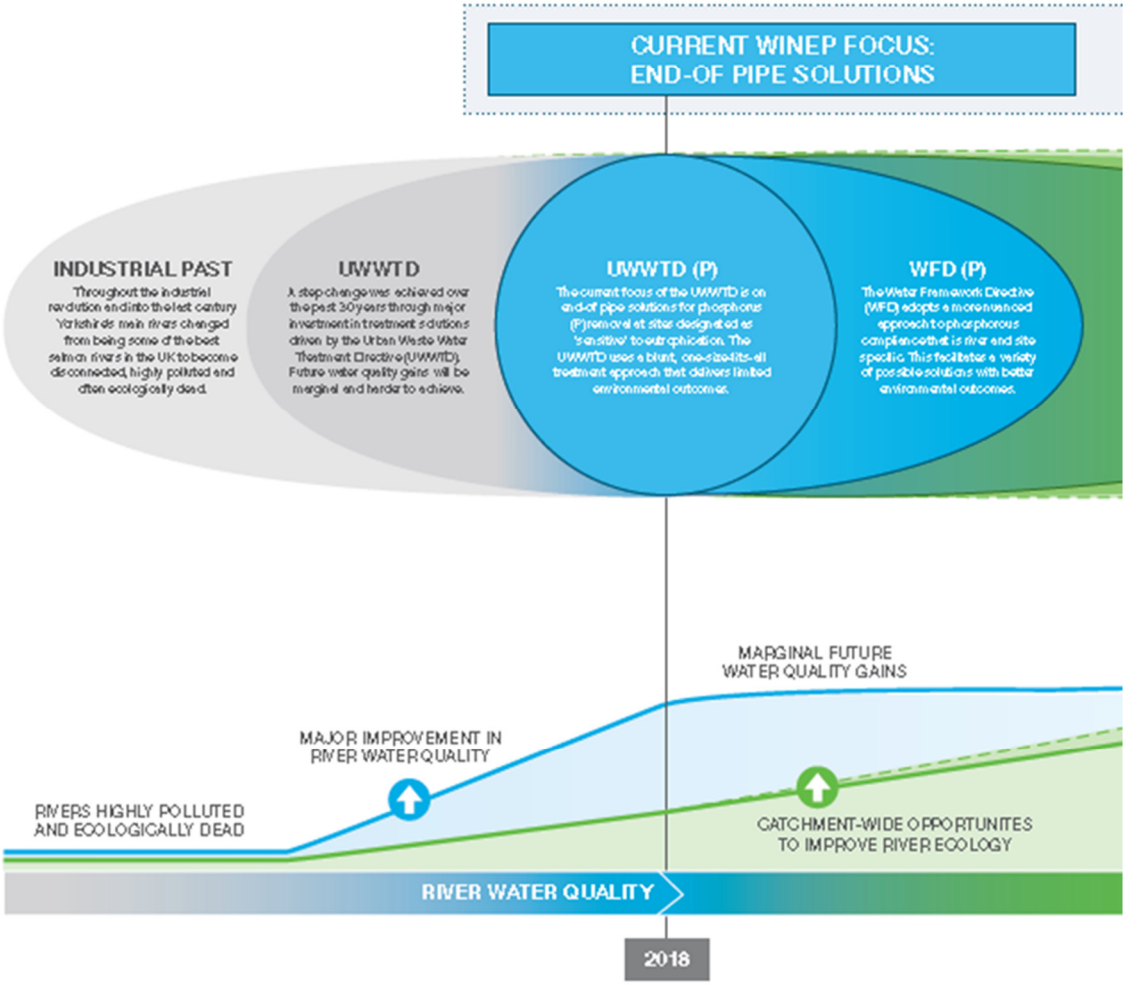
customer bill impact if we don't get this right

