Emerging plan for consultation

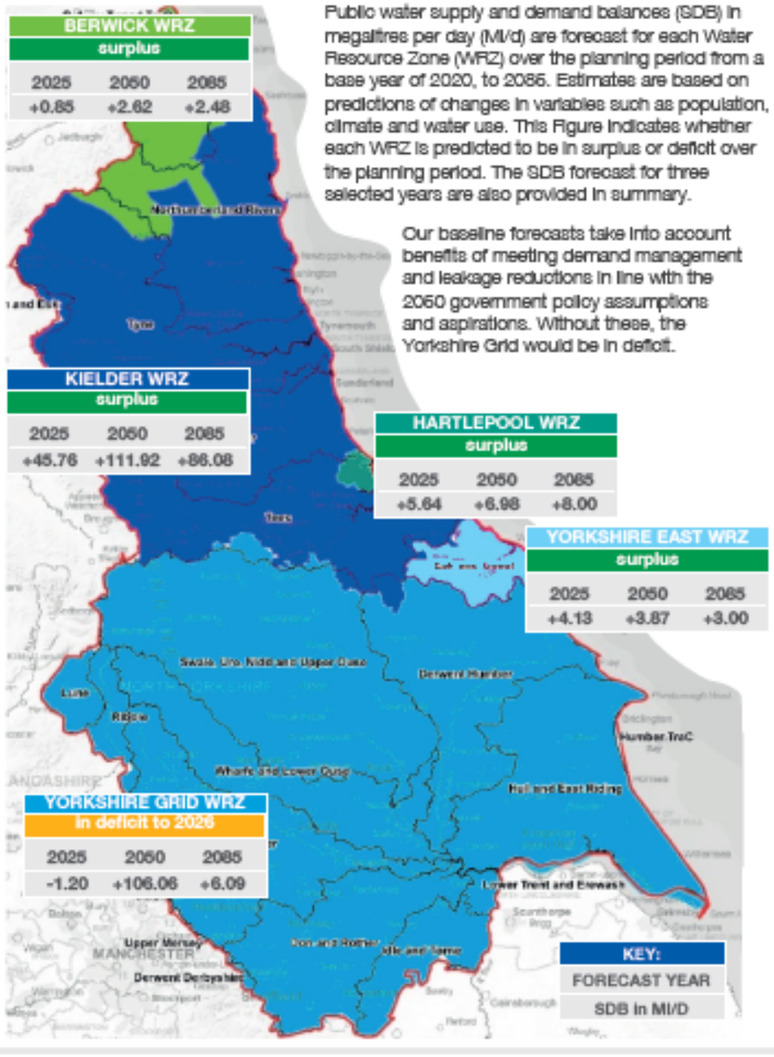
January 2022

WReN
Water Resources North

JANUARY 2022 EMERGING PLAN FOR CONSULTATION: SUMMARY ON A PAGE

Our emerging plan presents an update on our regional position as of January 2022 and a summary of our progress towards our first Regional Plan. It reports outputs from the inter-regional 'reconciliation' process through autumn 2021 which was developed collectively by regional planning groups and regulators to enable regional plans to iteratively appraise solutions and to align with each other. A further round of reconciliation is planned for spring 2022 following consultation on the emerging plans. This is a high level summary to complement the document.

SUPPLY AND DEMAND FORECASTS



Public water supply and demand balances (SDB) in megalitres per day (Ml/d) are forecast for each Water Resource Zone (WRZ) over the planning period from a base year of 2020, to 2085. Estimates are based on predictions of changes in variables such as population, climate and water use. This figure indicates whether each WRZ is predicted to be in surplus or deficit over the planning period. The SDB forecast for three selected years are also provided in summary.

Our baseline forecasts take into account benefits of meeting demand management and leakage reductions in line with the 2060 government policy assumptions and aspirations. Without these, the Yorkshire Grid would be in deficit.

DEVELOPING A BEST VALUE PLAN

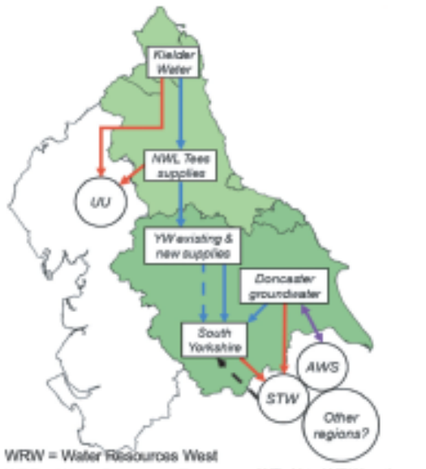
A Multi-Criteria Analysis (MCA) approach has been taken to appraise options against multiple metrics. This allows us to consider our plan against a wider set of considerations of interest to customers and stakeholders than just meeting the supply-demand balance as cost-effectively as possible. The criteria or metrics are linked to pre-defined objectives. Our process allows for consideration of "trade-offs" between different factors in selecting a best value plan.

Decision-making metrics summary

- PWS Drought resilience
- Leakage reduction
- Human and social well-being
- Multi-abstractor benefit
- Biodiversity
- PCC reduction
- Financial cost
- Carbon
- Natural Capital
- Flood risk management
- Option deliverability
- Customer preferred option type

AVAILABLE REGIONAL OPTIONS AND RECONCILIATION OUTPUTS

Potential regional transfer options explored



WRW = Water Resources West
WRE = Water Resources East
AWS = Anglian Water
STW = Severn Trent Water
UU = United Utilities
YW = Yorkshire Water

WReN to WRW options
WReN in-region options
WReN in-region existing
WReN to WRE options
WRW to WReN existing

In autumn 2021, regional groups carried out the iterative reconciliation process to collectively explore inter-regional and regional resource options. An output of this process is that other regions have not identified a need for any WReN transfer options in their regional plan work to date.

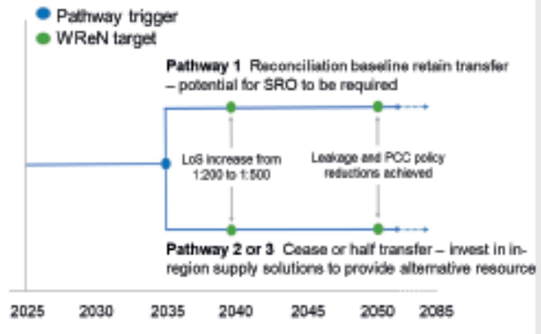
In addition, during this process it also became apparent that the most significant bearing on WReN's emerging plan, particularly in terms of short-medium term investment needs, was driven by the potential loss of all or part of the existing water transfer from WRW to WReN (--> STW to YW).

The way we address this lost water, or the potential for alternative solutions to allow the transfer to cease is a key choice area across regional plans. We have therefore presented two pathways: one with the STW import retained, and the other represented a full loss of the import.

THE EMERGING BEST VALUE PLAN

We have applied scenarios and stress tests around the two pathways to consider the best-value plan under each case, and considered how these solutions compare between pathways as part of developing our plans. At this stage, neither pathway can be stated as the formal 'preferred plan' in a national context, as it is dependent decisions in other regions; at this stage, they should therefore be viewed as equally likely.

WReN indicative pathways



Contents

1. What is a regional water resources plan?

Traditionally, Water Resources Management Plans (WRMPs) have focussed primarily on the supply-demand needs of public water supply companies within their supply areas, although options to transfer water with neighbouring companies have often also been considered. However, given the acute long-term water resources pressures that we are now facing, particularly in the South and East of the country, regional and inter-regional solutions now require more detailed consideration. We need to determine whether they can support national water resources resilience, and also whether they can offer better value and more sustainable solutions than those developed purely at a local level.

Given the complexities of developing WRMPs concurrently, regional planning has been promoted by water companies and regulators to bring about greater co-ordination of water resources planning, not only for public water supply, but also for other sectors that abstract water as well as ensuring that our environment is protected. Regional planning allows the exploration of strategic regional and inter-regional solutions (in particular transfer options between regions) more fully in advance of the WRMPs, and also to consider solutions that may meet the needs of multiple sectors. In March 2020, a Water Resources National Framework (WRNF) was published by the Environment Agency to help inform regional scale planning. By exploring the strategic regional and national picture up front of the statutory WRMPs, additional phases of dialogue, consultation and iteration can help to define strategic plans which inform the WRMPs, enabling a nationally coherent picture to be developed as well as considering needs that would normally fall outside the scope of a traditional company plan.

1.1. Regional planning context and objectives

In August 2018, the regulators of water in England (Defra, Drinking Water Inspectorate, Environment Agency and Ofwat) jointly wrote to all water companies. Amongst other things, the regulators' letter set out an expectation for greater co-ordination of water resources planning, the desire to consider solutions that meet the needs of multiple sectors and placed greater emphasis on the need to consider regional and inter-regional solutions. Importantly, the letter also stated the regional groups would have the "flexibility to tailor their organisation and governance structures, as well as the plans they produce, to match the challenges they face". Regulators wrote again to companies in October 2019, recognising the progress towards regional planning that had been made up to that point. This second letter also referenced the five regional groups which had by this time been set up. Water Resources North (WReN) is one of these groups. More details on our group and region are provided in **Section 3**.

Regional plans must uphold aims which support the Government's 25-year environment plan[1], which pledged that 'we would be the first generation to leave the environment in a better condition than we found it'. One of the goals within the environment plan is to reduce the risk of harm from environmental hazards including drought. To help meet this goal the Environment Agency led the development of a Water Resources National Framework (WRNF)[2]. The WRNF was published in March 2020, and outlines what regional plans must deliver[3]. Appendix 1 shows how WReN is meeting these requirements. The WRNF's development was led by the Environment Agency, in collaboration with Ofwat, the Drinking Water Inspectorate and Defra. In addition, a wide range of stakeholders was represented through a national senior steering group. This steering group included approximately 40 representatives from the water industry, other water users, environmental NGOs and government & regulators from England and Wales.

Each regional group has been tasked with pulling together a regional plan. These regional plans, which will include strategic and regional solutions, will be reflected into the more detailed set of water company Water Resources Management Plans (WRMPs) for the next round of Company Business Plans (known as PR24, see **Section 2.3**). Individual company plans will need to take account of the strategic picture from the

[1] A Green Future: Our 25 Year Plan to Improve the Environment, HM Government (January 2018)
[2] Meeting our future water needs: a national framework for water resources, Environment Agency (March 2020)
[3] It is worth noting that since publication of the WRNF, practical experience in delivering against the framework has highlighted the need for further clarity on meeting some of the objectives (e.g. planning for sectors other than public water supply). A regulator led review will inform future planning rounds.

regional plans. They will also allow for further refinement in terms of lower-level options or solutions at a local level or for zones that are not strategically significant at a regional level.

In summary, as per the aspirations of the WRNF, a regional group must:

- Take account of the national framework and set out its potential contribution to the national need
- Be reflected in WRMPs
- Forecast supply and demand over at least 25 years and set out solutions to any deficits
- Be a single strategic plan with a preferred adaptive solution
- Take a multi-sector approach
- Look beyond regional boundaries and use technical approaches compatible with other regions
- Include enhanced environmental improvements and demand management
- Take a catchment-based approach
- Consider wider resilience benefits, including reducing flood risk, when developing options
- Be open to market mechanisms
- Take into account growth ambition
- Comply with SEA and HRA legislation

1.2. Regional plan reconciliation process

One of the most important drivers for the adoption of regional level planning is the need to explore water resource resilience at a national and regional level rather than purely at a water company level. This is in order to promote and facilitate the exploration of water transfers within and between different regions.

The exploration of water transfers is particularly important for regions under serious water stress, who may have difficulty sourcing sufficient supply within their own region to meet demand for water. The transfer of water from a region (to another) may be possible due to there being a material existing surplus, or through creation of new supplies via the development of new options to facilitate the export of water (which could be cheaper or less environmentally impacting, for example, than developing new resources in other more stressed regions).

Even where a supply-demand deficit exists (or could plausibly occur in future) in the region from which the transfer of water takes place, it is possible that more cost-effective options could be developed compared to equivalent new resource option development in other regions, enabling transfers still to take place.

Each region has its own issues, risks and challenges to overcome in the next 25 years and beyond (our regional plan looks as far out as 2080). Nevertheless, the regional planning process gives rise to opportunities for collaboration with different regions and other water sectors to develop sustainable solutions which benefit both people and the wider environment. As such, the process is designed to offer more freedom, especially in the early stages, to explore strategic issues in advance of the statutory WRMPs.

Considering that all regional groups are working to the same timeline for submission of regional plans, delivery of a coherent set of best-value plans across all regions requires effective and planned collaboration. In recognition of this, regional planning groups and regulators have worked to develop a 'reconciliation' process. This process aimed to ensure that regional plans iteratively appraise solutions and align with each other as far as is feasible in the available timescales. The first round of reconciliation ran through autumn 2021, and a further round of reconciliation is planned for spring 2022 following consultation on the emerging plans.

All regions conducted a jointly coordinated set of plan stress tests, to ensure that the resulting reconciled outputs were suitably robust at this stage in the process.

Further details of the national reconciliation process are available in Appendix 9.

1.3. Purpose of this document (January 2022 publication)

This *Emerging Regional Plan for consultation* document succeeds the publication of our *Initial Resource Position in March 2020* and our *Revised Water Resources Position Statement* in February 2021.

The document follows a nationally agreed overarching structure and provides additional context on the current and forecast future resource position, which has been updated since WRMP19 (the position still remains a snapshot at this point in time, towards the WRMP24 submissions to be published in draft form in autumn 2022). The document is complemented by supporting appendices (listed at the back of this document) and explains the key drivers of change in the supply-demand position, particularly driven by new policy and methodological considerations.

Beyond staking out a baseline position (**Section 5**), this document summarises our approach to developing an adaptive, best-value plan at region level (**Section 6**), in the context of the decision-making[4] approaches and supporting metrics. It also summarises the salient choice or decision areas for our plan at this time (**Section 7**), the resulting indicative solutions to meet deficits at this stage, and shows the outcomes of scenario and stress tests (**Section 8**).

In addition, it explains how we have represented environmental destination, and accounted for non-public water supply needs as well as customer & stakeholder priorities in the process of building our future plans at this stage.

The plan is at an interim, evolving stage, which aligns to the overarching national narrative following reconciliation. The big themes of the plan are now clear. We are forming views on how challenges can be addressed and at this stage we would welcome feedback from customers, stakeholders and regulators to help shape our emerging plan. This consultation will help to shape our draft best-value plan for publication in autumn 2022.

In summary, with reference to the position nationally agreed across other regions and regulators, this (and other) January 2022 publications are:

- Signalling early sight of big issues and candidate solutions to get initial feedback from stakeholders
- Reporting outputs from inter-regional reconciliation and best value selection
- A public document that regional groups are seeking views on
- A step in an ongoing process of plan development.

This January 2022 report is not:

- A full set of WRMP data tables
- A formal preferred plan.

[4] This term is used interchangeably with ‘options appraisal’ in industry methodologies published by the organisation UKWIR.

2. Policy and National Framework

In building our regional plan, we are considering the aims and objectives of the Water Resources National Framework (WRNF) as well as other policies and plans relevant to England. Our aim is to put forward a plan that supports the needs of our customers, the environment and, where tangible needs have been defined, other sectors. Our plan will identify opportunities to support the recovery of waterbodies, in line with River Basin Management Plan (RBMP) and Catchment Plan (CP) actions. We also aspire to achieve leakage and per capita consumption (PCC) targets, and have proactively sought to explore the potential of water transfers whilst ensuring drought resilience and the environment are protected in our own region.

2.1. National Framework for Water Resources

Following on from reports completed by Water UK in 2016[5], and the National Infrastructure Commission in 2018[6], in March 2020 the Environment Agency published the Water Resources National Framework (WRNF)[7]. The Framework set out the need for regional water resources planning, to be led by the five regional groups that had been established by that point. The WRNF also defined expectations for a first round of regional water resources planning, and specifically defined a set of "must, should and could" requirements for the plans. We have used these expectations, amongst those from other regulators and stakeholders, as well as further guidance and expectations that have arisen since the WRNF was published, to help shape our approach to regional planning and our first emerging plan. Appendix 1 summarises specifically how we have accounted for the National Framework "must, should and could" expectations in this emerging plan.

The Environment Agency has recently signalled that it intends to update the WRNF following the current round of regional and water resources planning, with work starting on the next National Framework in early 2023.

2.2. Government 25-year Environment Plan – Policy aspirations

In 2018, the Government published a 25-year Environment Plan for England. The plan set out a number of goals including cleaner air and water, thriving plans and animals, reduced risk of harm to the environment from floods and drought, using resources more sustainably and improving engagement with natural and heritage environment. Of particular relevance to water resources are the objectives set out under the heading of "clean and plentiful water", specifically "improving at least three quarters of our waters close to their natural state as soon as practicable:

- Reducing the damaging abstraction of water from rivers and groundwater, ensuring that by 2021 the proportion of water bodies with enough water to support environmental standards increases from 82% to 90% for surface water bodies, and from 72% to 77% for groundwater bodies
- Reaching or exceeding objectives for rivers, lakes, coastal and ground waters that are specially protected, whether for biodiversity or drinking water as per our River Basin Management Plans
- Supporting Ofwat's ambitions on leakage, minimising the amount of water lost through leakage year on year, with water companies expected to reduce leakage by at least an average of 15% from 2020 to 2025."

[5] https://www.water.org.uk/publication/water-resources-long-term-planning/
[6] https://nic.org.uk/studies-reports/national-infrastructure-assessment/national-infrastructure-assessment-1/preparing-for-a-drier-future/
[7] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources

2.3. Guidance and interfacing planning processes

Water Resources Management Plans (WRMPs) and Water Resources Planning Guidelines (WRPG)[8]

The Environment Agency (and Natural Resources Wales) publish the Water Resources Planning Guidelines (WRPG) to provide water companies with guidance on how they can ensure that their Water Resources Management Plans (WRMPs) comply with all the statutory requirements and government policies. Although the regional planning process is currently a non-statutory one, we have ensured that our emerging plan follows the principles outlined within the WRPG as far as is relevant to a high-level strategic plan (noting that the regional plan is necessarily less detailed than company WRMPs).

Water Industry Price Review process (PR24)

Water companies in England and Wales are regulated in five-year periods known as Asset Management Plans (AMPs), and each AMP is informed by a Price Review (PR) process. The next Price Review is PR24; water companies will submit their business plan proposals for PR24 to regulators in late 2023. The Final Determination for PR24 is anticipated in late 2024. This will set water companies' performance and investment targets, as well as customer bills, for the AMP8 period, between 2025 and 2030.

It is important to recognise, therefore, that the public water supply component of the WReN Regional Plan, which will be confirmed in company WRMPs, is a part of the broader PR24 process which includes all other aspects of water company planning across both clean and wastewater services. It is possible, therefore, that some aspects of the Regional Plan may change, at least in the nearer term (first five years), depending on decisions made at PR24 and the impact that those decisions could have on company WRMPs (and hence the Regional Plan).

River Basin Management Plans (RBMPs)

River Basin Management Plans (RBMPs) look at the challenges that our water environment faces and provide a framework for protecting and enhancing the water environment. Clearly, this includes considering how abstractions, from all sectors, impact on the water environment, and RBMPs also provide a framework for the protection of sensitive habitats in England and Wales[9]. At the time of publishing our emerging plan for consultation in January 2022, the next round of RBMPs have also been published for consultation[10]. Our Regional Plan will consider how we can support delivery of actions in the RBMPs that are relevant to our region – the Humber and Northumbria River Basin Districts – in particular where the RBMPs include actions related to water abstraction.

UK Net Zero commitment

The UK has a binding legal target to reach net zero emissions by 2050, and in October 2021 the Government published its Net Zero Strategy[11]. This set out policies and proposals for decarbonising all sectors of the UK economy by 2050. The following aspects of the Net Zero Strategy are considered to have particular relevance to water resources planning:

- The importance of decarbonising the UK's electricity system and in particular the role that hydrogen may be able to play in this. Water demand in the energy sector including hydrogen is a major theme when considering sectors beyond public water supply although there remains considerable uncertainty in relation to the timing and geographical location of this demand (see **Section 5.2**).
- An emphasis on sustainable use of resources – including water – and the role of the circular economy.
- The importance of energy efficiency, including standards and regulation for energy efficient homes. Whilst the Net Zero Strategy is specifically focussed on energy, we would reflect that standards and regulation also have a role to play in delivering water efficiency and, indeed, efficient use of (hot) water can play an important part in reducing overall household energy use.

Abstraction licensing strategies (CAMS)

The Environment Agency regulates the abstraction of water from the environment via a permitting system, and through existing licences and granting of new licences. This is done through a process called the catchment abstraction management strategy (CAMS) process and via abstraction licensing strategies. Licensing strategies are published on a catchment

[8] Water resources planning guideline - GOV.UK (www.gov.uk), UK Government, 2021
[9] Due to be published in Final form in December 2022.
[10] https://consult.environment-agency.gov.uk/environment-and-business/draft-river-basin-management-plans/
[11] https://www.gov.uk/government/publications/net-zero-strategy

basis[12], and it is important that these strategies are taken into account when considering the amount of water that may be available in a particular catchment both now and into the future.