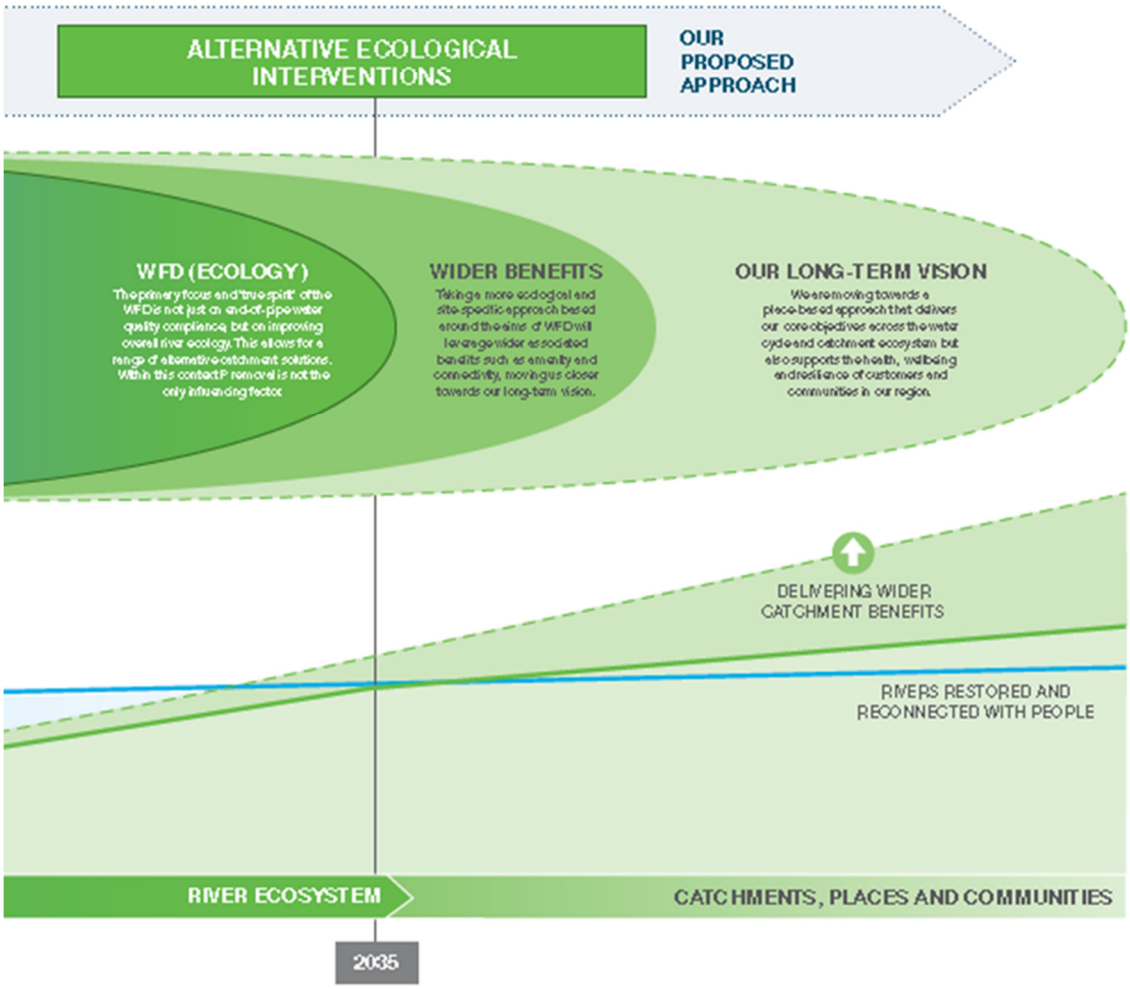
>163km

rivers improved by alternative approaches

Our proposal in context

Building on the successes of the past 30 years, we have combined the best of current practice with new innovative approaches to develop a proposal that is cost-effective, deliverable and sets us on course towards our long-term vision.




ALTERNATIVE ECOLOGICAL INTERVENTIONS
OUR PROPOSED APPROACH
WFD (ECOLOGY)
The primary focus and 'true spirit' of the WFD is not just on end-of-pipe water quality compliance, but on improving overall river ecology. This allows for a range of alternative catchment solutions. Within this context P removal is not the only influencing factor.
WIDER BENEFITS
Taking a more ecological and site-specific approach based around the aims of WFD will leverage wider associated benefits such as amenity and connectivity, moving us closer towards our long-term vision.
OUR LONG-TERM VISION
We are moving towards a place-based approach that delivers our core objectives across the water cycle and catchment ecosystem but also supports the health, wellbeing and resilience of customers and communities in our region.
DELIVERING WIDER CATCHMENT BENEFITS
RIVERS RESTORED AND RECONNECTED WITH PEOPLE
RIVER ECOSYSTEM
CATCHMENTS, PLACES AND COMMUNITIES
2035

Comparing alternatives

By comparing the costs and benefits of various options we have developed an alternative approach that delivers more improved rivers over the three-AMP period at prices that are more affordable to customers.