[12] https://www.gov.uk/government/collections/water-abstraction-licensing-strategies-cams-process

3. Who we are – Region at a glance

Our region is highly diverse, including significant population centres in Yorkshire, Teesside, Wearside and Tyneside, as well as widespread rural communities and significant expanses of environmentally important landscapes. Our major rivers include the Rivers Ouse, Tees, Wear and Tyne. The Ouse, with its tributaries, drains the vast majority of Yorkshire into the Humber. The natural and varied geography of our region influences the climate, with rainfall ranging from in excess of 1000mm per annum in the Pennine hills to some of the driest places in the country on the east coast. We have been working with regulators, stakeholders, customers and other regions to develop our regional plan, and help secure resilient supplies for the nation as a whole.

3.1. Introduction to WReN

Water Resources North (WReN) is one of five regional water resources groups working under the National Framework for Water Resources. We are developing a regional water resources plan for Yorkshire and the North East of England. Our ambition is to help to facilitate sustainable growth across Yorkshire, the Humber and the North East, whilst also protecting and enhancing our valuable natural environment. Our aim is to ensure that the region has a sustainable, long-term plan for water resources that protects our region's resilience (public water supply, environment, and multi-sectoral water supply) in the face of challenges such as climate change and population growth and changing demands for water use as our industrial and agricultural sectors evolve. We are working with other regions to help secure resilient water supplies for the country as a whole.

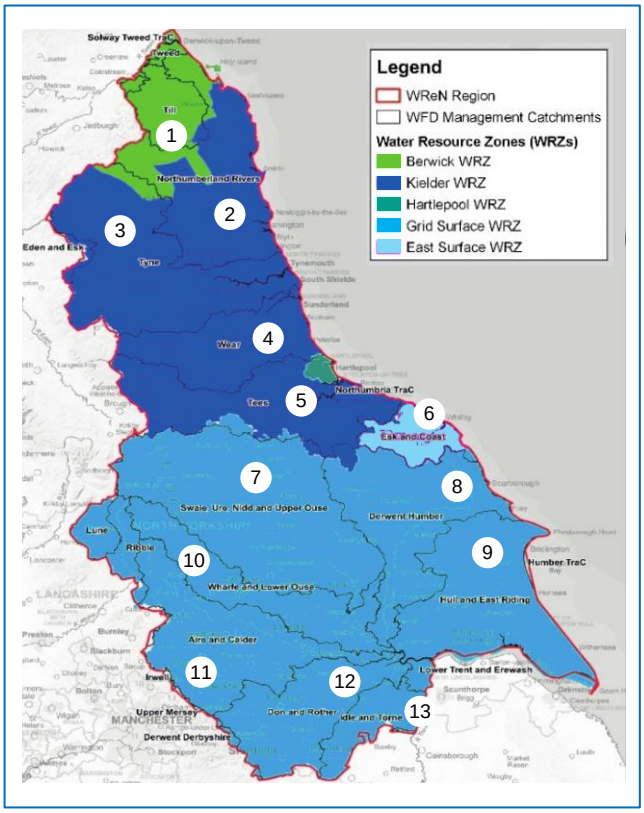


Figure 3.1 Mapping of water resource zones and WFD management catchments in the WReN region

Although our core members and funders are Yorkshire Water (YW), Northumbrian Water (NWL) and Hartlepool Water (HW), other stakeholders who have an interest in water resources in our region are working with us and are actively involved in the regional planning process. This includes sectors other than public water supply who make beneficial use of the water in our environment, such as agriculture, industry and energy. The importance of water to our region's environment, ecology and biodiversity will also play a key role in shaping our future plans.

3.2. Catchments and zones in the WReN region

Our region is highly diverse and is home to over 8 million water company customers across almost 20,000 km^2, from the Peak District south of Sheffield up to the border with Scotland. The five water resource zones (WRZs) in the WReN region are shown in **Figure 3.1** along with the main Water Framework Directive (WFD) surface water management catchments that map onto the region. The Northumbrian industrial WRZ is now included as part of Kielder WRZ.

Key to management catchments

No.	Management Catchment
1	Till/Tweed
2	Northumberland Rivers
3	Tyne
4	Wear
5	Tees
6	Esk and Coast
7	Swale, Ure, Nidd & Upper Ouse
8	Derwent Humber
9	Hull and East Riding
10	Wharfe and Lower Ouse
11	Aire and Calder
12	Don and Rother
13	Idle and Torne

These catchments experience a number of combined pressures. The degree and significance of these pressures varies between catchments but includes issues such as future lack of water availability, WFD concerns (notably modifications and water quality), growth in abstraction demand and risk of abstraction reductions. Flooding is also a major issue in many of these catchments.

3.3. WReN planning objectives

Options that have been identified as feasible for meeting our future water resources needs are being taken through an options appraisal process (**Section 6**). The WReN decision making methodology expands on the traditional Economics of Balancing Supply and Demand (EBSD) approach for WRMPs to include other criteria in addition to cost.

This process required development of bespoke WReN objectives. These were initially identified using the Water Resources National Framework and Environment Agency Water Resource Planning Guidelines (EAWRPG). Some of the objectives will be addressed via planning scenarios, whereas other objectives are performance measures represented as metrics for consideration in a multi criteria analysis (MCA) approach to producing a best value plan for the region. This best value plan – which we are still working towards creating at this point (January 2022) – will be either a single programme that performs best against all criteria / metrics, or a portfolio of the options that appear most often in the best performing programmes.

Following initial identification of objectives, the WReN objectives and metrics have been further refined in consultation with stakeholders, regulators and customer focus groups. Customer views, for example, were sought through focus group discussion from both household and non-household customers. Feedback from the participants provided information on level of support for different objectives, customer ranking of metrics and the type of options they would prefer to see included in a best value plan. The research also helped assess the aspects of the process customers understood, and where further clarity on objective and metric definitions was needed.

The strongest level of support was for:

- 'creating a plan that is affordable and sustainable over the long term'
- 'contributing to the Government's ambition in the 25-year environmental plan'
- 'meeting the future PWS' (now amended in response to specific customer and stakeholder feedback see below)

The detailed outputs of the customer engagement are presented in detail in Appendix 7- WReN Customer Research June 2021, and further summarised in **Section 4.3**). WReN is using the customer feedback along with other stakeholder feedback on balance to support in the decision-making process and we have made updates in response to feedback through the process (see Appendix 4 for further details of the changes made to objectives and associated metrics).

A high-level summary of the ten WReN objectives that have now been defined is provided below, with a more detailed description provided in Appendix 4.

1 Meet the future PWS and non-PWS needs in our region
2 Meet and maintain a PWS drought resilience level of service of 1:500 for level 4 restrictions
3 Contribute to the Government's ambition in the 25 Year Environment Plan to 'leave the environment in a better state than we found it'
4 Achieve the WReN environmental destination and RMBP objectives (sustainability reductions) taking a catchment wide approach
5 Meet demand management policy requirements to reduce leakage and per capita consumption as defined in the Water Resources National Framework
6 Identify WReN's potential to contribute to national resilience
7 Incorporate Strategic Environmental Assessment (SEA) outputs and other relevant environmental legislation (e.g., habitats regulations assessment) in decision making
8 Achieve multiple benefits (including non-drought resilience)
9 Produce a plan that supports the views of regional stakeholders and water companies' customers and is not detrimental to social wellbeing
10 Create a plan that is affordable and sustainable over the long term

4. Where we are today

This section provides information on the current water resources position for our region, as well as what our customers and broader stakeholders have told us about their priorities based on the engagement that we have completed so far. For public water supply, it summarises what we said in the last round of company plans (WRMP19) and, at a high level, our progress in delivering those plans. It also identifies what we currently know about future water needs in other sectors and for the environment.

4.1. Current water resources

Public Water Supply

As described in the previous section, there are only five potable Water Resources Zones (WRZs) defined in the WReN region, and 98.3% of the region's population is supplied by just two of these zones: Grid (YW, 65.9%) and Kielder (NWL, 32.4%). The remaining 1.7% is split across Hartlepool (HW, 1.1%), East (YW, 0.3%) and Berwick (NWL, 0.3%). The two largest zones are well connected at a WRZ level (i.e., within their respective zones). However, the region is currently less well connected between zones.

In addition to the potable WRZs, Northumbrian Water currently operates a non-potable Industrial WRZ in Teesside, which supplies water to industrial water users in that area. For the next round of planning, NWL has merged this zone with its Kielder Zone; the data presented in this submission reflects this merger.

In WRMP19, all zones in WReN showed a surplus against a 1 in 200-year drought after implementation of preferred plan actions; this means that we have a good underpinning resilience of our public water supply to drought. Since WRMP19, the National Framework has set a new national target of 1 in 500-year drought resilience (prior to the use of standpipes or similar emergency measures) by 2039. YW's zones were assessed against a 1 in 500-year drought event for WRMP19, and at that time were considered able to meet and maintain this level into the future with investment in leakage reduction. At WRMP19, NWL and HW did not formally assess the resilience of their WRZs against a 1 in 500-year drought, but they were still considered to be very resilient due to their large surpluses and the nature of their raw water resources.

For the WReN Regional Plan and WRMP24, all WRZs have been re-assessed against a 1 in 500-year drought using the latest planning methods, and the results of this are presented in **Section 5** of this report.

In WRMP19, with the exception of Yorkshire Water's Grid Surface Water Zone (SWZ), the supply-demand balance for WReN's water resource zones showed a surplus in the baseline (2020 start year) dry year annual average scenario over the full 25-year planning period, without the need for interventions. The Grid SWZ forecast showed a risk of the zone falling into deficit, starting from 6Ml/d in the mid-2030s, increasing to 34Ml/d by 2045. This deficit was primarily caused by the risk that climate change will significantly reduce future available water resources. However, through its WRMP19, Yorkshire Water committed to closing the Grid SWZ deficit through an enhanced leakage detection and repair programme that aims to reduce leakage by a minimum of 15% by 2025 compared to its 2019/20 target. YW will also invest in some existing borehole supplies by 2025 to improve resilience and help to ensure the risk of longer-term deficit in the Grid SWZ is mitigated.

Although WRMP19 did not show deficits in all WRZs, all three WReN water companies committed to reducing leakage throughout the WRMP19 25-year planning period. For the first five years of this period, 2020-2025 (AMP7) this amounted to a 12% reduction in leakage across the region as a whole. In addition, water companies were aiming to reduce customers' use to 125 litres of water per person per day (calculated based on a weighted average reflecting the size of each WRZ).

Water companies have to report on their progress against WRMP targets on an annual basis. We have summarised below the key points from the most recent annual reviews, which reported progress made by each water company against their WRMP19 for 2020/21. The key reporting areas that are most relevant to this Regional Plan relate to leakage and per capita consumption (PCC).

For leakage, Yorkshire Water reported an outturn figure of 304.2 Ml/d as a three-year rolling average. This number is not directly comparable to the targets set in WRMP19 due to changes in regulatory reporting methodologies. However, it is a better performance than the regulatory target of 304.6 Ml/d, which was set using the same method as the 2020/21 reported figure. NWL did not quite meet its leakage target, outturning at 138.7 Ml/d, against a target of 134.4 Ml/d; this was due to the impact of successive freeze/thaw events in January and February 2021. Anglian Water has a combined target for leakage for both its Anglian and Hartlepool regions, so it is not possible to report a leakage target specifically for Hartlepool. However, in 2020-21, leakage in Hartlepool was 4.03 Ml/d.

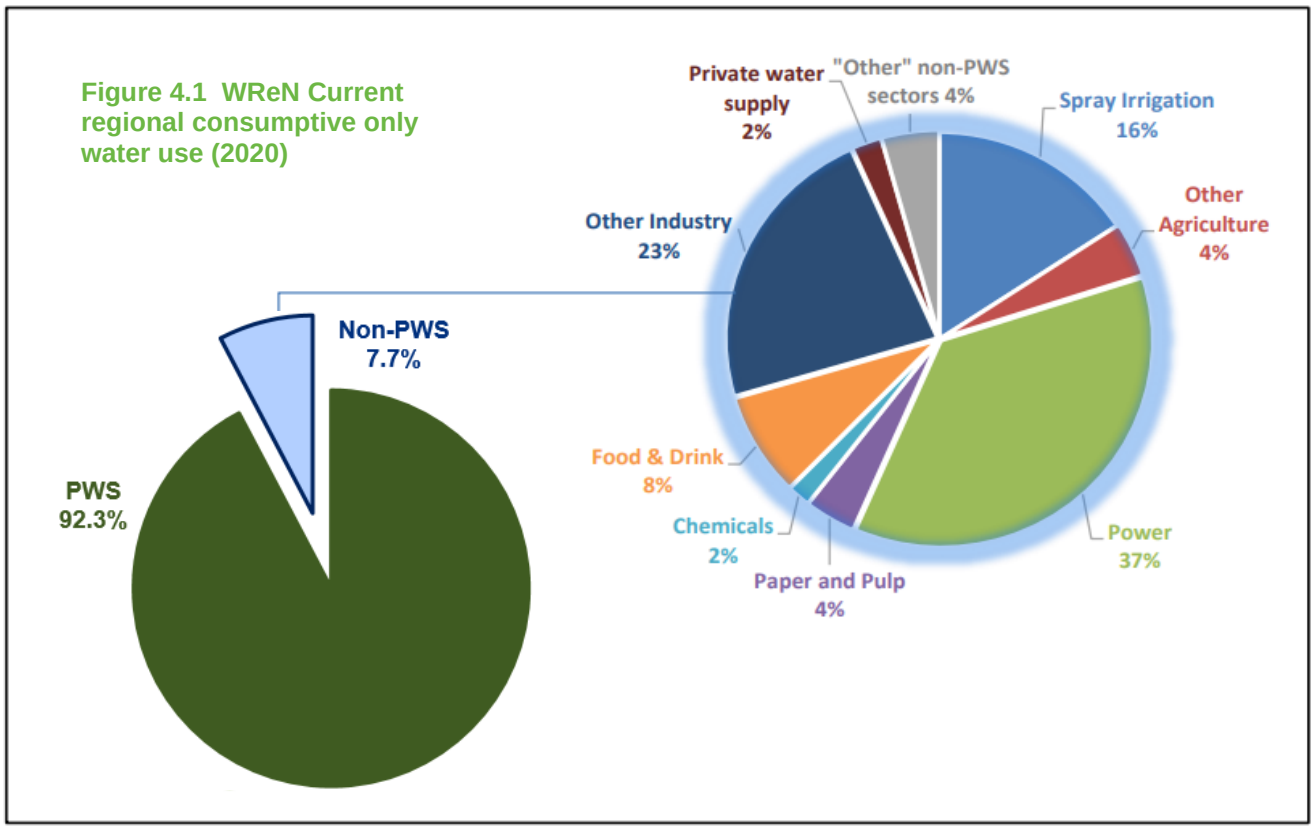
When it comes to PCC, for all water companies, the Covid-19 pandemic led to an increase in the amount of water used by customers through the reporting year. We saw a significant increase in demand due to more people being at home during the day (either because of working from home or having been furloughed) and using more water because of increased handwashing, more garden watering and more homes using paddling pools and hot tubs. Nationally, across the industry, the impact of this has been estimated as an increase in per capita consumption (PCC) of between 3 and 15%, with peak demand increasing by 20 to 40%[13]. Non-household demand was 15 to 40% lower than normal due to many businesses being closed for a significant proportion of the year. However, this reduction was not sufficient to counterbalance the rise in domestic use and across the industry total demand was between 2 and 5% higher.

Other sectors

The WRNF showed that demands for non-public water supply sectors in the WReN region amount to approximately 80.1% of total water abstracted including non-consumptive demand, but only 7.7% of the total water abstracted for consumptive use only. In other words, water abstracted and used in WReN is dominated by that taken for public water supply. However, as a part of the regional planning process, it is necessary to consider the current and future demands from other sectors as well as PWS. The current uses in other sectors are show on **Figure 4.1** below.

Unlike PWS, there is no holistic plan for water use in other sectors, and therefore it is not currently possible to report progress against targets in the same way as it is for water companies' WRMPs.

Figure 4.1 WReN Current regional consumptive only water use (2020)



[13] Northumbrian Water Group (NWG), 2021, Impact of Covid 19 on NW Demand, page 7

4.2. Status of the natural environment

The Government's 25 Year Environment Plan commits to improving at least 75% of WFD waterbodies to as close to their natural state as soon as practicable. The proportion of surface waterbodies currently achieving Good or High ecological status/potential in the Northumbria and Humber river basins[14] is 26% and 15% respectively[15], compared to the national average[16] of 16%. The proportion of groundwater bodies achieving Good quantitative status is 90% (Northumbria) and 80% (Humber), relative to the national average of 73%.

Pollution from wastewater (27%), physical modifications (26%) and pollution from rural areas (23%) are the three most common issues preventing waterbodies reaching Good Status within the Northumbria and Humber basins. Changes to natural flow and water levels account for just 3% of the total issues, although this does not account for longer-term flow pressures which the Environmental Destination component of the regional plans seeks to address.

The Environment Agency published the next round of River Basin Management Plans (RBMPs) for consultation in autumn 2021. It is also in the process of updating Catchment Abstraction Management Strategies (CAMS), and water company AMP7 Water Resources WINEP investigation schemes are ongoing. Collectively, alongside additional work in support of Environmental Destination (see Appendix 6), this will inform the Programmes of Measures, including water resources measures, within future RBMPs (see also **Section 7.5** considerations for longer-term investigation).

4.3. Customer priorities

For public water supply, the regional water resources plans ultimately feed into each water company's WRMP24 (as the statutory plan) and PR24 Business Plan submissions. This is important, because it is through those plans that investment is realised via approval from the appropriate regulators. Therefore, we have sought to ensure that our emerging regional plan is consistent with customer priorities so that we have confidence that it will ultimately gain water company customer support as part of WRMP24 and PR24 Business Plans[17].

Our customer engagement processes have been designed to complement and interface with those being completed by companies as part of Business Plan development[18]. Specialist teams within water companies have led this activity, working with external customer engagement experts, to ensure that our approaches meet good practice.

Although we have completed new research to inform the WReN regional plan, it should be noted that the evidence base of customer preferences and opinions is not starting from 'zero'. Rather, significant work was completed as part of the previous PR19 Business Plans, and so we have taken time to consider this at a regional level. This means we can compare and contrast earlier views as part of our evidence to building the plan, recognising that some themes are new and specific for regional planning. This is particularly important given aspects such as Covid-19 that have the potential to influence changing customer opinion and therefore new research was needed.

The sections below provide a summary of our PR19 customer engagement review, and subsequent new customer engagement completed as part of WReN.

WReN PR19 customer engagement review

A wealth of robust existing customer research exists from the last planning round in relation to water resources. A detailed review of this was completed, specifically for key water resource themes, to provide a strong foundation to inform the regional plan. The review aimed to draw out the key commonalities and identify areas of apparent differences between Company research related to water resources.

The key conclusions from the work were:

- A reliable supply of safe drinking water is a top priority across the region. However, affordability considerations bring a general preference for maintaining and protecting existing performance; where there is willingness to pay for improvements, water service tends to be lower valued that wastewater driven issues.

[14] WREN region comprises of river catchments within the Northumbria river basin, large parts of the Humber, parts of the cross-border Solway Tweed plus some upper sections of the Lune and Ribble in the North West basin.

[15] River Basin Management Plans – 2019 update

[16] England and Wales only (excluding Western Wales)

[17] It is important to note that the regulatory framework does not currently have this clear and direct link to investment when considering the non-public water supply sector, so any investment in these areas would need specific consideration.

[18] Based on a current understanding of likely requirements for PR24, but also noting that the requirements for customer engagement at the next Price Review are still being defined by Ofwat in discussion with water companies.

- Within water resource themes, reducing leakage and environmental improvements are generally seen as more important issues than level of service (e.g., customer use restrictions) issues. Level of service is typically seen as a low priority, although albeit this may in part be caused by the infrequency of experiencing such events; the duration of events (when they occur) is probably more important than the frequency.
- The review provided initial evidence of support for a number of objective areas particularly around leakage and consumption, meeting public water supply reliability needs, the environment and programme cost. However, it is clear that a number of areas would only have support to meet minimum levels or regulatory standards (e.g., drought resilience).
- Little research was completed previously specifically around water trading or drought permits / orders (related to environmental destination), again, showing the need for the further research that was subsequently completed.

WReN customer engagement workshops

Water resource themes are often complex, and the regional plans must contend with emphasis on a number of new areas of focus. For example, defining a 'best-value plan' requires an exploration and understanding of customer priorities beyond the traditional narrow focus on supply-demand based on 'least cost'.

With this in mind, we undertook deliberative research across 16 representative customer groups, each meeting twice over a period of a week. These groups comprised a mix of existing household customers, future customers and citizens, as well as a range of non-household customers. The non-household sessions were held with a mixture of water dependent businesses (e.g., farmers) and non-water dependent businesses. Whilst this type of approach typically engages a lower number of customers than quantitative survey approaches, it benefits from a much greater dialogue and opportunity for those involved to really understand the nuances of water resources management. This allows for more informed feedback on customer priorities for future plans, especially where topics are relatively complex or multi-faceted.

The key focus areas for the research were:

- Defining a 'best value plan' (linked to objectives and metrics, see **Section 6.4**)
- Environmental destination
- Water trading
- Opinions on option types

The full detail of the WReN customer research is provided in Appendix 7 accompanying this report. The remainder of this section provides some salient highlights.

When exploring best-value planning, some themes appeared consistent with PR19 research outcomes. In terms of objectives, the strongest level of support was for 'creating a plan that is affordable and sustainable over the long term', 'meeting the future PWS' and 'contributing to the Government's ambition in the 25-year environmental plan'. After discussing in detail candidate plan performance (or metric) areas, customers ranked these in order of importance. These are summarised in **Table 4.1** along with an indication of relative preference (detailed definitions of our final metrics are included in Appendix 4).

In particular, leakage, drought resilience (reliable supplies) and cost (affordability) showed the strongest customer focus, with a range of environmental and social considerations (plus PCC) sitting in the mid rank. Of particular importance was the fact that customers didn't place great importance on option deliverability[19], or on option type, indicating that achieving the desired outcomes is more important than how those outcomes are achieved.

Table 4.1 Ranking and strength of preference to WReN best-value performance metric areas.

Average points given	Metric area
16.66	Leakage
14.83	Public Water Supply (PWS) drought resilience
14.22	Financial cost
9.57	Biodiversity net gain
9.38	Human and social wellbeing
9.06	Non-drought resilience
8.79	Per Capita Consumption (PCC)
8.24	Carbon
7.26	Natural capital
5.72	Option deliverability
5.63	Customer preferred option type
4.71	Stakeholder preferred option type

[19] The view was that option deliverability seemed confusing and lacked appeal. That said, there was an indication that customers also gave this view either because it was hard to measure / score, or alternatively that risky options should be avoided entirely.

Overall, the following key messages were observed:

- Customers, citizens and non-household customers are unaware of current or potential water scarcity within the WReN region.
- WReN WRMP objectives also gained support, although a focus on education was something that was felt to be potentially missing.
- Customers, citizens and non-household customers were open to the idea of water trading as long as there were no adverse effects on their supply, and recipient companies don't use it as the easy option which could lead to greater inefficiencies (proxy for leakage).
- Timescales of targets were perceived as being too far in the future. Customers want to see shorter timelines (5-10 years) even if this progress target against any long-term goal.
- Given the importance of WR and ensuring an improved environment, there appeared to be a general willingness to pay a small increase in bills for investment against targets as long water companies are transparent about this.
- Support was also evident for the environmental ambition, with the general consensus being that abstraction should be reduced and also the last resort.

The views of customers will be taken on-board and accounted for on-balance with those of wider stakeholders and regulators (including Government priorities).

4.4. Stakeholder priorities

WReN recognises the importance of engaging with those who have an interest in water resources in the region for the creation of a truly regional plan. The WRNF emphasised the importance of involving stakeholders from non-PWS sectors in order to better understand the future water needs of other sectors as well as key environmental groups to inform and contribute to the development of WReN's environmental ambition.

Stakeholder Steering Group

WReN's Stakeholder Steering Group (SSG) consists of water company leads, regional EA representatives and primary stakeholders from the energy, agriculture and environment sectors. The group meets bi-monthly and has been important in steering the development of our regional plan. A selection of priorities from discussions with stakeholders through this channel and WReN's responses are provided in the table below.

Table 4.2 Stakeholder priorities and WReN's responses

Stakeholder priority	WReN response
Ensuring future demand from other sectors is represented as accurately as possible, noting there are considerable challenges around this.	WReN undertook further sector specific engagement to target discussion and gain wider understanding of non-PWS needs. See sector specific engagement discussion below for more information.
Keen to understand catchment specific pressures, even if not water resources related as this will help formulate the environmental destination and allow WReN to screen areas out of future consideration.	WReN has created catchment dashboards in response and whilst the main driver is around water resources, they also highlight other catchment pressures.
Ensuring flood risk benefits have been considered in plan.	WReN gave presentation to SSG concluding that there are negligible benefits so are not currently included in the plan and further modelling is required to provide evidence for water resource impacts as well as flood risk. The flood risk related SEA scoring for options has been included as a metric in the plan for options appraisal.
Expectation that there is/will be a surplus of water in the region and questions around if this work needs to be completed in the first place. Other stakeholders reluctant to commit to trading water as they anticipate demand may increase.	WReN highlighted the importance of demonstrating this is definitely the case before discussing options for water trading with other areas, taking future abstraction and environmental needs into account.

Sector specific engagement

Outside of the Stakeholder Steering Group, WReN has undertaken separate discussions with other sectors such as energy, agriculture and environment.

The absence of coherent, overarching plans for non-public water supply sectors, together with other constraints such as competition law, makes it extremely difficult for many of these sectors to accurately plan for their future water needs at a sectoral level. We have therefore been working with non-public water supply stakeholders to better understand how well the national framework data represents reality and seek to ensure any new abstractions are accounted for as accurately as possible.

WReN has engaged with representatives from the energy, agriculture and environmental sectors. A detailed overview of this sector specific engagement is provided in Appendix 8. WReN recognises that there are many other non-public water supply abstractors covering a broad range of other sectors across the region (**Section 5, Table 5.4**). These abstractors are largely smaller or individual bodies with no overarching representative body as with the energy and agriculture sectors which makes it difficult to effectively engage with them. However, the energy and agriculture sectors together represent a significant proportion of non-public water abstractions within the WReN region, particularly in relation to estimated growth (**Section 5**).

For the environmental sector, one key group of stakeholders are the organisations (largely Rivers Trusts and Wildlife Trusts) who lead on the Catchment Based Approach (CaBA). WReN recognises the importance of engaging with CaBA partnerships to understand their Catchment Plans – and to support delivery of these plans where applicable to water resources.

Other organisations who have set expectations for regional water resources plans including Waterwise and the Blueprint for Water coalition. Waterwise is an independent organisation focused on reducing water consumption in the UK who have published a list of 10 things[20] that they would like to see from regional plans. The Blueprint for Water coalition[21] has also identified a number of common areas that they expect to see addressed in all of the regional plans.

Energy UK (EUK) have recently released Joint Environment Programme (JEP) reports[22], which provide further insight into the likely energy sector water demand trajectory over a number of possible scenarios based on recent developments in technology and government policy. Representatives from EUK gave a presentation to the SSG on the outputs from this report, from a WReN perspective. The key messages are highlighted below:

Key messages from JEP reports:

- Water use in the Power/Energy sector is likely to increase significantly after the mid-2020s
- As Energy Sector water use increases, uncertainty also increases
- If existing power sector licences are reduced, this would preclude development new power/energy asset options dependent on freshwater, that would otherwise contribute to achievement of UK net zero 2050
- Future development of power assets is likely to be required both inland and at the coast
- Unintended consequence of restricting water abstraction for power stations sites → failure of energy sector and possibly the UK to meet net zero 2050
- Power sector requires access to water and water rights now and in the future to ensure decarbonisation in a resilient, robust, efficient and affordable way.

There is a high degree of uncertainty when forecasting future water demand by the energy sector. There is some degree of confidence that the transformation to net zero will result in higher freshwater demands at some locations, however, the volumes of water required, geographic spread and the timing of this increase in demand are all unknown at this stage. This is largely owing to the various different pathways towards net zero, which all have different freshwater consumptions attributed to them. Therefore, at this

[20] Waterwise, December 2020 - https://www.waterwise.org.uk/knowledge-base/waterwise-asks-for-regional-water-resources-plans-2020/?seq_no=2

[21] Blueprint for Water, July 2021- https://www.wcl.org.uk/docs/Blueprint%20for%20Water%20Asks%20for%20Regional%20Plans_Final_20_07_2021.pdf

[22] Projections of Water Use in Electricity and Hydrogen Production, under the 2020 Future Energy and CCC Scenarios including BEIS 2020 lowest system cost analysis – with a focus on the East of England by U Gasparino and N Edwards, project number JEP20WT08, report number ENV/675/2021;
Projections of Water Use in Electricity and Hydrogen Production to 2050, under the 2020 Future Energy and CCC Scenarios – Regional Analysis by A Moores, project number JEP20WT09, report number ENV/677/2021.

stage of the planning process, the WRNF dataset provides an indicative view of future position only, and WReN will continue to review and seek to validate against specific regional and catchment level variabilities.

Engagement with the agriculture sector, including National Farmers' Union (NFU) and Country Land and Business Association (CLA), enabled WReN to better understand the distribution and variation of agricultural activities across the region. Through this engagement it was deemed that the growth factors in the WRNF dataset attributed to each sub-sector for agriculture were appropriate, however, there are still considerable uncertainties regarding the distribution of agricultural practices across the WReN region in the future.

It was also noted that agricultural licences are often historic and have multipliers attached, and consequently may not be representative of actual abstraction volumes. Therefore, recent actual data rather than the full licensed values are more reliable when applying growth factors and considering potential future abstractions and licences for agriculture and other sectors. In addition, although some previously unregulated abstraction will be licensed going forwards, they are currently not represented in the data. WReN will continue to engage with stakeholders and consider how to incorporate abstractions outside of the current licensing regime.

Following publication of the catchment dashboards, WReN has continued to engage with stakeholders to ensure priorities have been captured and to gather further, more localised validation on the data presented. The dashboards have been updated for the January 2022 consultation in response to feedback received from our stakeholders. The aim is for these to evolve in collaboration with our stakeholders and may be further developed to support the in the planning process as we progress towards draft regional plan submission.

5. What the future looks like

This section sets out what we are seeing in terms of future trends for water supply in our region. It reflects updated modelling of forecast future public water supply and demand as we have completed to date, although it is important to note that these forecasts are subject to further work and refinement, as explained below. This section also sets out what we currently know about future demand in other sectors, work we have completed to date on regional transfer options, and some other considerations that will continue to evolve as we further develop our regional plan.

5.1. Public water supply forecasts

The availability of future water supply is influenced by a range of factors. In some areas, supply availability is constrained by asset or licence factors; in others, variability in climate is the greatest influence on future supplies. The following sections outline some of the primary influences on our future supply availability.

Assessment of 1 in 500-year drought resilience

The WRNF set out a new expectation that water companies would achieve resilience to a 1 in 500-year drought, without recourse to Level 4 drought restrictions, by 2039. In order to better inform our understanding of drought resilience, we have used new, more sophisticated methods for our public water supply forecasts for this round of planning compared to WRMP19. We have done this specifically to assess our region against the 1 in 500-year average frequency for Level 4 restrictions (i.e., standpipes, rota cuts or in the case of some areas of the region, pressures reductions) required in the WRMP planning guidelines, but also because in-region resilience is a key question when considering the ability to transfer water to other regions.

Specifically, we have applied long-periods of 'stochastic hydrological' data (plausible synthetic scenarios based on historical hydrological patterns) to water company water resources models, to better assess supply availability under severe and extreme drought events. This is particularly important for the Kielder and Yorkshire areas, given the potential for water exports or inter-regional transfers to be considered.

This updated modelling shows that the combined effects of the new stochastic data, the requirement to be resilient to a 1 in 500-year drought, and the updated climate change projections result in a significant reduction in our future supply forecasts. In our initial baseline, prior to inclusion of any drought measures and demand/leakage reduction interventions, for the Yorkshire Grid zone this results in a deficit from the start of the planning period. Initially the deficit is significant as the climate change reduction is exacerbated by increased demand as a result of Covid-19 (see below). However, once demand declines closer to 'normal' (but still post-Covid) levels the deficit reduces until the mid-2040's when it starts to rise again due to the combined effects of climate change and population growth. The Kielder zone also shows a declining surplus until a deficit is reached in the 2060's in the initial baseline supply-demand balance. The drawdown of Kielder reservoir and the overall reduction in Water Available for Use (WAFU) is significant enough to mean that transfers out of the Kielder zone to support other areas may no longer be viable depending on the volumes and utilisation required.

Both the Yorkshire Grid and Kielder zones are forecast to be in surplus once the benefits of drought measures and demand reduction policy assumptions are included in the supply-demand balance. The Yorkshire Grid zone still shows a deficit in the early years of the forecast period but is in surplus by year 2 of the 25-year planning period, which starts 2025/26. This creates a risk to the zone's resilience to a 1 in 500-year drought in the short term.

The new stochastic data results in a significant step change in our supply forecast compared to previous plans in some cases. Whilst there is likely to be some change due to the move to using UKCP18 data, the magnitude of the change – which impacts the baseline as well as climate change forecasts – is such that we need to carry out further work to refine our supply forecasts. This means that the data inputs and assumptions presented in Appendix 2 will change as we move towards the draft WRMPs and regional plan in summer / autumn 2022.

It should also be noted that whilst Level 2 (Temporary Use Bans) and Level 3 (Non-Essential Use Bans) are

a key part of our Deployable Output (DO) assessment approach, we do not consider these to be a key driver of investment or choices in their own right. The main constraint to DO is considered to be the 1:500 resilience level for Level 4 restrictions in the main strategic zones. Regardless, we believe that the 48-year scenarios used in stochastics have a propensity to overstate the frequency of existing historic Level of Service events (such as 1995/96), and as such should be interpreted with care should this be important to plan decisions in due course.

Climate change impacts

The potential impacts of climate change on water resources for public water supply have been considered in all WRMPs published since 1999. In the 2019 WRMPs, water companies used UK Climate Projections 2009 (UKCP09) data. For the development of our regional plan and the next WRMPs, we have updated our assessment of the potential impacts using the latest UK Climate Projections 2018 (UKCP18) projections.

Like other regions, our focus on the first draft of our regional plan has concentrated on applying the Regional Climate Models (RCMs) data, which is spatially coherent and allows for consistent assessment across regional modelling. Water resources modelling results using the new data outright showed that the expected impact of climate change was significantly greater than was shown by the UKCP09 data used at WRMP19. This is partly because the RCM data is based on a high emissions scenario (RCP8.5, 4 degrees temperature increase) rather than medium. There may also be drier autumn conditions observed, which is of importance to winter reservoir refill, but with wetter springs and winters.

As a result, we have used a published study by Atkins to scale down the supply impacts to a medium emissions scenario (RCP6, 2 degrees temperature increase), for use in our central estimates in the supply-demand balance. We understand similar approaches have been taken in some other regions. In terms of scaling the impact of climate change over time, climate change impacts have been scaled back to 1990, so some climate change influence is included on our forecasts even at the start of the planning period.

A summary of the mid impacts of climate change included in our central estimate of supply availability are shown in **Table 5.1**.

Climate change is a major uncertainty area on available supplies and is a key component of our target headroom uncertainty allowance. We have also included it in our list of stress tests that can be applied in defining our adaptive plan (**Section 6.4**). Ongoing work at national level and with regulators will likely refine how we scale climate impacts over time and incorporate the latest climate products into our plans towards the summer / autumn 2022 draft WRMPs. It is too early to draw firm conclusions on the impacts at this stage.

Table 5.1 Mid climate change impacts in the 2070s from RCM UKCP18 scenarios (scaled to RCP6 medium emissions)

	Hartlepool	Berwick	Kielder	East	Grid
Ml/d impact	0	0	-57.58	-1.27	-109.86
% loss	0	0	7	9	8

Transfers of water

Our work to explore both inter and intra-regional transfers of water is explained further in **Section 5.3**. However, with respect to existing transfers, a material impact on supplies in the Yorkshire area is possible through reduction, or cessation, of an existing transfer of water from the Water Resources West area. We have been in dialogue with WRW about the future availability of this transfer through the planning process and notably also through reconciliation. This has led to a joint submission by YW and Severn Trent Water proposing a new Upper Derwent Valley Reservoir Expansion Strategic Resource Option (UDVRE SRO), which, if delivered, would protect YW's import whilst also addressing supply-demand deficits within the WRW region. As the final position on this scheme will only be known later in the regional planning process, at this stage we have considered two pathways in the plan related to the transfer – one where it is maintained, and one where it is stopped. This is discussed in more detail in **Section 6.5** and **Section 8**.

Major influences on demand

The effect of the Covid-19 pandemic will continue to affect PCC and demand in the next few years and could potentially cause permanent changes to demand and PCC henceforward. In 2021/22 restrictions will still be in place for at least a proportion

of the year which will once again have effects on household and non-household demand and PCC. However, we expect that there will be longer term impacts because of this pandemic on societal activities, for example the increase in working from home. Some areas in the region – notably in the commercial sector – have seen a large decrease in water use due to lockdowns. There remains considerable uncertainty as to how long it will take for the sector to return to pre-Covid levels; whether all non-household sectors will return will have an impact on non-household consumption for the planning horizon.

Research suggests a new normal base demand will develop as a result of the changes in water use. As part of the industry project with Artesia[23], the impact of Covid on demand at an individual company level was investigated including the continued impact of Covid-19 for the remainder of current AMP (to 2025). For most of the region, full lockdown conditions are predicted to produce the highest increase in consumption in households and highest decrease in consumption in non-households with partial lockdown conditions being around 10% less than this. As household consumption accounts for the majority of Distribution Input (DI) it would be expected to therefore increase overall DI under new normal conditions.

Work continues to understand the short to medium term impact of covid on our plans, and we continue to participate in collaborative water industry studies and engage with Regulators to understand and discuss covid impacts and how we should consider them in our forecasts. However, based on recent research, we have applied a 'new normal' impact of covid on demand to household and non-household consumption for all demand scenarios. Where appropriate water companies have updated their demand management options (metering and water efficiency) which have a direct impact on household consumption.

Supply-demand balance summary

The key data components of the supply-demand balance position along with the underpinning assumptions are provided in Appendix 2. A summary of the supply-demand balance position is shown below. **Table 5.2** shows our supply-demand position[24] prior to the inclusion of further demand management and leakage reductions beyond the AMP7 2020-2025 period, whereas **Table 5.3** shows our position with the benefit of enhanced demand management and leakage reductions in line with the 2050 policy assumptions and aspirations (with an initial assumed delivery profile over time).

The new data as currently presented indicates that, with the exception of the Yorkshire Grid, we expect all WRZs to be in surplus through the planning period once drought measures and policy assumption benefits are included in the supply-demand balance. However, the combined impacts of new stochastic data, increased climate change impacts and higher demand mean that without these benefits we are forecasting a significant deficit within the Grid zone during the early stages of the planning period and a less significant deficit in the Kielder zone in the later years of the planning period. The Grid deficit reduces for a number of years once the covid impacts lessen, before increasing again. As noted previously, we are continuing to refine our forecasts, and this picture may change. The future of the Severn Trent Water (STW) import to the Grid creates further uncertainty that could drive a deficit in the zone which cannot be offset by the demand reduction policy assumptions.

Table 5.2 Supply-demand balance: Position prior to demand management policy aspirations

	Summary of forecast surplus (+) and deficits (-) – Ml/d		
Zone	**2029/30**	**2039/40**	**2049/50**
Berwick	+0.84	+1.40	+1.75
Hartlepool	+5.11	+5.08	+4.80
Kielder[25]	+26.36	+21.04	+16.24
Yorkshire East	+4.01	+4.00	+3.87
Yorkshire Grid	-0.26	+6.74	-0.68

The above forecasts **include drought measure benefits.**

[23] Collaborative Study - The impact of COVID-19 on water consumption during February to October 2020 – Final report, (2021), Artesia Consulting – available upon request.

[24] This data is for the core 25-year planning period to 2050 that drives planning needs in our plan. We have also forecasted out to a 60-year planning period, albeit at higher level, which is used rather for the purpose of scenario analysis on our plan (Section 8.2).

[25] It should be noted that the Northumbrian Water Industrial zone has been presented as part of the Kielder zone as these two zones have been merged for this round of planning. This represents a change in zonal reporting from WRMP19. It should also be noted, however, that the merger of these two zones does not result in a straightforward addition of the DOs, and surpluses/deficits, because of the way that potable demands were previously accounted for within the Industrial zone. Further, it should be noted that the definition and confirmation of dead water for Kielder may influence this DO number in future; this question has arisen given the extreme drawdown in some stochastic and climate change scenarios.

Table 5.3 Supply-demand balance for reconciliation: Reconciliation baseline with demand management policy aspirations applied

	Summary of forecast surplus (+) and deficits (-) – Ml/d		
Zone	**2029/30**	**2039/40**	**2049/50**
Berwick	+1.08	+2.06	+2.62
Hartlepool	+5.83	+6.53	+6.98
Kielder[25]	+53.77	+88.16	+111.92
Yorkshire East	+4.01	+4.00	+3.87
Yorkshire Grid	+21.09	+70.78	+106.06

It is important to recognise that all forecasts have inherent uncertainty around them, which are in part accounted for in our target headroom uncertainty assessment, but also which for major uncertainty areas we are considering within our scenario framework. These are detailed further in **Section 5.4**.

Supply-demand scenarios

There are uncertainties when forecasting supply and demand, particularly in the longer term. If the future outturns differently to our forecast, this could change our supply-demand balance position and whether we have a supply surplus or deficit in each resource zone. To assess the sensitivity of our supply-demand balance position to these uncertainties, a number of supply-demand scenarios have been considered. These scenarios are described in **Section 6.4**.