OPTIONS APPRAISAL

The current WINEP process is not working well for the Yorkshire region. It is not affordable and it does not deliver significant environmental, customer and community benefits. Our specific challenge relates to Urban Waste Water Treatment Directive (UWWTD), under which areas designated as 'Sensitive' require an additional sewage treatment to remove phosphorous (P). We also have targets for P removal under Water Framework Directive (WFD). Here we summarise the different ways we might meet these obligations and show why we have selected our approach.

1. UWWTD PHOSPHOROUS COMPLIANCE

End-of-pipe treatment interventions to remove phosphorous (P) in all areas defined as 'sensitive' to eutrophication (see map on page 8). A uniform approach which, unlike WFD, doesn't allow for cost-benefit or technical feasibility. Limited environmental benefit and high cost.

2. WFD PHOSPHOROUS COMPLIANCE

End-of-pipe treatment to remove P. Unlike UWWTD, WFD is river and site-specific so delivers better environmental outcomes. This option is affordable because it only delivers those sites that are technically feasible and cost-beneficial in line with WFD rules.

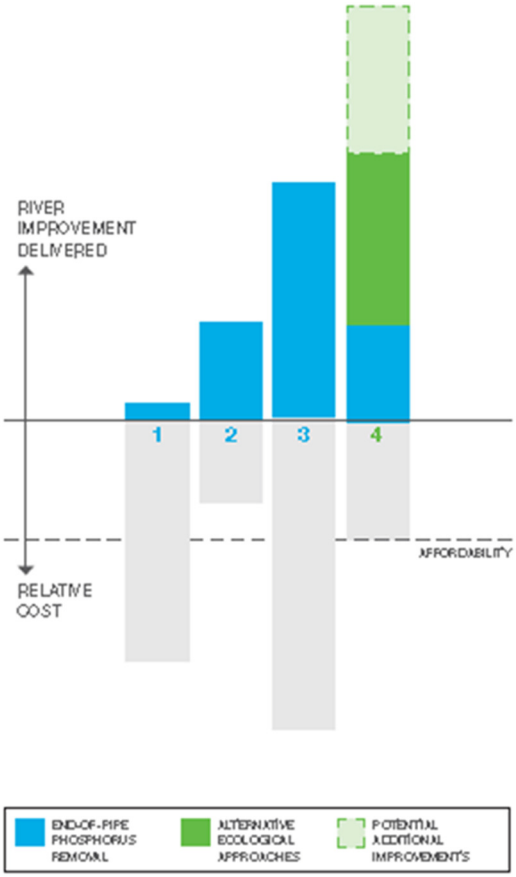
3. UWWTD + WFD PHOSPHOROUS COMPLIANCE

Compliance with both programmes together brings some additive benefits in terms of environmental outcomes, but wider benefits are still limited and the overall cost is very high and therefore not affordable.