Whilst some scenarios reduce the amount of surplus available in the resource zone (such as the scenario representing a long-term higher future environmental destination), the position is still one of surplus under most scenarios in the majority of resource zones with the following exceptions:

- Berwick WRZ – consideration of a long-term higher future environmental destination scenario indicated that Berwick could be in deficit by mid 2040s. However, the approach to apportioning higher future environmental destination adjustments to each WRZ was very high-level and needs further refinement to be more reflective of the specifics associated with the Berwick area. It is expected that the deficit under this scenario for Berwick is overstated, but in any case, is not strategically or regionally of relevant in scale. Specifics around any future deficit in Berwick will be addressed at the Company WRMP level.
- Yorkshire Grid WRZ – this was indicated to be in deficit under a number of the scenarios considered. The extent of the deficit and when it is reached in the planning period varies depending on the scenario but are regionally material and are discussed in more detail in **Section 6.4** and **Section 8.2**.

The testing of the supply-demand balance positions against future uncertainties indicates that the majority of resources zones within the WReN region would still be in surplus and/or can be addressed at a Company level with the exception of Yorkshire Grid. For this reason, our future choices and emerging plan is largely focussed on the Yorkshire Grid.

5.2. Non-public water supply forecasts

A summary of baseline and future predicted abstraction for the WReN region is provided in **Table 5.4** for primary and secondary sectors. All data are sourced from work undertaken by Defra for the WRNF which studied water demand outside of the water industry, particularly the drivers for and uncertainties around future demand. The data below presents figures for total abstraction, including non-consumptive water use, as well as consumptive only abstraction. Further detail is provided in the sections below.

Consumptive only water use

Table 5.4 shows that, consumptively, public water supply uses significantly more water than other sectors in the region. Based on consumptive abstraction only, the industrial and power sectors have the largest demand for water outside of public water supply, however as a proportion of overall water use these are both relatively small. Moreover, just 7.7% of current demand and 9.6% of future demand is credited to non-public water supply.

Based on these data, it is estimated that approximately a further 27.6 Ml/d will be required to meet future demands of other sectors in 2050 outside of the water industry. The largest contributors to this estimated increase in demand are the agricultural sector, specifically spray irrigation, and the power sector.

Non-consumptive water use

The numbers associated with other sector abstractions are considerably larger when inclusive of non-consumptive data, with the power sector

surpassing PWS abstraction more than three-fold. This is largely attributed to the hydropower and non-evaporative cooling energy processes which return a large proportion of the water initially abstracted to the environment directly and locally, with little or no treatment.

At this stage, the demands presented for non-public water supply sectors remain those contained in the WRNF. There are various uncertainties around these data, particularly around the future projections for water demand including the long-term impact of behaviour changes following the Covid-19 pandemic. However, engagement with other sectors to date has largely validated the growth factors attributed to each sector. Validating future demand for water within the power sector is challenging as there are a number of potential scenarios all dependant on a number of unknowns. These unknowns include where energy production will be focussed, the type of technology being used (and the associated water demand) and when any changes will occur. Having more confidence in these unknowns is important to understand the distribution and timing of demands for the power sector. WReN will continue to engage with the power sector and review any new information as and when it is made available to update the future demand forecasts.

Table 5.4 Baseline and future predicted abstraction in the WReN region, by primary and secondary sector[26].

Primary Sector	Secondary Sector	Baseline abstraction		Future abstraction in 2050	
		Recent actual - estimated consumptive abstraction - Ml/d	Recent actual – total abstraction (inc. non-consumptive) - Ml/d	recent actual + best estimate growth factor, consumptive only – Ml/d	recent actual + best estimate growth factor, total abstraction (inc. non-consumptive) - Ml/d
Agriculture	Aquaculture	0.09	336.38	0.09	336.38
	General	6.73	11.84	6.73	11.92
	Horticulture	0.17	1.24	0.34	2.49
	Other Agriculture	0.06	67.00	0.06	67.00
	Spray	25.92	25.92	37.33	37.33
Total Agriculture		**32.97**	**442.37**	**44.55**	**455.11**
Industry	Chemicals	2.92	8.64	3.57	10.54
	Food and Drink	13.36	42.28	16.70	52.85
	Industry General	0.63	2.97	0.63	2.91
	Metals	2.45	11.03	2.33	10.43
	Minerals	16.77	32.63	15.85	31.33
	Other Industry	17.70	33.29	16.79	31.62
	Paper and Printing	6.48	11.64	7.25	13.04
Total Industry		**60.31**	**142.47**	**63.13**	**152.72**
Other	**Total Other**	**7.23**	**297.21**	**7.23**	**303.39**
Power	Evaporative Cooling	41.89	41.89	51.10	51.10
	Hydropower	0.00	7032.69	0.00	8579.88
	Non-evaporative Cooling	0.00	44.46	0.00	54.24
	Process Water	11.78	19.64	14.38	23.96
	Production (general)	6.38	40.58	7.79	49.51
Total Power		**60.06**	**7179.26**	**73.27**	**8758.70**
Private Water Supply		**3.78**	**5.67**	**3.69**	**5.50**
Non-PWS Total		**164.35**	**8066.98**	**191.87**	**9675.42**
Public Water Supply		***1962.55***	***2004.66***	***1805.35***	***1847.41***

[26] Figures from 'Understanding Future Water Demand Outside of the Water Industry', Defra (2020)

5.3. Exploring water transfers

WReN has assessed the potential for new PWS transfers to other regions, working closely with the neighbouring companies and regions. This work has significantly progressed our understanding of the feasibility of transfer options from our region compared to the previous WRMP planning round.

As a result of this process, we identified four technically feasible options; WRW is the only direct recipient. As our region has previously considered to have significant 'surplus' resources in the Kielder zone due to Kielder Water, there are two options available for a transfer to United Utilities, a direct Kielder Water transfer and an alternative that is supported by Kielder Water. Kielder Water could also be transferred to STW via Yorkshire Water to provide a further possible inter-regional transfer. The fourth feasible option is a transfer from Yorkshire Water to STW, which would require supporting options to make the water available.

However, it should be noted that when planning for a 1 in 500-year level of drought resilience and the latest UKCP18 climate change projections, the supply surplus in the Kielder WRZ is significantly less than that published in NW's WRMP19. Additionally, simulated modelled reservoir storage in Kielder reservoir has reduced from ~75% in a 1 in 200-year drought resilience scenario in its WRMP19, to ~40% in a 1 in 500-year drought resilience scenario in its latest draft WRMP24 forecasts using stochastic datasets. A 100Ml/d export from Kielder reservoir to UU would reduce storage in extreme droughts further. There are also significant cost and environmental implications surrounding the options, including an INNS risk that would need to be mitigated by significant treatment at source. So far, neither of the UU export options have been chosen through the regional reconciliation process. Nevertheless, as part of the RAPID SRO gated process, UU has recently submitted its Gate 1 reports and Kielder remains one of 27 potential options carried forward for more detailed assessment for Gate 2. Should the water resources planning process reveal a requirement for continued high transfer volumes in the long term, then the option might become more preferable, especially if other sources are discounted through Gate 2 feasibility.

In addition to the water transfer options, WReN has assessed scenarios for a reduction to an existing import from STW to Yorkshire Water. This is a feasible option in the WRW regional plan and WReN has identified potential solutions that could substitute the import if it was either ceased or reduced.

Further information on the water transfer options is provided in Section 7.4 and Appendix 5.

5.4. Evolving considerations

Use of reservoirs for flood risk management

There are various reservoirs around the region that include flood drawdown or release rules, which are already included in our supply-demand balance assessments (e.g., Kielder, Derwent (North east), Cow Green). Exploration of the future use of reservoirs to reduce flood risk elsewhere in the region is more progressed in some catchments, and highly uncertain in others.

Creating storage in water supply reservoirs to help mitigate flood risk has the potential to impact on water supply availability and drought resilience, carbon (through loss of the use of gravity-fed resources) and local supply system resilience. With this in mind, a holistic and evidence-based assessment is needed of these schemes, taking account of the above risks alongside any tangible flood benefits.

Previously, a study on behalf of Yorkshire Water by JBA (*June 2018, Regional analysis – using reservoirs for flood risk management*) assessed the potential impact of flood mitigation schemes on water resources. This study took a high-level approach to assessing flood scheme impacts, by reducing reservoir storage at a range of sites individually and in-combination to 80-90% of current capacity. Importantly, the study aimed to cap combined flood scheme DO impacts at 25 Ml/d, on the basis of disproportionate increases in the cost of offsetting water resources schemes, a price point that has since changed with the current supply-demand position for the Yorkshire Grid. A 25 Ml/d would indicatively be equivalent to a cost of over £50m NPV[27] even prior to taking account of a higher price point due to the current deficit position. This demonstrates the importance of an evidence-based assessment to ensure appropriate investment via the WRMP process.

The study showed the impact of a flood scheme on DO could differ markedly between an 80% and 90%

[27] Coarsely derived for illustration using AISC ranked WRMP19 options, representing £m NPV over planning horizon.

loss of capacity. In some cases, impacts on DO were assessed to be negligible. At the time the work was completed, when seeking to optimise schemes (based on impact, rather than benefit[28]), it was possible to drawdown a large number of groups across the three assessment areas without exceeding 25 Ml/d reduction in regional DO, although there is still the potential for significant localised impacts (not always visible at the Grid modelling scale). Further, this conclusion should be severely cautioned now given the deficit position shown in the Yorkshire Grid for the current round of planning, and in light of the stochastic & climate change DO findings. The previous study implies 'slack' in the system without taking account of the loss of drought resilience. It is also the case that where there are local supply resilience implications, these would influence the investment cost of such schemes. Now that our regional plan has a new baseline DO using the latest methods, significant further work would be required to explore schemes and their benefits.

At this time, a prospective scheme at Hebden Bridge is under consideration and is relatively well defined. Indicatively this would have an impact of around 1.5 Ml/d[29] on Grid DO, which is immaterial to the regional plan in a strategic context and when viewed in isolation. However, local operational factors and resilience will also need to be taken into account to implement such a scheme in future. No adjustment to DO has been made to the Grid zone supply forecast for the scheme. Given the scale of impact, further assessment of this scheme may be addressed at the YW company-level WRMP stage of the process.

Theoretically, there are potentially a high number of other candidate flood management schemes. However, none of these are currently at a level of maturity or definition to include in the core plan – in all cases further work to assess the flood benefits needs to be undertaken by the Environment Agency and this needs to be completed before any assessment of other impacts (such as water resources) can be carried out. For the purposes of this plan, therefore, no additional consideration of reservoirs and flood risk has been included. As mentioned above, the impact of drawing down the Hebden Bridge group is not material at a regional scale (it is instead a planning issue for YW's WRMP).

Other sectors

A number of new non-household water demands have been identified in the north east of our region including hydrogen production on Teesside and car battery production within the wider Kielder Water Resource Zone. NWL has met with these companies to agree demand forecasts which have subsequently been included in the WReN baseline Distribution Input forecast. We will continue to work closely with Northumbrian Water, the Environment Agency and both existing and new non-household businesses and will further refine demand forecasts for both raw and potable water prior to publishing the draft regional plan.

Critical period and peak demand

As an overall region, dry year average considerations are the dominant driver of the resource position and need. Month to month seasonality of demand is inherently included in the water resources modelling assessment of DO. Operational experiences during recent hot, dry periods (notably 2018 and 2020) have tested public water supply system but not led to any security of supply risks.

A peak demand scenario is being investigated to determine if there is a critical period risk that Yorkshire Water should plan for in their WRMP, or if investment at PR24 to strengthen grid connectivity and water distribution systems could provide further resilience utilising existing resources. This is considered to be a local area concern, primarily, rather than one that materially affects the WReN strategic regional plan. However, is important when considering water transfer needs to ensure that the lost capacity from a transfer does not impinge on local peak demand considerations. As the autumn 2021 reconciliation process did not result in any transfers out of the region this is not currently a factor. However, if in the future another region does select a transfer from our region the availability during a critical period scenario would need to be considered.

[28] Importantly, the study did not assess the flood risk benefit as such of the schemes, rather sought to understand the impact of scenarios on water resources; as such, it therefore did not constitute a full impact-benefit assessment.

[29] This figure relates to the impact under historic hydrological conditions and may be subject to change given the changes to the supply position with stochastics and climate change applied.

6. Our Approach

We have undertaken a problem characterisation (a form of risk assessment) for our region alongside consultation with stakeholders including regulators and other regional groups to develop planning process methodologies that are aligned with policy, guidance and where appropriate, consistent across companies and other regions. As part of the problem characterisation (which is typically focussed on water resource zones), we carried out catchment pressure mapping to identify catchments with significant concerns, particularly relating to current and future abstraction and other environmental pressures. We built on the catchment mapping exercise to develop catchment dashboards, which focus on the long-term abstraction and environmental pressures and potential water resource implications within each catchment.

In consultation with stakeholders, regulators, and our customers, we have developed planning objectives and measurable criteria (metrics) to support our decision making for the development of a best value plan through an iterative process including reconciliation with other regions. We use multi-criteria analysis supported by environmental appraisal in our decision-making process to support us in finding the plan which meets both (inter- and intra-) regional needs and provides the best value to society and customers. The plan is currently at an emerging stage, and the process will continue, informed by consultation on this document.

6.1. Overall plan timeline and approach

The overall timeline and approach for development and delivery of the final regional plan in September 2023 is provided in **Figure 6.1** and this reflects a collaborative view across all regions. The reconciliation process between August and December 2021 was a key step to enable alignment with other regions, confirm strategic choices and select options that meet the national need across regions.

The outputs of the reconciliation process is reflected in this emerging plan and views will be gathered from the consultation on the proposed solutions. A further consultation and feedback process on the draft plan will be carried out later in 2022 in parallel with consultation on water company draft WRMP24s. Further details on the next steps are presented in **Section 9.**

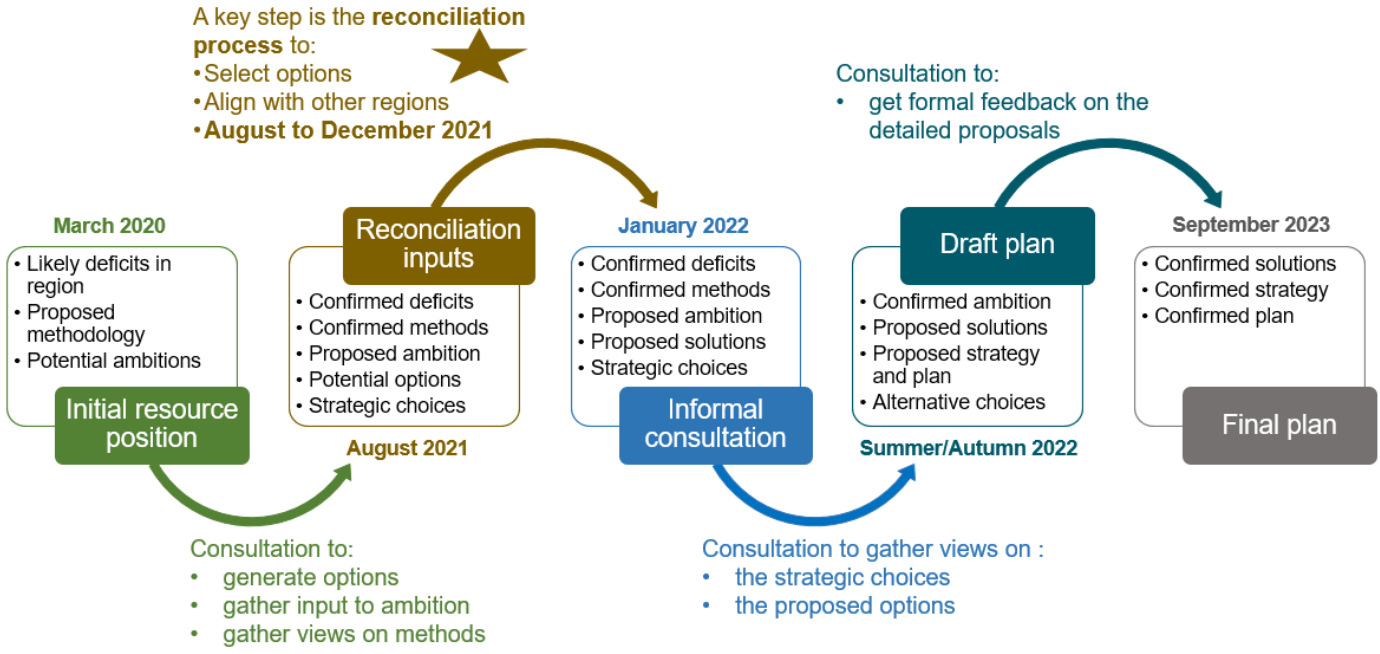


Figure 6.1 Stages of regional plan development
(based on RCG working group material, noting that date for Draft plan is to be confirmed)

6.2. Problem characterisation summary

As part of developing their next WRMPs, each water company completed a "problem characterisation" exercise. This is essentially a risk assessment, carried out at Water Resource Zone level, to guide which methods companies should appropriately apply to their planning.

The outputs of the problem characterisation exercise are provided in **Table 6.1**. This shows that, at a strategic level, most of the WRZs in our region were assessed as low risk in terms of both strategic needs and complexity factors. However, the Yorkshire Grid, covering most of the population of Yorkshire, was deemed to be of high complexity given the blend of supply and demand influences. This zone was assessed as having a heightened risk of a significant supply-demand deficit due to climate change reducing available resources in a dry year and other influences and uncertainties such as COVID-19 impacting on household and non-household demand.

Additional future potential problems to address were also identified including:

- The potential loss/reduction in the Severn Trent Water (STW) import
- Use of reservoirs for flood alleviation (e.g., Hebden Bridge).
- Strategic transfer requirements – both inter- and intra-regional – and third-party requirements further influencing needs for the Yorkshire Grid zone, as well as, to a lesser extent, that of the Kielder zone.

Policy requirements to reduce leakage and per capita consumption at the time of Problem Characterisation were seen to have the potential to close a baseline deficit. However, it was recognised that alternative solutions may need to be identified depending on the timing of any deficit and the uncertainties of demand side solutions that rely on new technologies and customer behaviours. Demand reduction may not provide a secure solution to fully replace the loss of existing resources.

Methodologies were developed in response to problem characterisation to ensure suitable testing of relevant factors in the plan such as drought resilience and climate change (which has since shown that the combined effects of such influences result in a significant deficit appearing from very early in the planning period for the Yorkshire Grid zone).

The evolving position since problem characterisation on the availability of future water supply in the Yorkshire Grid zone and other WRZs in our region is discussed in **Section 5.4.**

Table 6.1 Current "Problem Characterisation" position for Water Resources North resource zones

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	**2-3 (Small)**	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	All other WRZs			
	Medium (7-11)				
	High (11+)		Yorkshire Grid		

Initial catchment scale "problem characterisation" and how we have moved on

Using information from the National Framework for Water Resources, WReN carried out catchment pressure mapping to identify catchments with significant concerns, particularly relating to current and future abstraction and other environmental pressures.

Catchments identified as having the most concerns are highlighted in dark purple on the map in **Figure 6.2**. These catchments experience a number of significant combined pressures including lack of water availability, Water Framework Directive (WFD) concerns, moderate-high growth in abstraction demand as well as moderate-high risk of abstraction reductions. Therefore, these were identified as "priority" catchments for further exploration.

Figure 6.2 shows the spatial coverage of the catchments facing the highest combined pressures and the WRZ status. It demonstrates that the south of the region faces greater pressures from all elements compared to the north. However, when considered at this initial high level, the north of the region, with its access to water from Kielder, appears to have greater potential for water exports. Since the catchment scale characterisation, these export options were further appraised and considered as part of the reconciliation process.

Following publication of the Environmental Destination guidance and through consultation with stakeholders, the catchment mapping exercise detailed above was built upon and catchment dashboards were developed. These dashboards consider abstraction with a focus on the long-term environmental pressures of each WFD management catchment to develop a more detailed understanding of the long-term abstraction pressures and potential water resource implications within each catchment.

In consultation with relevant stakeholders, the dashboards have been and will continue to be a key tool to understand the joint pressures, validate with local knowledge and ultimately inform the development of the regional plan. Since August 2021, the catchment dashboards have been updated further in response to feedback from stakeholders including the Environment Agency. More information on the catchment dashboard approach is provided in Appendix 6.

Figure 6.2 Map of the WReN region demonstrating the spatial combination of catchment and WRZ pressures

6.3. Regional supply-demand options under consideration

We have developed a range of PWS options for appraisal within the regional plan where a deficit, or where a material risk of deficit exists. The specific choice of options is key to the plan development process and development of the best-value plan. This may be to meet a supply-demand deficit under our central estimates and forecasts, to meet a regional need, or to facilitate in the exploration of supply-demand scenarios within the adaptive plan.

Options have not been developed in zones where there is no strategic supply-demand planning problem to solve, for example, no options have been developed for the Hartlepool zone, as was the case in the detailed WRMP19 submission (although demand options for Hartlepool are included in the development of WRMP24). For the Northumbrian Water area, rather than develop specific Northumbrian Water feasible options, our focus has been on further understanding the potential future use of Kielder as an export option to a greater extent (i.e., use of surplus or available water is assumed in this zone as opposed to development of new resources).

From the perspective of the WReN area, the focus of options appraisal will be on addressing material forecast deficits in the Yorkshire Grid area. The options developed cover both transfer options and zonal options akin to those included in the previous WRMPs. The options were revised prior to the autumn 2021 reconciliation from the previous planning round and new options have been identified. Our focus has been on strategically relevant options to the regional plan, and for this purpose, a 5Ml/d size threshold (de-minimus) has been applied to the supply options listed for the Yorkshire Grid zone in the Appendix 5.

Options to meet public water supply needs

The range of different types of supply options available to meet a deficit in the Yorkshire Grid are shown in **Figure 6.3**. These options have potential to support regional decision making (a possible change to the STW transfer to support the WRW needs) and align with the Yorkshire Water WRMP.

Over 40% of options are either new groundwater options or partially treated bulk supply/transfer options types. The latter bulk supply options account for over 60% of the potential benefit provided by all the options identified to meet the Yorkshire Grid needs. However, the options present variations of use for several of the potential new resources, therefore many of the options are mutually exclusive with others. This means that the combined benefit of all the options exceeds the actual total resource that could be used for supply, and it is not appropriate to sum the benefit of all supply options.

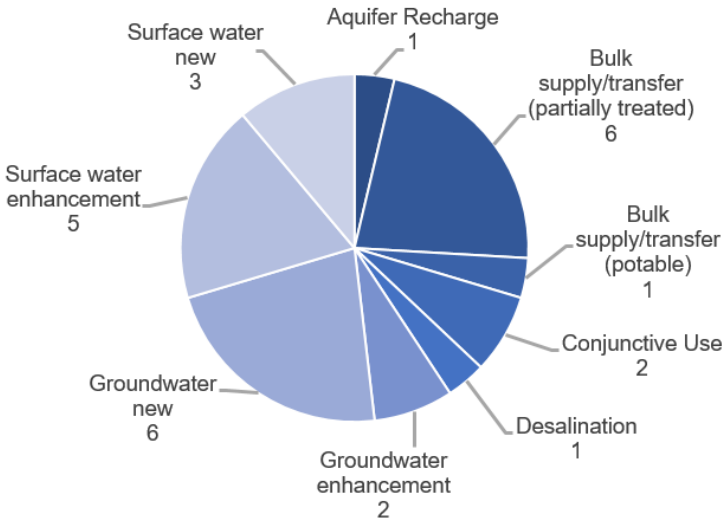
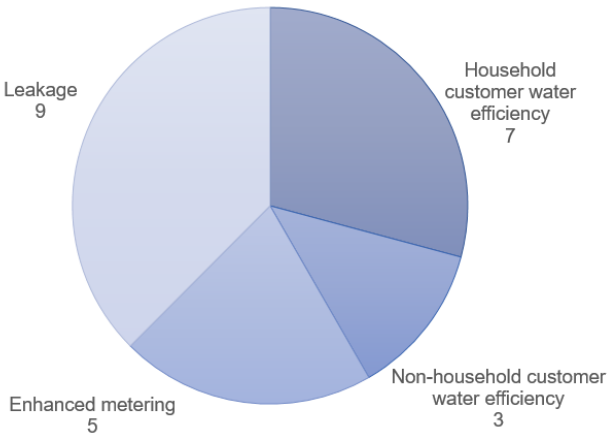


Figure 6.3 Number of supply options by option type identified to meet Yorkshire Grid deficit needs (5 Ml/d de-minimus)

There are also a number of demand management options identified to address a deficit (Yorkshire Grid Zone) and to support resilience in areas where there is decreasing surplus. **Figure 6.4** presents the types of different options available to meet demand reduction for the main WReN zones. It should be noted that it does not represent the breakdown of how we will meet the policy requirement.

Figure 6.4 Number of demand reduction options by type for key zones



In the previous round of Business Plan submissions, each Company developed a Bid Assessment

Framework[30] for submission of third-party options to the WRMP process. We will fully consider any third-party options that are submitted via this route and consider whether this is relevant to the strategic regional plan or WRMP only. To date, no third-party options have been proposed that would contribute to the loss of the STW transfer and support the national approach. Companies will consider third party options again when producing WRMP24.

Options to meet non-public water supply needs

Options to meet other sector needs, outside those of public water supply, may be broadly split into those that solely and specifically address other sector needs (in their own right), and those that could be jointly developed to also meet public water supply deficits in a holistic manner.

There are no non-PWS solutions identified for the emerging plan, however, we will continue to explore potential multi-sectoral opportunities as we continue to engage with other sectors to understand non-public water supply needs as outlined in **Section 6.7**. In **Section 8**, we pose a specific consultation question for other sectors on the current evolving plan, should there be specific comment of relevance to shared options or options risks/benefits of note.

6.4. Decision making process for best-value

Options appraisal overview

The outcome of the WReN options appraisal and decision-making process will be a best-value plan to meet the region's objectives, which aligns with other regions and supports the national goals. The Environment Agency's Best Value Plan supplementary guidelines defines a best value plan as *'one that considers factors alongside economic cost and seeks to achieve an outcome that increases the overall net benefit to customers, the wider environment and overall society'*.

We have selected a Multi-Criteria Analysis (MCA) approach as it allows options to be assessed against multiple objectives to produce a solution based on both monetised and non-monetised criteria. The criteria or metrics are derived from pre-defined objectives. This builds on the more traditional Economics of Balancing Supply and Demand (EBSD) aggregated methodology (programme optimisation based on least cost to meet supply-demand deficits over time). The outputs of the EBSD optimisation model are assessed against wider metrics (i.e., other than cost) to evaluate both financial and non-financial impacts and benefits.

Our process allows for consideration of "trade-offs" in selecting a best value plan. This approach was chosen based on our initial regional problem characterisation presented in the WReN Methodology document (July 2020). Since producing the initial methodology statement, the Environment Agency supplementary guidelines have been published and the MCA approach aligns with the supplementary guidelines, and MCA type techniques have also subsequently been included within the UKWIR *Deriving a best value Water Resources Management Plan* publication.

The assessment of future needs in our region has highlighted a PWS risk in the Yorkshire Grid zone. This risk requires a best value plan to be identified through the options appraisal and decision-making process. The risk is an output from the regional plan reconciliation process as WRW's plan showed the future of the existing transfer from STW to Yorkshire Water to be uncertain. The best value plan for addressing this risk will not be available until the formal draft regional plan consultation is published. An initial best value plan assessment has been carried out for this consultation on our emerging results (see **Section 8**). The following steps were taken to produce the emerging plan:

- Simulation modelling was used to produce scenario deficits for two scenarios – a full transfer loss and a 50% transfer loss compared to the base year benefit of the transfer.
- The EBSD optimisation model was used to produce least cost solution programmes[31] for each scenario.
- The optimiser was run repeatedly for the two scenarios with different combinations of feasible supply options available for selection. Options were constrained in or out to provide a range of solution programmes. This was done to address a subsequent risk that the

[30] Found for each of the 3 Companies at https://www.ofwat.gov.uk/regulated-companies/markets/water-bidding-market/water-resources-market-information/

[31] The term solution programme is used to represent a sub-set of options from the feasible options that make up a potential investment programme for closing the deficit. Each optimised solution programme provides a scheduled programme of options to be delivered at pre-determined time steps over the planning period.

least cost solution creates, which is over reliance on a single water treatment works in the Yorkshire Grid zone.
- Each potential solution programme was selected from the options available based on minimising costs then scored against the WReN metrics.
- The metric scores can be compared at a programme level to understand the trade-offs between each of the solution programmes. This information will be used when formulating the preferred plan for formal consultation on the draft plan later this year when further information on the future of the transfer and potential solutions is known.

The risk to the STW transfer presents an alternative scenario to the reconciliation 'in-region' baseline, which did not highlight a supply-demand deficit that required an options appraisal (as it assumes the demand reduction policy aspiration will be met). In addition to the STW transfer risk we have considered alternative scenarios to the reconciliation baseline. These were used to stress test the risks to the baseline scenario assumptions. The stress testing steps are outlined here and further information on the stress test scenarios provided in **Section 8** and Appendix 5:

- The EBSD optimisation model was initially run for each scenario showing a deficit with all feasible supply options available for selection. This provided a least cost solution. Demand options were excluded at this stage as they will be assessed by each water company to meet company leakage and PCC targets as part of WRMPs.
- The EBSD initial outputs were reviewed by the Option Appraisal workstream to assess if the selected solution for each run was feasible. If any option or combination of options included in the solution programme posed a potentially unacceptable risk, the option(s) were constrained out and the optimiser re-run. The learning from the early runs was taken forward to the subsequent runs to constrain out high risk options and reduce the number of scenario iterations.
- The EBSD optimiser provided several optimised solution programmes for each scenario by selecting from alternative sub-sets of options.
- The options that were selected most frequently when all the scenarios were compared will be considered for inclusion in an adaptive plan pathway(s) that could be triggered in the future.

Each optimised solution to the scenarios provides a scheduled programme of options to be delivered in pre-determined time steps over the planning period. For the formal draft WReN regional plan, a single scheduled programme will be put forward as the preferred plan to meet the baseline needs (currently the reconciliation baseline does not show a deficit, but the uncertainty of the transfer may drive investment). The preferred plan could be a solution programme provided by the optimiser or alternatively, a portfolio[32] programme of options could be selected from those that appear most often in the multiple solution programmes produced. The selected solution or portfolio programme will be that which provides the most optimum 'trade-off' when compared to all the objectives.

As the stress test scenarios are uncertain and it is not possible to select a single preferred pathway, the best value plan will include alternative pathways to the preferred plan that could be triggered in the future. The alternative pathways will be a selected portfolio programme that provides the most optimum 'trade-off' and allows sufficient flexibility to adapt to the alternative pathways.

The optimisation model has to date been run to meet scenarios that represent the supply-demand balance need created by the risk that the STW transfer may not be available in the future, and to stress test the baseline scenario. Further optimisations will be run in the coming months to explore different candidate plans using alternative combinations of trade-offs between the metrics (e.g., enhance environmental benefits). This could influence the preferred solution for the Yorkshire Grid zone but will not impact on the regional plan reconciliation outputs.

The best value plan WReN ultimately put forward for public consultation later this year will be either a single programme that performs best against all criteria / metrics or a portfolio programme of options that appear most often in the best performing solution programmes. The plan will be subject to uncertainties and an adaptive planning approach will be used. The

[32] A portfolio programme is not a solution provided by a single optimised scenario. It is a selection of options that appear frequently in optimised runs and collectively the impacts, as measured by the metrics, are considered best value when compared to the alternative programmes.

solution programmes to meet the stress test[33] scenarios will provide a portfolio of options that are considered best value for addressing the potential impacts if the planning assumptions, identified risks or solution benefits are materially different to the baseline and final planning forecasts. We will identify a number of potential pathways (**Section 6.5**) and variations on the options we propose to implement. We may alter the final planning solution if any individual options or combination of options are considered too vulnerable to the uncertainties. We will also identify the uncertainties that could impact on the success of the preferred final plan solution as we progress through the planning period and identify triggers for diverting to an alternative path if our preferred plan is not successful.

Metrics and trade-offs

Metrics are associated with, and sit beneath the overarching WReN objectives. Metrics describe the performance of alternative optimised solutions and selected portfolios (at a programme level) that we will consider in determining our plan. This is not to say that the metrics used will (or should practically) cover all aspects of our planning considerations in line with our objectives. For example, we may be completing long-term work towards environmental destination that brings benefits of a non-supply-demand nature, yet cannot be reflected in an options appraisal process aimed at solving supply-demand resource needs. However, metrics are the key descriptors of programme performance when assessing how best to meet future supply-demand needs (including potential water exports). Over time, if new needs manifest, metrics could also be added to the process in future plan iterations.

The development of our objectives and metrics has been completed taking into account, **on balance**:

- Regulatory and policy aspirations (**Section 2**);
- Customer preferences (**Section 4.3**); and,
- Stakeholder engagement[34] (**Section 4.4**).

As part of the process, we have attributed how each metric would influence the optimisation. For example, metrics may be defined by whether they should be achieved, optimised (to minimise or maximise), or for the purpose of a specific options appraisal, set as a scenario constraint (where a particular objective outcome may be constrained into the plan to compare to alternative programmes). These concepts are explained further in Appendix 4, with extensive additional detail on the development and definition of our objectives and metrics, including taking into account associated engagement.

Our current metric areas included in our options appraisal are shown below:

Table 6.2 Decision-making metrics summary (Detailed metric technical definition is included in Appendix 4)

Metric areas	Planning status
PWS Drought resilience	Achieve or enhance
Biodiversity	Optimise
Natural Capital	Optimise
Leakage reduction	Achieve or enhance
PCC reduction	Achieve or enhance
Flood risk management	Optimise
Multi-abstractor benefit	Optimise
Carbon	Optimise
Customer preferred option type	Optimise
Human and social well-being	Optimise
Financial Cost	Optimise
Option Deliverability	Optimise

[33] Stress test scenarios include those agreed as part of the national reconciliation process and those that reflect the WReN regional uncertainties.

[34] As described above, this is not to say that it is possible for all such views to change the metrics used in technical options appraisal process, but rather may influence the future plans in other ways, or identify future required activities to better define tangible needs in future plan revisions.

As described earlier, we may apply scenario constraints to meet specific objectives by constraining relevant options in or out of the solution. These scenarios will be compared against those that do not meet the desired objectives to evaluate the impacts. At this point in time, not all such scenario constraint areas may be definable to constrain into the options appraisal, but this ensures that our process could accommodate this in future (which may be in future planning rounds). Scenario constraint metrics currently include:

- **Regional transfers**: This was a primary focus area during the autumn 2021 reconciliation process. Our process allows us to constrain in an export option(s) selected by another region(s). The output of round 1 and 2 of the reconciliation process concluded there was no requirement from the other regions for a transfer from WReN.

- **Non-PWS option benefits:** This is dependent on specific other sector needs and solutions being identified and quantified at a catchment level with sufficient certainty for the interested parties to take forward in a WReN investment plan. **Section 6.7** describes our current approach to exploring non-PWS needs. No specific or tangible needs were identified at the time of producing this report.

- **Flood resilience:** This is dependent on a flood resilience need and solution being identified at a catchment level with sufficient certainty for the interested parties to take forward in a WReN investment plan. The current position on flood resilience is detailed in **Section 5.4**. No needs were incorporated at the time of producing this report.

Stress-testing the plan: Scenarios driving adaptive best-value plan development

Our regional plan should be adaptive, and as part of the process we will test 'what-ifs' using scenarios representing key future uncertainty areas for our plan. This type of scenario assessment is called 'stress testing'.

By looking at how the solutions change between these scenarios, should the future turn out differently to our central supply-demand estimates, we will seek to identify potential options or solutions that are more adaptive or allow us to minimise the risks of a sub-optimal plan in the future. Depending on the influence of these uncertainty areas, these scenarios could form adaptive pathways (**Section 6.5**) within our overall plan (with appropriate triggers to move between pathways). It is too early to lock into or confirm this position at this stage, in particular as it is not yet known what the final decision on the future of the STW transfer will be.

The WReN stress test scenarios include common national stress or sensitivity test scenarios agreed during the reconciliation process to assess the impact on national scale decisions associated with the reconciliation process. Given the different uncertainties and influences on each region, it is not necessarily desirable or expected that regions plan to the same scenarios, and we have created additional stress test scenarios applicable to the WReN decision-making process for our region.

The following scenarios have been used for stress testing the plan for this January 2022 submission:

- **Lower leakage reductions and demand management achieved (innovation uncertainty and delivery risks) –** To meet future regulatory aspirations on leakage and demand management we will require significant future innovation and the development of new or uncertain options. Some aspects may also be outside of our control (e.g., dependence on future innovations to deliver cost-effectively), and/or subject to assumptions of available funding. This scenario assesses and presents the impact of achieving leakage reductions and demand management aspirations by 2050 that are lower than the policy levels.

- **High demand growth –** Long-term demand forecasting is subject to significant uncertainty, not least due to it being in part influenced by future population and housing growth (which itself is subject to many factors). As part of developing our demand forecasts we have explored a range of different scenarios, and this high demand growth scenario is based on the potential for increased population growth.

- **Enhanced or long-term higher future environmental destination –** At present, there is significant uncertainty in the future environmental requirements in some

catchments, which may be subject to further investigation, evidencing and ground truthing. As described in **Section 4.2** and **Section 6.6**, following further detailed appraisal of the National Framework data, our BAU environmental destination is expected to be zero. However, in future, there is the potential for higher impacts.

Whilst these are not tangible enough to include in the central estimate, this warrants sensitivity testing of the plan should there be greater needs in future. This ensures our plan can reasonably adapt to meet environmental destination needs in the future. The definition of this scenario is covered further in Appendix 6.

- **Reduction or cessation of STW to YW export –** The autumn 2021 reconciliation process, has identified a risk STW will seek to reduce or cease this existing transfer into the YW area. WRW is continuing to consider these as options in its regional plan and working with Yorkshire Water to collaborate on an option that would retain the existing transfer as currently used. This scenario addresses the risk that the transfer will not be retained as currently agreed and Yorkshire Water would need to invest in an alternative supply.

  WReN is assessing options for a full (50Ml/d on average), 50% (25Ml/d on average) or no loss of the existing import. Any solution would need to consider peak needs as well as average. The impact of a change to the transfer on deployable output is subject to specific scenarios and STW and YW agreeing new terms linked to reservoir levels. This means the option benefit to STW does not necessarily translate to an inequivalent loss in supply to YW. As the Yorkshire Grid is a conjunctive use system, the benefits of existing local resources and internal transfers that support the south Yorkshire area are scenario dependent. Options that provide new supplies will also need to be considered in combination with existing supplies that have potential to be displaced to the south Yorkshire demand area and any solution will require system modelling to confirm feasibility and benefits. A dry year annual average impact has been assessed for both a full and 50% reduction of the existing transfer. Impacts, including peak requirements, will be investigated further as we progress through the planning process.

- **Lower / higher climate change scenario –** With a range of UKCP18 climate products and potential approaches to scaling the impacts of climate change, this is a major uncertainty area to consider scenario impacts on our plans (beyond its inclusion within target headroom as part of the supply-demand balance assessment). Our central estimates of supply impact are based on scaling down to the more modest RCP6 projections (based on a 2-degree warming level), however, the original DO modelling is based on the more severe RCP8.5 scenarios representing around 4 degree warming – these may be used as representing a higher impact climate change scenario. Scaling to lower emission products can also be applied using the same DO assessments, should further stress testing of low climate change be required to support the national process.

National stress test and reference scenarios

In the previous section we outlined the regional scenarios defined to support the development of our adaptive plan for WReN specifically. As part of the national reconciliation process for regional plans, further scenarios were applied to ensure that the nationally aligned evolving plans were duly suitable and robust. The scenarios have a high degree of compatibility with those we have developed at a regional level. Three tests were applied:

- **Reference scenario:** A sensitivity test and common scenario to directly allow comparison across regions. This was as our own baseline, but included a 1:200 drought resilience level before 2040 (rather than 1:500) and National Framework Environmental Destination BAU impacts[35];

- **Adverse scenario:** This stress test utilised the high emissions RCP8.5 climate change scenario, whilst also reflecting only half of the

[35] This used the EA model outputs outright and unadjusted and without local evidence applied. Our own BAU estimate has significantly lower expected impacts.

policy aspirations for demand management (PCC) and leakage to be met.

- **Loss of the Derwent transfer:** We also tested this scenario in combination with the two above.

The outcomes of stress testing in the context of the best-value plan are presented in **Section 8.2**.

Other reference or comparative scenarios

Aside from the uncertainty stress tests to build the regional plans outlined above, other reference scenarios may be required for comparison between regions or companies by regulators. A recent discussion paper published in November 2021 by Ofwat[36] has suggested, for example, specific scenarios to underpin strategies in the next round of water company Business Plans. We will track and where appropriate report on new requirements as we move through the regional planning process, in discussion with regulators.

Beyond these regulatory requirements, in some cases we present specific alternative scenarios by way of supporting the transparency and understanding of the regional plan. Such scenarios are comparative or illustrative, and include:

- **Supply-demand balance without demand management and leakage policy assumptions:** The long-term supply-demand surplus position in WReN is largely a result of meeting government policy aspirations, which are included in our plan baseline. However, these are the outcome of investments by water company customers, and therefore we believe it is important to show in some cases how the plan would look without these interventions.

- **Least cost plan** – Our aim is to develop a best-value plan. However, to ensure transparency of the direct cost impacts of this compared to a traditional 'least cost' WRMP process, we will present this alternative view where this helps transparency of the cost implications.

Environmental assessment within the options appraisal process

The regional plan must ensure appropriate environmental appraisal is carried out on potential options to suitably inform the plan decision making. The aim of the environmental appraisals within the plan is to provide for a high level of protection of the environment, integrating environmental considerations into the preparation and adoption of the plan with a view to contributing to sustainable development. Throughout the course of the development of the plan the environmental appraisal will seek to identify, describe and evaluate the likely significant effects on the environment of implementing the plan and propose measures to avoid, manage or mitigate any significant adverse effects and to enhance any beneficial effects.