OUR PROPOSED APPROACH

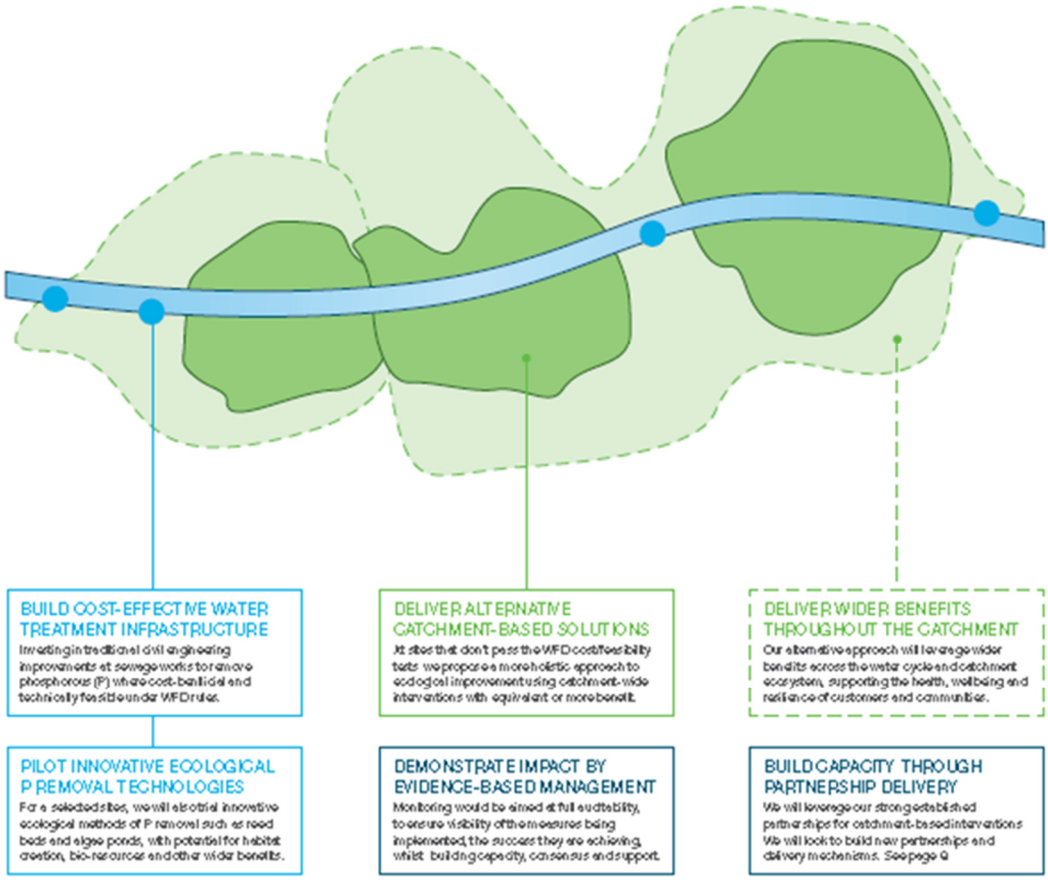
4. WFD PHOSPHOROUS COMPLIANCE + ALTERNATIVE ECOLOGICAL APPROACHES

We propose to deliver WFD P compliance where feasible and cost beneficial to do so. Where WFD P compliance is not cost beneficial we propose an alternative ecological approach based on delivering improving river ecology in line with WFD principles. This delivers the best overall outcomes whilst being affordable and delivering wider catchment benefits. It also builds capacity for longer-term interventions. The key components of our approach are summarised on Page 7, opposite



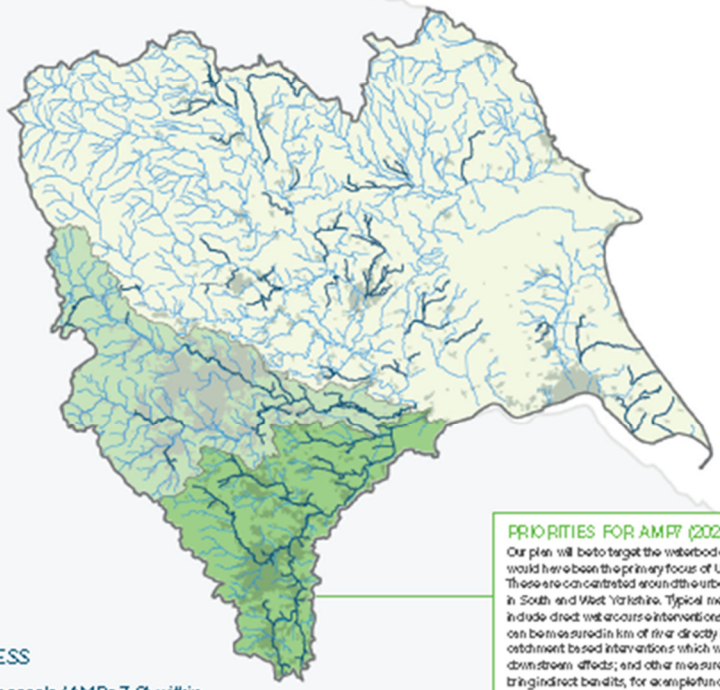
Our proposed approach

Our approach focuses on achieving improved river ecology by combining targeted phosphorous removal with ambitious catchment-based interventions. We will work in partnership and demonstrate impact through evidence-based management.



Our delivery focus

The highest concentration of 'sensitive' designations is in South and West Yorkshire, with many in urban areas. Cost-effective delivery in these priority catchments will build capacity to extend our approach across the region.