For water resources planning purposes, these assessments consist of Strategic Environmental Assessment (SEA), Habitats Regulation Assessment (HRA) and Water Framework Directive (WFD) assessments, including Invasive Non-Native Species (INNS) and natural capital considerations. Environmental assessments are being undertaken following the most up to date guidance, including the Water Resources Planning Guideline (WRPG) for WRMP24[37], EA Direction, UKWIR decision making/best value report and UKWIR environmental assessment guidance[38].

Water companies are required to undertake assessments at a WRMP level. Many options for consideration at the Regional Plan come from companies WRMPs, and Regional Plans will feed into WRMPs via identification of new options to consider and by providing planning solutions with which WRMPs will need to align. Therefore, WRMP24 and WReN options are being assessed in an integrated way to ensure consistency and allow comparable assessments.

Consideration will be made of how the environmental assessment findings will actively inform and add value to decision-making, alongside other considerations such as cost, affordability, resilience and customer service expectations. The WReN options appraisal workstream uses the outputs from the environmental assessment workstream to inform the environmental,

[36] PR24 and beyond: Long-term delivery strategies and common reference scenarios - https://www.ofwat.gov.uk/publication/pr24-and-beyond-long-term-delivery-strategies-and-common-reference-scenarios/

[37] Environment Agency (2021) Water resources planning guideline, July 2021. Available at Water resources planning guideline - GOV.UK (www.gov.uk)

[38] UKWIR (2021) Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans. Report Ref 21/WR/02/15.

societal and resilience decision-making metrics which are included in the option appraisal process. Further input from the environmental assessment workstream is also considered in a qualitative review during development of planning solutions.

The methodologies for environmental assessment are documented in the environmental assessment Scoping Report[39], which is available on the WReN website. The Scoping Report was issued for consultation with the Environment Agency, Natural England and Historic England as well as wider stakeholders e.g., members of the WReN steering group to seek agreement on the scope and approach. Following consultation, the comments received were reviewed and amendments to the scope and/or approach have been made (where relevant). A table detailing comments received and our response is provided as supporting information to "Appendix 8 – Stakeholder engagement and collaboration" and will also be provided as an appendix to the SEA Environmental Report.

6.5. Pathways

A pathway is akin to a 'plan within a plan', allowing us to show how our solutions would change if a different path or branch was followed. Hypothetically, any of the material plan uncertainty areas could trigger alternative pathways in the regional plan. In line with the EA supplementary guidance, pathways should be kept to a small number to aid communication and clarity on the plan.

Having worked through the reconciliation process in autumn 2021, it became clear that the most significant bearing on our evolving plans, particularly in terms of short-medium term investment needs, was driven by the potential to lose all or part of the existing water transfer from Water Resources West (WRW) to WReN (from the Derwent Valley reservoirs). Whilst in the long-term other uncertainty areas such as climate change could have a major influence on the supply-demand balance (which we have tested via our stress testing / scenarios approach), the longer timescales involved and/or the more incremental nature of the impacts makes the choices less immediately acute. Also, the potential loss of the Derwent Valley import requires specific solution types to maintain supply integrity in the zone, and so is a particularly specific type of problem to resolve.

Therefore, in **Section 8.1**, we have presented two pathways: one with the Derwent import retained, and the other represented a full loss of the Derwent import. We have then applied scenarios and stress tests (**Section 8.2**) around the pathways to consider the best-value plan under each case and considered how these solutions compare between pathways as part of developing our plans. At this stage, neither pathway can be stated as the formal 'preferred plan' in a national context, as it is dependent decisions in other regions; at this stage, they should therefore be viewed as equally likely.

Further explanation and context on the status of this transfer is covered in **Section 7.4**, as a key 'choice area' driven by the needs of the adjacent Water Resources West area linked to the autumn 2021 reconciliation process.

6.6. Environmental destination

Our February 2021 *Revised Water Resources Position Statement* included an initial review of the national 'Environmental Destination' modelled scenarios. Through consultation with the WReN stakeholder steering group, we have since built on this review to improve our understanding of the long-term abstraction pressures within each WFD management catchment and the potential water resources implications.

The modelled scenarios are the start of a conversation to understand what changes to abstraction may be required in the long-term, and at this stage in the planning process the model outputs are the basis for:

(i) initial engagement with stakeholders and regulators to validate the national figures with local knowledge;
(ii) beginning (or continuing) dialogue with catchment partners to explore long-term ambitions;
(iii) selection/prioritisation of catchments requiring further investigation; and
(iv) selection of scenarios to sensitivity test within the regional plan.

Our approach is consistent with that set out in the final guidance[40] and latterly the joint EA/NE/Defra letter to

[39] Ricardo Energy & Environment (2021) Water Resources North Regional Plan – Environmental Assessment. Scoping Report. Available at https://www.waterresourcesnorth.org/about-us/document-library/

[40] Long-term water resources environmental destination - Guidance for regional groups and water companies. October 2020 v1

regional groups[41] (plus further communication from the EA[42]) on expectations around long term Environmental Destination. Appendix 6 outlines how we anticipate our final plan will align with these expectations.

For each WFD management catchment within WReN we are developing a dashboard to summarise the national model outputs, validate these with local knowledge and ultimately inform the development of the regional plan. Each dashboard includes an overview of current and future abstraction pressures by sector, model-estimated abstraction reductions to recover to environmental flow indicators, initial feedback through local validation and proposed next steps, including scenario-testing (see Appendix 6).

6.7. Non-PWS approach

Whilst we have been undertaking significant work with other sectors to better understand their resource needs and risks (see **Section 5.2**), the understanding of future supply-demand need for other sectors is significantly more ambiguous than that for public water supply. For the WReN area, this has represented a particular challenge, and therefore we consider that at this stage the definition of targeted options that may solely and specifically address other sectoral needs across the region to be impractical. It is anticipated that this journey will continue to evolve into future plan revisions, and later planning cycles.

Instead, our focus is to explore and seek opportunities either to enhance other sector or catchment utility from our public water supply options selection, or to consider where there may be joint holistic solutions in future. The August 2021 stage of the planning process marked a key stage in this journey because:

- We had a better understanding of the new supply-demand balance position for public water supply, taking into account the 1:500-year drought resilience level and climate change in particular;
- Catchment dashboards were produced that summarised our latest knowledge of catchment level need including other sectors; and
- Through comparison of these two positions, we were better placed and informed to explore and discuss combined opportunities between zonal and catchment / other sector needs.

The public water supply-demand balance and catchment dashboards from August 2021 pre-reconciliation has been used in stakeholder and other sector forums to discuss approaches to addressing identified needs – and potentially multi-sectoral options – to inform our plan development process through to January 2022 and beyond.

NWL's technical and wholesale teams are working closely with existing and known potential new businesses on Teesside to understand what their future water demands are likely to be. Recognising the importance of this, NWL will be setting up a new Teesside Senior Management Group with attendees including NWL, WReN, the EA and Teesside businesses. This will help determine what additional raw water should be reserved for other, currently unknown, businesses that may operate from Teesside in the future.

6.8. Non-drought resilience considerations

In line with the Company WRMPs in the previous planning round, generally we do not consider that there is a significant non-drought resilience need or risk at regional scale that warrants specific assessment. For example, Hartlepool has a single source of supply, but assessment and appraisal of this is very much a local issue rather than a regional one. Aspects such as asset flood risk and water quality are mainly addressed by Company business plans, or in design standards within options development completed by engineering teams. We will ensure that new options meet relevant minimum design standards. We have also included an overarching flood resilience metric and a multi-abstractor benefit (e.g., water quality) metric in our options appraisal process. Both these metrics will measure option impacts qualitatively, using SEA objective outputs. See Appendix 4 for further details.

The potential for loss of the existing transfer from the WRW area to the Yorkshire Water part of WReN (**Section 7.4**) would fundamentally change the configuration of the Yorkshire Grid, which leads to specific additional resilience considerations as part of options and solutions development. This has been accounted for as part of exploring the impacts and candidate solutions to address a potential loss of the import (**Section 8.1**), but further detailed work will be

[41] Defra, Natural England, Environment Agency – letter issued to regional groups, 12th August 2021.

[42] Environment Agency – Item from Environment Advisory Group meeting agenda 01/11/21: Expectations for long term environmental destination in final plans

required towards the draft regional and WRMPs to optimise the final preferred solution (whilst also taking into account the views of this consultation). For the Yorkshire Water WRMP24 submission, a specific resilience metric may be introduced to help facilitate the identification of the formal preferred plan as part of further, more detailed examination of this issue.

7. Future choices

When developing a regional plan there are a myriad of potential considerations, choices and asks of the plan that need weighing up. Ultimately, as we are creating a strategic plan, it is not feasible to focus on every nuance and choice at a regional scale. It would be impossible for us to meaningfully engage with stakeholders on all factors equally, and so we've distilled these down to the key strategic choice or planning areas for consultation.

In this section we outline some of the key strategic choice or question areas at this stage of the planning process, and present example questions for consultation at key points. This sets the scene for the evolving regional plan and plan stress testing in the following section.

7.1. Strategic choices

Earlier in the year, prior to the national plan reconciliation process and the outcome of various technical investigations, the potential list of strategic choices or plan questions remained high. However, over recent months, both our own in-region position and that of the national narrative has crystallised such that the big issues are now much more apparent.

Firstly, whilst recognising long-term forecasts have inherent uncertainty and will continue to evolve over time, the latest supply-demand balance baseline forecasts did not show material strategic deficits in the WReN area. This position, taking account of 1 in 500-year drought resilience to Emergency Drought Orders, means that as a starting position there was no need for new supply options to be assessed.

However, the baseline supply-demand position is heavily dependent (like in other regions) upon delivery of stretching long-term demand management and/or leakage targets. This brings risks, especially in the short-term where the Yorkshire Grid supply-demand balance is particularly tight. Beyond getting views on Companies planning to meet these future government aspirations, the pace of delivery over time could influence the cost and performance of our plans.

Critically, as part of the reconciliation process, the potential for a loss (or reduction) of an existing import from the WRW area to WReN (Severn Trent Water to Yorkshire Water) was a key consideration for us. The way we address this lost water, or the potential for alternative solutions to allow the transfer to cease is a key choice area across regional plans.

At this time, the main strategic choice or planning considerations linked to consultation have been distilled to:

- Should we continue to plan for meeting **demand management and leakage government aspirations** by 2050? – **Section 7.2**
- What **pace and profile** should we pursue towards achieving the long-term **demand management and leakage** reduction targets? - **Section 7.2**
- If there is a **deficit prior to 2039**, should our strategy be to **adopt a lower 1 in 200-year drought resilience level** to help meet that deficit? – **Section 7.3**
- What is our **best-value adaptive plan** to address loss of the existing Derwent transfer? What key **alternative solutions** are there? **– Sections 7.4 and Section 8**
- What is our current view of **Environmental Destination** impacts? How far should we pursue **evidence** of flow-based benefits prior to adopting into our core plans? – **Section 7.5**

As described earlier, the above list does not represent every potential future consideration; it summarises the most tangible major choices at this stage, and should not be seen solely as a priority or importance of these water resources issues compared to wider aspects. As described in **Section 5.4**, there are various evolving considerations (e.g., flood mitigation) that in time may require new choices to be made in the

planning process, but that at this time still require further definition and exploration. This is particularly important for other sector water resources issues because significant uncertainty on future needs is evident from our engagement activities; at this stage specific tangible choices are not evident, but we will continue to work with other sectors to track and monitor future needs over time (**Section 8.4**).

7.2. Demand management and leakage reductions

Our evolving plan includes the Government Policy assumptions for demand management (customer consumption, PCC) and leakage reductions by 2050. Each Company in the region plans to meet these long-term aspirations as part of our plan, to achieve a 50% reduction in leakage and 110 litres/head/day PCC by 2050 (although there may be practical variations at a sub-Company or zonal level). However, meeting these aspirations is still subject to suitable investment over time, and it is important therefore to test support for this choice area as part of consultation.

To summarise some of the key considerations in decision-making around this strategic choice area, we have presented these against key external factors below. **Table 7.1** shows PESTLE analysis (Political, Environmental, Social, Technological, Legislative and Economic) as to the considerations in planning to meet Government Policy aspirations. We would like to consult with stakeholders on the two broad questions below.

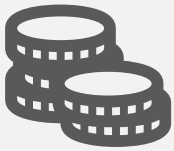
Should we meet the government policy aspirations for PCC and leakage? (as the current planning assumption)

What pace should we work towards to achieve our long-term targets? What importance do you place on cost-effectiveness, reliability and risk of delivery?

Table 7.1 PESTLE table for meeting demand management and leakage reduction Government policy aspirations

Political 	Reducing demand (including leakage, household consumption and non-household consumption), is a strategic government priority A *national* 50% reduction in leakage was recommended by the National Infrastructure Commission and endorsed by Defra Government recognises the role of water efficiency in the drive toward Net Zero[43] and adopts a 'whole house' efficiency approach in which water efficiency is fully integrated into future national energy efficiency schemes
Environmental 	Reducing consumption and leakage further below baseline may generally be considered beneficial for the environment in terms of reduced abstraction Reducing consumption and leakage helps to mitigate the risk of longer-term uncertainty such as climate change, and impact positively in relation to levels of service and resilience *Specifically linked to the above*, leakage reductions mitigate an otherwise long-term supply-demand deficit in the Yorkshire Grid, which is detailed further in **Section 8.1** Reducing demand results in more water available in the natural environment, protecting the environment for future generations

[43] Net Zero and the Role of Water Efficiency – Waterwise (2021) – Waterwise

Social 	Customers and stakeholders generally support reducing leakage, increased metering and water efficiency. Our latest WReN customer research outputs (**Section 4.3**) show leakage reductions in particular to be a top priority Customers see metering as a fair way of paying for their water Water efficiency activity increases customer engagement and can support customers in feeling like they can protect the environment National campaigns – for example Water's Worth Saving – raise awareness of the value of water, the connection between water use and the environment and highlight why reducing demand is important The general public and media perceive current leakage levels as being too high, resulting in reputational issues for the industry and resistance against customer and water use restrictions during drought Having a high level of leakage is unlikely to help in persuading customers to reduce their own consumption The new legal targets for water in the Environment Act today will help wider efforts to tackle pollution, reduce demand for water and secure clean and plentiful water for all On the counter side, leakage reductions can result in more disruption for customers and citizens through increased roadworks, for example, to complete repairs etc.
Technological 	There are a range of new tools and technologies that are becoming available for leakage detection, metering and water efficiency Smart metering has proven to reduce leakage and customer consumption which is a technology that will become an increasingly cost-effective option over time. Behaviour change apps support reductions in household consumption by providing tailored tools, information and advice Technology and innovation are expected to drive efficiency and change the economics of leakage management and reduce customer consumption
Legislative 	There is not a specific legislative driver for the policy aspirations, however, companies do have a statutory duty to promote water efficiency to customers under the Water Industry Act 1991. Ofwat has challenged the industry to set more challenging and stretching leakage and PCC reduction targets, and the EA WRNF sets out that Regions must 'include enhanced demand management' A government-led mandatory water labelling scheme, linked to building regulations and minimum standards, would drive deeper reductions in household demand New build homes are currently required to be built to a 125 l/hd/d. Legislation to amend this to 110 l/h/d will ensure that the (water) efficiency of new homes fall in line with agreed long-term ambition
Economic 	There are cost-effective demand management options available to enable the reduction on total demand At this time, reducing leakage further solely from an economic perspective is uneconomical, as it would result in us operating below the Economic Level of Leakage (ELL). However, customer research places this as a high priority for water resources (**Section 4.3**), and there are wider benefits of doing so, in particular in offsetting the need for supply options. A government-led mandatory water labelling scheme, linked to building regulations and minimum standards, has a cost-benefit ratio of approximately 1:60 suggesting good value for money[44]

[44] Microsoft Word - 190626_WESTrategy001-EXT_SummaryReport_2.3 (waterwise.org.uk)

Company and zonal level context

For the Northumbrian Kielder, Berwick and Yorkshire East and Grid resource zones there is an existing commitment of a 15% reduction in leakage by 2024/25. These levels remain static for the Baseline planning period until 2080. For the assumption adjustments to baseline scenario, the reduction in leakage to 50% by 2050 meets the national leakage target set by the National Framework for Water Resources, and as recommended by the NIC. For Anglian's Hartlepool water resources zone, leakage has been modelled to reduce by 30% while WRMP24 modelling continues (bearing in mind the National Framework target is for 50% nationally). For Hartlepool this would mean that leakage would reduce from 17% of DI down to 12% of DI by 2050 (it was 14.5% of DI in FY20-21).

It should be noted that demand management options are currently being reassessed for WRMP24. For the purpose of the supply-demand balance forecast, a medium demand management scenario has been used for leakage, metering and water efficiency where data is available.

Household consumption will include the government intervention of water labelling for Northumbrian Kielder, Berwick and Hartlepool. Any adjustments to household consumption take account of behavioural changes and restrictions on movements, working from home with the aim to meet the 110 l/h/d target by 2050. Household projections have been modified to reflect the impact of Covid, which has produced a significant increase to household demand, forecast have been derived using internal data and analysis from a collaborative project completed by Artesia Consulting.

PCCs vary between resource zones. While all three water companies have final plan PCC targets of 110 l/hd/d, the baseline scenario does not include the final demand management options and so for NWL and HW, do not reach the planned targets.

The Yorkshire Grid and East zone baseline demand scenarios result in a PCC of 110 and 112 l/h/d respectively by 2050. As the East zone represents less than 1% of the total population in Yorkshire, the Yorkshire Water total average PCC is forecast to be 110 l/h/d by 2050. Therefore, Yorkshire Water have not included any further adjustments to the baseline scenario for meeting the PCC demand management policy commitment. Yorkshire Water shall explore scenarios on demand management actions including goods labelling and include water efficiency options in our options appraisal. This may lead to a reduced PCC estimate in the final planning scenario or in an adaptive pathway.

In alignment with WRMP Guidance, population and property forecasts have been designed to reflect Local Authority planned growth, for WReN this is the Housing Plan scenario used by all water companies for Baseline forecasts as well as the forecast used to calculate the DMO options. The Housing Plan scenario is a housing-led scenario, with population growth underpinned by each local authority's Local Plan housing growth trajectory. Following the final year of data, projected housing growth in non-London areas returns to the ONS-14 & ONS-16 long-term annual growth average by 2050. For the Baseline forecast, using the Local Authority planned growth in the WReN regions, growth is expected to increase 12-15% by 2050 and potentially 15-29% by 2085.

7.3. Drought resilience

In line with the Government's 25-year Environment Plan, Companies should plan to be resilient to a 0.2% annual chance (1 in 500 year) of failure caused by drought by 2039 (where failure is defined as implementing an emergency drought order). Our supply-demand balance assessments have forecast this standard will be met (once demand management and leakage reductions are taken into accounts), apart from a negligible deficit in the Yorkshire Grid at the start of the horizon. However, changes in the supply-demand balance in future – could cause material deficits to address (**Section 8.2**).

In this circumstance, our strategy would be to adopt a lower stated drought resilience level of 1 in 200 years average risk of failure prior to 2039; the 1 in 500-year resilience level would be met from 2040. This has the following potential benefits:

- Allows time for demand management and leakage interventions to deliver - potential avoidance (or reduction of) the need for any further supply options to be developed in the longer-term (cost and impact reduction)

- Greater certainty of the supply-demand deficit as drought and climate science evolves, and following further investigation of environmental destination and other sector needs (more cost-effective long-term solutions)

It may be that, in practice, companies would still operate at a better than 1:200-year drought resilience level in the interim, as completed interventions towards the 1 in 500-year policy target down the line. However, this would not be formalised as part of the formal Company stated Levels of Service until the improved supply-demand position was consolidated.

Do you agree with our general strategy to adopt a 1 in 200-year level of drought resilience before 2039, if there is a future deficit?

We welcome views on this approach.

7.4. Water transfers

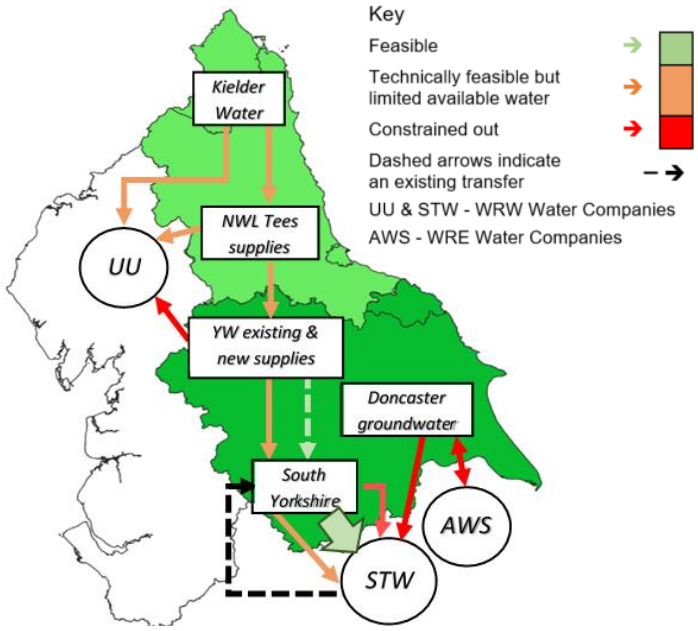
Figure 7.1 provides a conceptual representation of eight WReN options explored in further detail for the potential transfer of water to other regions. Further details of these transfers are provided in Appendix 5.

An option from Yorkshire Water (near Rotherham) to Severn Trent Water (south east Sheffield) is technically feasible, but dependent on additional in region investment in new supplies to ensure a secure supply to STW could be made available. Further discussions will be held with STW on this option as we develop the plans over the coming months. There are also another three technically feasible inter-region options supplied by Kielder, but WRMP24 deployable outputs and climate change modelling result in limited water availability for these options that need to be factored in when being appraised by other regions. Four further options have been constrained out. The option for a bi-directional link between Yorkshire Water and Anglian Water is still being considered but requires further investigation for its feasibility to be confirmed; WRE regional assessment suggests that this option may merit testing at a later date.

We have included a reduction in an existing Severn Trent Water import to Yorkshire Water in **Figure 7.1**. This is an option for Water Resources West which creates a WReN SDB scenario with options to replace loss of supply.

No water exports from the WReN area have been selected by other regions in their plans, however, we continue to explore these possibilities

Figure 7.1. WReN options considered for transfer of water to other regions



Scheme Name	Status
Yorkshire Grid network to STW	
Kielder to UU transfer	
Cow Green to UU transfer	
Tees to STW via YW	
Doncaster to STW	
Bi-directional Doncaster to AWS	
Sheffield to Peak District (YW to STW)	
York to UU transfer	
Reduce STW import to YW	

The output of the reconciliation process carried out in the autumn of 2021 is that the other regions have not identified a need for any WReN transfer options in their regional plan work to date.

It is worth noting also that a recent RAPID commissioned modelling study by The University of Manchester[45] concluded that there were few, if any, cost-effective inter-regional transfers originating from WReN, and that with respect to accessing Kielder, the distance between WReN and areas that require the water significantly increases the costs of possible transfers.

Would you be supportive of water exports from the WReN area?

What key risks and opportunities do you think we need to consider?

We would welcome your views on WReN exports.

[45] Slaughter, A., Harou, J.J., Tomlinson, J., Matrosov, E., Wilson, J., Dennis, J., Read, M., Dunford, T., Stokes, M., O. Walker, A. Widmaier, 2021, "A water supply-demand model for England and Wales", RAPID commissioned report

WRW's emerging plan could have a significant impact in our region as the current transfer to Yorkshire Water is at risk due to the deficits WRW needs to address in its own plan. WRW presented some indicative optimised scenarios as part of the reconciliation process. The option to reduce or cease the transfer to Yorkshire Water was included in the majority of WRW's optimised solutions to a range of scenarios. An alternative option to raise the Derwent valley reservoirs (which provides the transfer volume) was also selected in a number of the scenarios runs. The reservoir raising option would allow Yorkshire Water and STW to retain the transfer agreement. Both companies are working collaboratively to develop the option details and in December 2021 the scheme was proposed to RAPID as a new SRO for the gated process.

The Derwent Valley dam raising option requires significant further work, environmental assessment and stakeholder engagement in order to determine its feasibility. Once known the costs and benefits would need to be compared to alternative options. This means we must consider scenarios that plan for the current transfer not being available in the future or being available at a reduced benefit.

Based on WRW's emerging plan the change to the transfer would be in the mid to late 2030s. We have considered two scenarios; one is a full loss of the transfer and the other a 50% reduction to the transfer. We have assumed the loss would be in 2035 as this is the earliest date the current agreement allows for a change to be implemented (although if both parties agreed it could be implemented earlier) and meets WRW scenario outputs. Our assessment of these scenarios is described in **Section 8**.

We would welcome your view on the transfer from WRW to WReN.

What are your views on the potential cessation (or partial) loss of the existing transfer to WReN (YW) from WRW (STW)?

Do you support us jointly pursuing a new option (increasing Derwent reservoir storage) with Water Resources West to enable the existing transfer to continue?

7.5. Environmental destination

In Appendix 6 we have set out how and why we consider that the national framework data is inappropriate for direct use as Environmental Destination 'numbers'. Nonetheless, we do recognise the importance of ensuring that abstractions by all sectors remain sustainable. We will therefore continue to maintain an approach to reviewing abstractions that is based on locally appropriate data and discussions with stakeholders, to ensure that decisions around abstractions are robust and deliver the anticipated outcomes.

At this stage, on the basis of the evidence reviewed, we do not propose any reductions in abstraction in support of Environmental Destination. Importantly, however, this does not equate to a lack of ambition, rather that we will maintain an evidence-led approach within an adaptive planning framework to ensure that the long-term ambition for the environment is achieved.

We would welcome your views on this position.

Do you support our position not to include any abstraction reductions linked to Environmental Destination at this stage, instead preferring to take an evidence-led approach to understanding long-term flow requirements in the region?

Through consideration of the regional (and subsequently national) resource position and potential pathways it is likely that further investigations will be required. As set out in the Environment Agency's WINEP methodology[46], it is envisaged that the WINEP will be the mechanism for investigating, and then implementing solutions (where required) linked to the WRMPs and regional plans.

Acknowledging the strategic water resources focus of the regional plans, these investigations will necessarily be water resources focussed. However, we recognise that there will likely be opportunities to incorporate other issues or drivers into the investigations as the regional plans evolve. This is consistent with the WINEP methodology which is designed to support the delivery of wider environmental outcomes and accommodate more

[46] water industry national environment programme (WINEP) methodology. December 2021

catchment-orientated approaches with a longer-term focus. The four expectations for wider environmental outcomes in the draft WINEP methodology are impacts on the natural environment, net zero, catchment resilience and amenity / access / engagement. We will work collaboratively with the Environment Agency in aligning the WINEP investigations with the those required in the support of the region plan.

8. Our emerging Regional Plan

We are developing our regional plan in conjunction with the inter-regional reconciliation process. As part of this process the needs of each regional group have been shared, and the interventions required to address these needs identified at a national level. The autumn 2021 reconciliation process outputs have informed the development of this section, which describes our emerging regional plan (and recognising that further rounds of reconciliation are expected following the consultation period).

Our baseline plan position includes meeting the long-term demand reduction policy targets, which offset long-term supply-demand deficits in the Yorkshire Grid. Implementation of the policy leakage targets over time (along with already meeting demand management aspirations) allows to meet the 1 in 500-year drought resilience level for Level 4 Emergency Drought Orders in the long-term. We have also presented a plan pathway, for potential loss of existing transfers into our region should this occur and tested our evolving plan as to how it would adapt under different stress testing scenarios.

The potential costs, risks and benefits of options have been assessed and we have started to develop a plan to meet both intra- and inter- regional needs. This plan will require further scrutiny and development. The responses we receive from this consultation will influence the draft plan we will put forward for further consultation in the autumn of 2022.

8.1. Best value plan

Given the strategic supply-demand position presented in **Section 5.1**, and the needs of other regions identified during the reconciliation process, our focus for best value plan development in this section is on the Yorkshire Grid zone. This zone has been identified as vulnerable to future supply-demand balance uncertainties that have the potential to require investment over the core 2025 to 2050 planning period.

Our emerging best value plan has been developed through implementation of our options appraisal and decision-making process described in **Section 6.4**, and which is further detailed in Appendix 4. The emerging plan addresses the known risks to the Yorkshire Grid zone and the outputs of the regional reconciliation process, but it is not the confirmed, preferred formal plan which will be consulted on later this year. Some details may change as further work is carried out which could have a material impact on the plan, and some of these changes could be externally driven by the needs of other regions. However, consulting on our emerging plan at this stage is intended to provide early feedback that we can consider in our decision making when forming a preferred, best value plan for further consultation later this year.

As well as planning for in-region needs, WReN is planning for a risk that an existing transfer to Yorkshire Water from the Derwent Valley reservoirs managed by Severn Trent Water (STW) in the WRW region may not be available in the future. We have presented the loss of the transfer as an alternative pathway to the baseline and are consulting on both plans. At this time we consider there is an equal likelihood that we will need to invest to find an alternative to the transfer as there is that we will retain the transfer and follow the reconciliation baseline pathway. This risk has arisen because the impact of sustainability reductions and other supply-demand pressures on STW means that STW may need to retain more of the Derwent Valley water for its own supply. This could lead STW to cease or alter the transfer from the mid-2030s, in line with the terms of the agreement between Yorkshire Water and STW. This was a key area of focus as part of reconciliation, and whilst WRW's stated preference is to retain the transfer, the potential loss was included as a key plan stress test in the reconciliation process.

Recognising the importance of the Derwent Valley sources, both STW and Yorkshire Water are collaborating to develop a Strategic Resource Option (SRO) to raise the Derwent Valley reservoirs, which could allow the transfer to be retained in the future. As the SRO requires further work to assess its feasibility and must be developed under RAPID's gated process, we cannot assume it will be the final solution. We have therefore assessed alternative options to the

SRO, enabling us to consult at this point on potential alternative plans.

The uncertainty over the future of the import and the risk that our supply-demand balance will be worse than the baseline scenario creates a need to stress test the Yorkshire Grid zone baseline against alternative futures. These risks and the potential solutions help form our best value plan and future pathways if the supply-demand balance of the zone deviates from the baseline.

We've explored what our best value plan might look like both with and without the existing transfer from the WRW region. In both cases, we've used stress testing scenarios to explore an adaptable plan.

Baseline supply–demand balance

The supply-demand balance for the Yorkshire Grid has been created for 1:500 drought resilience scenario over a 60-year planning period. In our initial dry year baseline, prior to applying the benefit of drought measures and further leakage reductions, we see deficits throughout the planning period. The deficit is mostly due to a steadily increasing risk that climate change will significantly reduce available water supply during dry years. The initial supply-demand balance results in an average PCC value of 110 l/h/d without the need for further interventions in this policy area. We have not assumed any further PCC reductions at this stage (Yorkshire Water will consider PCC scenarios in its WRMP24).

The 1:500 level of service deficit is almost entirely offset by the benefit of drought measures and the year-on-year reduction in leakage to achieve the policy requirement. The leakage reduction is sufficient to close the deficit in the medium to long term without the need for drought measures, however in the short term the drought measures are needed. It is this supply-demand balance scenario, with the drought measures and policy reduction assumptions incorporated, that the regions have considered in the regional reconciliation process as the starting position and formal baseline for appraising options.

Once drought measures and policy assumptions are incorporated into the 1:500 scenario, the only year showing a forecast deficit in the Yorkshire Grid zone is year 1 of the planning period and it is only 1Ml/d. This is not considered material and can be addressed by planning to a 1:200 instead of a 1:500 level of service in the early part of the planning period. This means the reconciliation supply-demand balance baseline scenario does not drive any further investment. However, it does strongly demonstrate the importance and benefit of investment to achieve further leakage reduction in line with policy aspirations over time (as well as maintaining the current baseline demand management activities).

Without the benefit of the future leakage reduction interventions (in addition to our baseline demand management activities) in our baseline, the Yorkshire Grid would be in a long-term deficit. Regardless, short-term deficits are only avoided given the benefit of drought measures such as customer use restrictions, when required.

At this stage, the key focus of the decision making has therefore been the risk to losing the import from WRW and we have considered pathways to allow for the possibility of the import being either retained, fully stopped or partially reduced. To ensure the plan is adaptable to uncertainties and a situation worse than the base year we have considered a number of future scenarios (stress tests), which include the reference and adverse scenarios that all regions developed as part of the reconciliation process. These are described in **Sections 6.4** and the optimisation outputs discussed in **Section 8.2**.

Meeting demand management policy aspirations

The reconciliation baseline 1:500 level of service scenario for the Yorkshire Grid zone suggests there is a risk of a supply-demand deficit, but that this would be closed by meeting the demand reduction leakage policy requirement. For the purposes of reconciliation process, we have assumed that this would be achieved via a year-on-year linear reduction in leakage. **Section 6.3** outlines demand management options the WReN water companies are developing to achieve the policy demand reduction requirements. The initial baseline demand forecast for the Yorkshire Grid achieves the PCC 110 litres/head/day requirement, but significant investment in additional leakage control and new technologies is needed to achieve the requirement to half leakage compared to 2017/18 levels.

Further work is required to determine the leakage reduction trajectory and leakage reduction solutions. As a minimum we will plan to achieve the policy

requirement by 2050. The funding and leakage target for AMP8 will be determined through the Ofwat 2024 Price Review. The final trajectory for achieving the target will need to consider the cost-effectiveness of leakage reduction techniques and customer affordability, as well as the limitations of reducing leakage under current techniques, particularly if background leakage levels are reached. It will be reviewed with each iteration of water resource plans and price reviews taking into account progress since the previous plans and updated technologies. This would be primarily considered in further detail in Yorkshire Water's WRMP, which will be published as draft later in the year.

Although further work is still required, an initial leakage option appraisal has already been carried out to identify types of options and indicative costs. Leakage options were added to the optimiser, which was run to select options to meet the year-on-year linear leakage requirement. It should be noted that the leakage options were based on ongoing development of potential options and used indicative costs and benefits as an interim measure. They do not necessarily represent the leakage options that will be put forward in the formal plans. The early outputs suggest the leakage policy reduction could be achieved through investment in further active leakage control, mains relining, trunk mains leakage detection / repair and identifying and repairing unmeasured household continuous flows. However, there are significant costs associated with achieving this level of leakage reduction. Further work is required, as we head towards the formal draft plan, to refine our cost estimates for leakage reduction, understand how they relate to a preferred best value plan, and also consider the impacts on customer bills.

The leakage reduction incorporated into the reconciliation baseline is extremely challenging, and if not achieved this could have a material impact on the Yorkshire Grid zone's security of supply in the 1:500 level of service scenario. A least cost scenario has been created to demonstrate an alternative solution to the reconciliation baseline assumption that the policy leakage reduction requirement will be achieved. This scenario optimises supply options only. The metric impacts of achieving the leakage reduction, as presented in the reconciliation baseline, compared to the metric impacts of an optimised least cost (with supply options only) solution programme to meet the initial baseline deficit (no leakage reduction beyond 2025) are presented in Table 8.1 overleaf.

Table 8.1 presents the normalised metric score of the reconciliation baseline scenario (which forms the basis of our evolving plan). The normalised score are the actual values converted to a value between 0 to 100 (a convention used by regions during the reconciliation process). As the metric units differ, the normalised scores provide a method of comparing inconsistent units. The least cost (with supply options only) solution programme is represented by plus, minus or equal signs to aid communication across a range of consultees. For each metric the range is from four plus signs to four minus signs (representing improvement and deterioration from baseline respectively), and an equal sign represents no material change to the metric score. The actual metric values for both scenarios are also shown in Appendix 5, which also provides further explanation of the above categorisation method for transparency.

The least cost (with supply options only) solution programme achieves a lower normalised total score than the reconciliation baseline. This suggests the reconciliation baseline scenario provides better value, although it should be noted that this does not account for any weighting of metrics. The least cost (with supply option only) solution programme scores significantly better on cost and option deliverability and reaffirms the reliance on leakage reduction creates a risk if new technologies and efficiencies cannot be identified over the life of the plan. As the least cost scenario includes only supply options, the solution programme scores poorly on leakage and also customer preference as our customer focus groups highlighted leakage reduction was favoured. It would also impact negatively on the environment (biodiversity and natural capital metrics), although in line with Environment Agency guidelines any inclusion of supply options in the final plan would require additional investment to offset impacts on biodiversity and achieve a biodiversity net gain of at least 10%.

We welcome views during consultation on our incorporation of the reconciliation baseline position into our evolving plan, as opposed to a traditional least cost plan approach.

Table 8.1 WReN regional reconciliation metrics compared to a least cost (with supply options only) scenario

	Cost of the plan £M NPV	PWS Drought resilience	Biodiversity (supply options only)	Natural Capital £ NPV	Leakage reduction Ml/d	PCC 2050 l/h/d	Flood risk management (non-drought resilience) (SEA)	Multi-abstractor benefit (SEA)	Carbon 000s tCO2	Customer preferred option type	Human and social well-being	Option Deliverability	Total normalised score
Reconciliation baseline normalised score (i.e., evolving plan position)	**31**	**96**	**100**	**2**	**100**	**100**	**50**	**61**	**83**	**100**	**44**	**19**	**719**
Least cost (supply only*) scenario impact on normalised score	+++	=	--	-	----	=	-	-	+	---	+	+++	530

* A least cost scenario, including demand reduction options will be created for the formal submission

Derwent Valley import risks

During the regional plan reconciliation process, all regions put forward an initial view of options that were appearing in their solution scenarios and were material to other regions. The only option selected as a candidate solution by the other regions that impacted on WReN was the WRW option to stop or reduce the existing transfer from STW to Yorkshire Water. This would have a significant impact on the Yorkshire Grid zone and would require investment in new infrastructure and resources to provide an alternative supply to South Yorkshire and secure supply to Yorkshire's customers. To address this impact, in December 2021 Yorkshire Water and STW jointly proposed a new SRO into the RAPID gated process. This scheme, the Upper Derwent Valley Reservoir Expansion (UDVRE) SRO will look at options to increase storage in the Derwent Valley, which could protect the STW to YW transfer, alongside a more detailed evaluation of YW's in-region options to 'backfill' the import if it is stopped.

As the feasibility of the SRO is still subject to uncertainties at this stage, WReN is developing scenarios and solutions to three potential pathways:

1. **Retain the transfer** – assume no change to the dry year annual average supply-demand balance for the Yorkshire Grid.
2. **Cease existing Derwent Valley transfer** – assume the import, which averages c. 55 Ml/d in a typical year, is no longer available. This creates a 40 Ml/d deficit for the Yorkshire Grid zone in the dry year annual average scenario as the loss is partially offset by the Grid's conjunctive supply system.
3. **Half the Derwent Valley transfer** – assume the baseline benefit (which averages c. 55 Ml/d in a typical year) provided by the transfer is halved. This creates a 21 Ml/d deficit in the dry year annual average scenario as the loss is partially offset by the Yorkshire Grid conjunctive supply system.

Pathway 1 assumes that the current agreement between Yorkshire Water and STW continues in its present form for the life of the plan, which was the WReN position in Round 1 of the reconciliation process. Round 2 concluded that WRW's plan had identified STW would need additional storage to continue the transfer, which consequently led to the proposed new SRO. The costs/impacts and benefits of raising the reservoirs will be converted to best value planning metrics once the information becomes available.

Pathways 2 and 3 are scenarios that produce a deficit in the Yorkshire Grid zone and a range of in-region options are available to close the deficit. For detailed information on the potential individual options to replace the transfer see Appendix 5. WRW's modelling suggests, if required, the options to reduce/cease the transfer would be implemented in the mid to late 2030s. We have therefore assumed the earliest potential date of 2035.

The Yorkshire Water supply simulation model has been used to derive the impact of both the full transfer loss (pathway 2) and the 50% transfer reduction (pathway 3) in the dry year annual average scenario. The result is a deficit of 40Ml/d and 21Ml/d respectively. As the Yorkshire Grid supply system has high connectivity, it is possible to offset a proportion of the deficit through internal transfers. A significant contribution to the offsetting is a treated water main connecting the York area to South Yorkshire. The existing main is already required to support the South Yorkshire supply area with the full Derwent Valley transfer volume available and the supporting sources of water are limited. Therefore, it is not possible to fully substitute the loss using any existing surplus resources in either scenario, so the deficit identified by the simulation model must be met.

Several potential solutions to the two transfer loss scenarios have been produced using the WReN optimisation model. In all solutions an option to 'twin' the existing York to South Yorkshire treated water main has been included. As part of the options identification process, options to provide a new local source of supply to the water treatment works that is currently receiving water from the Derwent Valley transfer were considered and included in the unconstrained list. However, these were not considered to be feasible options and the new main is therefore required to transfer water to the South Yorkshire area. As a new raw water transfer is likely to be prohibited, due to the risk of transferring invasive species, we have only considered treated water transfers. An existing water treatment works is also essential to each of the solutions, which creates a supplementary risk that the Yorkshire supply area becomes too reliant on one water treatment works. We have therefore considered more resilient solutions that require investment in additional supplies to meet some of the York WTW's existing demand areas thereby 'freeing' the works to feed South Yorkshire on a daily basis.

The optimisation model was used to produce a least cost solution to both the 'cease' and 'half' transfer scenarios. The first optimisations included a sub-set of the Yorkshire Grid supply options, which were those that could provide a direct source of supply to South Yorkshire. The optimiser was then rerun with an alternative set of available options that would supply water to other areas of the zone and free up supply from the York WTW to supply South Yorkshire. For the 'cease' scenario the optimiser was also rerun to optimise on carbon and on the six capitals. These runs provide indicative solutions to the loss of the transfer which have been compared against the WReN metrics (see Appendix 5 for more information). Further work is needed to determine the exact combination of options that will be put forward for the consultation on the draft regional plan later in the year, although we welcome views from consultees on the candidate and feasible options in our plan at this stage.