PRIORITIES FOR AMP7 (2020-2025)

Our plan will beto target the waterbodies that would have been the primary focus of UWWTD. These are concentrated around the urban areas in South and West Yorkshire. Typical measures include direct watercourse interventions, which can be measured in km of river directly improved; catchment based interventions which will have downstream effects; and other measures that will bring indirect benefits, for example funding for rivers trusts, river rangers, access improvements, habitat creation, improved amenity, supporting community groups and raising awareness of rivers.

TARGETING EARLY SUCCESS

We will plan over a 15-year timescale (AMPs 7-9) within the context of our long-term vision. We acknowledge that our alternative approach requires a new way of working for Yorkshire Water, our partners and our regulators. We know that more effort will be needed in the early stages as new techniques, processes and governance are built.

In the first cycle we will focus on interventions with a high level of certainty around delivery and compliance success. This will build confidence and capacity. In parallel, we will identify the critical pressures on our catchments put in place the partnerships, monitoring, technology and enabling measures to extend our programme during the later AMP periods.

DON, DEARNE AND ROTHER CATCHMENT
AIRE AND CALDER CATCHMENT
OTHER YORKSHIRE WATER CATCHMENTS
URBAN AREAS
RIVERS IDENTIFIED FOR PROPOSED NEW DESIGNATION AS SENSITIVE UNDER THE UWWTD
RIVERS
YORKSHIRE WATER OPERATING BOUNDARY

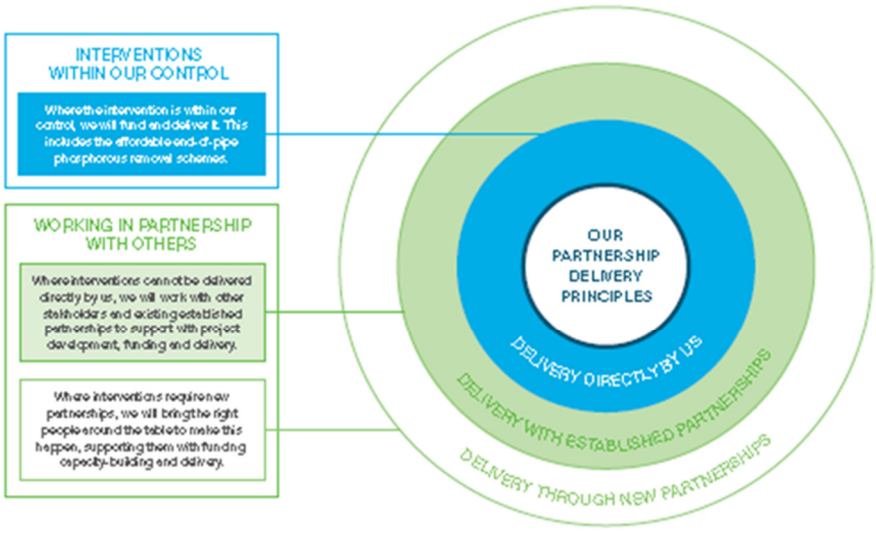
Working in partnership

We will fund and drive the proposed interventions, delivering some ourselves, some through support of strong established partnerships and others by acting as a catalyst for new and innovative partnership approaches.

We have tried and tested delivery routes and strong established partnerships for catchment-based interventions across Yorkshire. The multi-agency Living with Water Partnership in Hull and the East Riding is an example of us taking a leading role in driving innovative partnerships and governance mechanisms. Working together we can deliver more benefits for customers, communities and the region and we can build capacity for long-term change. Our partnership delivery principles are set out below.

'The Aire & Calder Catchment Partnership strongly supports Yorkshire Water's proposal, which aligns with our aim to improve the ecology of our rivers and catchments whilst delivering wider benefits to communities. The potential for the programme to support our work through development, funding and delivery of specific targeted projects would be extremely welcome.'

Geoff Roberts,
Chair, Aire & Calder Catchment Partnership




We want to deliver in ambitious yet cost-effective ways that move us towards our long-term vision for Yorkshire. Our alternative proposal will do just that - balancing the needs of the water environment with the aspirations of customers, delivery partners and communities, and reconnecting people with their rivers.

Contact

For further information

Nevil Muncaster
Director of Asset Management
Yorkshire Water Services Limited
Western House
Halifax Road
Bradford
BD6 2SZ

YorkshireWater