Table 8.2 summarises the solution programmes that have been produced for the two transfer loss scenarios (pathways 2 and 3). Further solution programmes will be produced and compared for the draft regional plan and for Yorkshire Water's WRMP. The results are also subject to simulation modelling to confirm the benefits for option portfolios. The final solution may not be one of the solution programmes produced, but instead a portfolio programme may be selected from the best performing options that appear in the optimisations for these scenarios and the stress testing scenarios.

We have assessed an alternative pathway with full and partial loss of the existing Derwent import to our region. This requires specific solutions, should this option be selected by WRW in future reconciliations, which continue to be explored in detail. A loss of the transfer results in material investment in the WReN area, and results in deterioration of several metrics, but would avoid potentially greater negative impacts and facilitate sustainability improvements in other regions. The relative benefits and impacts across regions will continue to be explored.

Table 8.2 Derwent Valley transfer loss solution programmes

Scenario Ref.	Solution description	Solution benefit Ml/d	Optimisation criteria	Resilience summary
Scenario 5.1: Cease transfer	Increase R Ouse abstraction to York WTW, install new main, no WTW investment	50-60	Cost	Over reliant on a single WTW
Scenario 5.2 and 5.3: Cease transfer	Increase R Ouse abstraction to York WTW, install new main + WTW investment	50-60	Cost	
Scenario 6.1: Half transfer	Increase R Ouse abstraction to York WTW, install new main + WTW investment	22	Cost	
Scenario 5.4: Cease transfer	New main from York WTW + displace existing sources of supply to York WTW #2	43	Cost	Reduces reliance on a single WTW
Scenario 5.5: Cease transfer	New main from York WTW + displace existing sources of supply to York WTW #2	48	6 capitals	
Scenario 5.6: Cease transfer	New main from York WTW + displace existing sources of supply to York WTW #2	43	Carbon	
Scenario 6.2: Half transfer	New main from York WTW + displace existing sources of supply to York WTW	22	Cost	
Scenario 6.3: Half transfer	New main from York WTW + displace existing sources of supply to York WTW #2	21	Cost	
All results subject to additional optimisation runs and simulation modelling to confirm the benefits				

The metric results of the pathways are presented in Appendix 5 and summarised in **Table 8.3.** The potential pathways have been compared to understand the impact they would have if we deviated from the reconciliation supply-demand balance. Although the retain transfer pathway presented in Round 1 of the reconciliation process is arguably the best value for WReN, it does not consider WRW's needs or the potential costs and benefits of the SRO, which is required in WRW's plan if the transfer is to be maintained. **Table 8.3** compares the change in metrics relative to the reconciliation baseline supply-demand balance for pathways 2 and 3. The plus, minus and equal signs are based on the same method as **Table 8.1** and compare the normalised scores (categorisations are also detailed further in Appendix 5). However, **Table 8.3** is showing the impact of solutions that would need to be implemented in addition to the reconciliation baseline leakage reduction and not as an alternative. Pathways 1, 2 and 3 all assume the policy reduction to halve leakage by 2050 compared to 2017 leakage will be achieved. As the SRO to raise the Derwent Valley reservoirs is still under development the metric values for the option are not available for this consultation but will be added for the formal draft plan submission.

Table 8.3 WReN least cost versus reconciliation metrics comparison

Scenario	Cost of the plan £M NPV	PWS Drought resilience	Biodiversity (supply options only)	Natural Capital £ NPV	Leakage reduction Ml/d	PCC reduction l/h/d	Flood risk management (non-drought resilience) (SEA)	Multi-abstractor benefit (SEA)	Carbon 000s tCO2	Customer preferred option type	Human and social well-being	Option Deliverability
Reconciliation baseline	31	96	100	2	100	100	50	61	83	100	44	19
Pathway 1: Retain import as existing*	=	=	=	=	=	=	=	=	=	=	=	+++
Pathway 2: Cease transfer (scenario 5.4)	-	=	---	+	=	=	-	-	--	--	-	+
Pathway 3: Half transfer (scenario 6.3)	-	=	--	-	=	=	-	-	-	-	-	++

* This scenario assumes no change to the transfer and is not assessing the potential SRO. Metric data on the SRO will be assessed once available.

Table 8.3 compares the normalised metric scores of the alternative pathways relative to the reconciliation baseline. If the existing transfer could be retained this would have no impact as there would be no requirement for further investment and it scores best on option deliverability because of this (it does not score the maximum four pluses due to the residual risk of the leakage reduction). If the SRO is required for the transfer to continue this would impact on the metrics and will be assessed once further data is available.

The majority of the metrics are negatively impacted if we follow pathways 2 or 3. Pathway 2 shows greater negative impacts than pathway 3, however, as it represents a need to provide a larger volumetric supply benefit this is to be expected. Pathway 2 does show a positive impact on natural capital, which represents the benefit of water supply security gained from investing in a new resource. Depending on the type of solution, natural capital impacts can be positive or negative. The overall natural capital score for pathway 3 is negative. However, it will achieve similar benefits to pathway 2, but they are outweighed by negatives impact and result in a score that reduces the natural capital compared to pathway 1. Before we made a final decision on a solution, a more detailed scrutiny of the environmental impacts would be required, including an environmental appraisal (SEA, HRA, WFD, INNS) as outlined in **Section 6.4**.

Further work is required to understand which combination of options provides best value for the Yorkshire Grid zone, and which should be taken forward if the Derwent Valley transfer was reduced or stopped in the 2030s. These options will not be SROs but will present an alternative that would enable Yorkshire Water to meet demand without the transfer and therefore without the SRO. This could either support selection of the SRO if the alternative options are less favourable than the SRO or provide a potentially better performing plan if the alternative is more favourable.

We would welcome your views on our initial plans in relation to the potential loss of WRW import to WReN.

What are your views on our initial plan to tackle deficits should there be a loss of the existing import from WRW / STW?

8.2. Stress testing scenarios

All the WReN PWS zones have been tested against a number of alternatives to the baseline regional reconciliation position (see **section 5.1**). The stress test scenarios have been produced to understand the potential impact of known uncertainties that present a risk to the future supply-demand balance and could trigger a need for interventions. These uncertainties include higher demand growth, a more extreme climate change impact on supply, not achieving the leakage policy reduction and an enhanced environmental destination.

The 25-year period to 2050 is the key driver of planning needs and focus in our plan. However, higher-level forecasts have also been developed over a 60-year period to 2085, which has been used to support scenario testing.

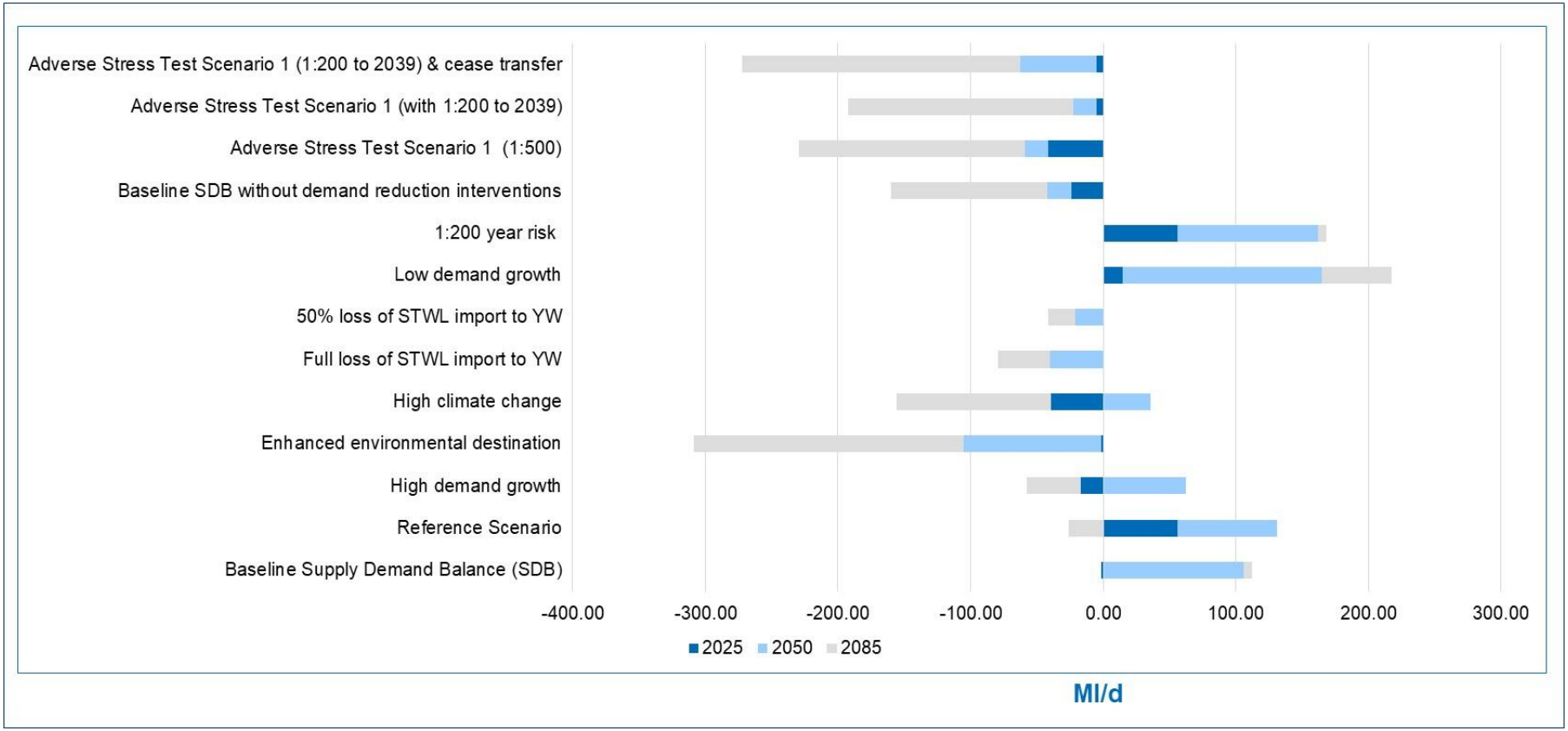
Figure 8.1 summarises the scenario surplus / deficits for the Yorkshire Grid zone over a 25 and 60-year planning period. Solutions have been produced for the scenarios that are showing a risk of a deficit using the WReN optimiser. If a deficit is present in the first 25 years of the planning period both a 25 year and a 60-year solution has been produced. If there is no deficit in the first 25 years, only a 60-year solution has been produced. The optimiser produced a least cost solution to each scenario. If any options included in a solution presented a potentially unacceptable risk, the options were constrained out and the optimiser rerun to produce an alternative solution to the scenario. For example, a number of the optimisation runs selected options to increase abstractions that are currently being reviewed as part of the AMP7 WINEP investigations and may not be available in the future. In these instances the optimiser was rerun with the WINEP related options constrained out.

The stress test scenario outputs are summarised in **Table 8.4** and discussed further in Appendix 5. We have included the regional reference scenarios all regions produced during the reconciliation process. The outputs of the stress testing provide indicative solutions to scenarios with a greater deficit than the baseline. The solutions are alternative programme solutions that meet a different future deficit. They do not provide additional investment if an alternative pathway is triggered. Further work will be carried out to understand the implications of the combinations of options selected and to identify a portfolio of options that could be implemented in the future if a different pathway was triggered.

A number of the more extreme scenarios show a deficit in the early years of the planning period. In the baseline reconciliation scenario we achieve the 1:500 strategic objective by year 2 of the plan, however this is only achieved with the inclusion of drought measures and achieving the leakage demand reduction strategic objective. The stress testing shows in more extreme drought conditions than planned for in the baseline or if we experience significant reductions to achieve the enhanced environmental destination, we will not achieve the 1:500 without investment in new supplies. Our final planning solution will achieve the 1:500 level of service no later than 2039/40, but further assessment is required to decide when we move from a 1:200 to a 1:500 level of service.

If the future impact of climate change on supply is greater than forecast in the baseline scenario, investment will be required within the 25-year period. Depending on the outcome of the Derwent Valley solution, this investment could be in addition to the options to provide an alternative source of supply to South Yorkshire. The enhanced environmental destination scenario also increases the future risks in both the near term and the longer term. The other scenarios (achieving half the leakage reduction and higher growth) could be met through planning to a 1:200 level of service in the near term and allow further evidence to be sort before a decision on the supply-side investment is made.

Figure 8.1 Yorkshire Grid zone stress testing



Our plan stress testing shows that our baseline supply-demand balance remains in surplus under different planning assumptions (under a common reference scenario). However, higher climate change and lower demand management / leakage reductions being achieved could push the Yorkshire Grid back into deficit, requiring investment in further in-region options in the long-term. Our current strategy would be to operate to a lower 1 in 200-year drought resilience until 2039 if a deficit occurs in future, so that further options are only developed to meet long-term needs. Loss of the Derwent transfer requires specific targeted solutions to be developed.

Table 8.4 Summary of stress test scenario optimisation runs

Scenario	Scenario description	Surplus/deficit (Ml/d)			Solution summary description[47]	Indicative NPV (£m) to meet 60-year deficit
		2025	2050	2085		
Regional reconciliation baseline 1:500 level of service (LoS)	Meets demand reduction policy requirements Climate change RCP 6.0 No sustainability reduction due to environmental destination	-1	106	6	The early deficit would be met through planning to a 1:200 LoS. No additional investment beyond leakage reduction to meet policy requirements. Uncertainty over Derwent Valley import.	1600
Cease transfer	Regional reconciliation baseline with full loss of existing Derwent Valley transfer	-1	-40	-40	This scenario assumes the solution to the regional reconciliation baseline resolves the early deficit and the zone benefits from leakage reduction. The residual deficit is met through investment in a new internal transfer main and supporting supply-side options. Further decision making is required to assess the resilience risk of the solution and avoid over reliance on a single WTW.	1800-2000
Half transfer	Regional reconciliation baseline with existing Derwent Valley transfer halved	-1	-21	-21	As above. Although the residual deficit is smaller there is still a need for an internal transfer main and further consideration on the resilience risks.	1800-2000

[47] Figure A5.3 in Appendix 5 presents the frequency of specific option selections across scenarios during options appraisal.

Scenario	Scenario description	Surplus/deficit (Ml/d)			Solution summary description[47]	Indicative NPV (£m) to meet 60-year deficit
		2025	2050	2085		
RP Reference scenario	2025-2039 = 1 in 200 LoS >2039 = 1 in 500 LoS BAU* 2030 - 2050 (linear profile) 50% leakage by 2050 110 l/p/d by 2050 Climate change RCP 6.0	56	76	-26	No investment required in first 25 years, showing robustness of baseline surplus position. After 2050 some investment in additional supply options could be required, but this could be resolved through future plan iterations.	1800
RP Adverse Stress test scenario 1:500 LoS	Half of policy leakage and PCC aspirations achieved by 2050 (delivery uncertainty) Climate change RCP 8.5	-41	-18	-170	This scenario creates a greater risk in the early years of the planning period if demand reduction policy requirements could not be achieved. Significant investment in new supplies would be required to close the long-term deficit, and this will influence our option selection when considering the loss of the transfer (pathways 1 and 2). Due to the magnitude of the early deficit the near-term solution is to plan to a 1:200 LoS.	1650
RP Adverse Stress test 1:200 LoS scenario + cease transfer	RP Stress test scenario 1:500 LoS aggregated with full loss of STW import	-5	-58	-210	This scenario reduces the short-term risk of a more extreme climate change impact by planning to a 1:200 LoS, and provides a solution to the combined risk of a loss of the transfer (pathways 1 and 2) and a climate change impact worse than the baseline.	1800-2050

Scenario	Scenario description	Surplus/deficit (Ml/d)			Solution summary description[47]	Indicative NPV (£m) to meet 60-year deficit
		2025	2050	2085		
Least cost (supply only)	Baseline SDB without policy aspiration demand reductions incorporated	-24	-18	-118	The early deficit could be met through planning to a 1:200 LoS followed by investment in new resources and treatment. This scenario would not achieve the leakage strategic objective.	125-200
High climate change	Regional reconciliation baseline 1:500 LoS with climate change RCP 8.5	-39	35	-116	The early deficit could be met through planning to a 1:200 LoS. Later in the planning period investment would be required in new resources and treatment, which could be resolved in future iterations of the plan.	1800-2000
Enhanced environment destination	Regional reconciliation baseline 1:500 LoS with enhanced environment destination	-1	-104	-204	The early deficit could be met through planning to a 1:200 LoS. Later in the planning period investment would be required in new resources and treatment. As with other scenarios any alternative to the Derwent Valley transfer would be influenced by this risk.	2500
High demand (growth)	Regional reconciliation baseline 1:500 LoS with a higher population growth scenario	-17	62	-41	The early deficit could be met through planning to a 1:200 LoS. Later in the planning period investment would be required in new resources and treatment, but this could be resolved in future plans.	1800

8.3. Environmental destination

As described in **Section 7.5**, at this stage we have not included specific reductions in supply to reflect Environmental Destination as defined by national framework data. This is because there is insufficient evidence for their inclusion in a way that is meaningful and locally relevant – a position that has been discussed with regulators and stakeholders. Our plan at this stage is therefore to maintain an approach to reviewing abstractions that is based on locally appropriate data and discussions with stakeholders, to ensure that decisions around abstractions are robust and deliver the anticipated outcomes.

Notwithstanding the above, as described in **Section 8.2**, the reference scenario with an alternative view of "BAU" environmental destination using WRNF data still did not change our long-term surplus position in the Yorkshire Grid. However, given the long-term uncertainty in this area, we have included an enhanced environmental destination scenario in our stress testing.

The combined impact of the sustainability reductions under this scenario is a significant supply reduction of 210Ml/d (see Appendix 6 for more detailed definition of this scenario, which represents a worst-case example for purposes of stress testing). This creates a risk of a step reduction in 2035. The reconciliation baseline scenario creates a surplus of over 50Ml/d in this year; therefore the loss will be partially offset by leakage reduction. The solution to this deficit would include investment in the Tees transfer and could require the full 140Ml/d benefit. The Tees option is also selected in a number of the high climate change runs.

As there is still high uncertainty over the environmental destination, our strategy is to carry out further investigations before making any firm decision on the investment. The Tees transfer would require significant infrastructure and a lengthy main in addition to that which could be potentially required to substitute the loss of the Derbyshire Derwent Valley transfer if the reservoir expansion SRO cannot go ahead. Both options would rely on increasing output from the same York WTW. This creates a resilience risk that means we should consider options that do not rely solely on that WTW and further investigations are required. The largest proportion of the potential 210Ml/d total loss is a reduction in the volume we are permitted to abstract from the Yorkshire River Derwent. There is a risk that the actions to naturalise the flows on the River Derwent could harm environmentally designated areas (see Appendix 6). This does not present a no regrets solution and we consider it is essential to gain increased certainty on the loss, and an understanding of the future of the Derwent Valley[48] transfer before making any decisions.

8.4. Non-public water supply sector

Overall, other sectors account for less than 10% of overall consumptive abstraction in the WReN region with the majority of demand for public water supply. The sectors with the largest consumptive demand outside of the water industry are power generation and industry with agriculture behind these. The forecasts for future demand show potential increases across all other sectors at a primary category level, with the biggest growth seen in the power and agricultural sectors.

Despite the relatively small levels of consumptive abstraction amongst other sectors, engaging and working collaboratively with stakeholders to understand other sector needs within the regional plan context enables the sharing of ideas, and helps to identify potential multi-sectoral opportunities for meeting future water needs, and protecting the environment.

We have engaged with representatives from the power, agriculture and environmental sector to better understand their current and future position. However, water resources planning is inherently less established in non-PWS sectors, and the regulatory framework is also less robust and defined with regards to other sectors. A key challenge in this regard has therefore been the relative ambiguity of resource needs from other sectors. In part, this has been acknowledged by the nationally agreed focus on public water sector supply-demand across all regions during the autumn 2021 reconciliation period. Our stakeholder group has presented in some cases evolving future scenarios (e.g. energy sector), but participants have acknowledged that the main plan action at this time is 'track and monitor' as we progress between planning rounds.

Therefore, a key focus of our plan development has been (and continues to be) to engage and work with

[48] For clarity it should be noted that this paragraph refers to two different Derwents – one is the Derbyshire Derwent (STW reservoirs) and the other is the Yorkshire Derwent (Yorkshire Grid abstraction).

other sectors to understand and identify potential needs, from which solutions or opportunities could be explored. This has been informed by both direct sectoral dialogue and via stakeholder forums. Whilst ultimately the potential for joint options or appraisal may be considered, in the first instance it has been necessary to undertake a parallel process to public water supply assessment (as has been the case in several other regional groups).

We will continue to explore other sector water needs, and where appropriate will develop joint options and/or opportunities as our understanding of other sector needs evolves (and into the next round of planning). This consultation stage is a key time that other sectors may wish to call out risks, opportunities or additional options now that the more tangible candidate plans and solutions are presented (noting more specific feasible and candidate options level information is available in Appendix 5); we have included a specific consultation questions below on this basis.

Do you see any synergies, opportunities or risks in our plan with regards to the impacts on non-public water supply sectors?

We would welcome your views.

Are there specific risks or opportunities linked to our feasible or candidate options listed in Appendix 5, or any joint options that may now be evident having seen our emerging plan?

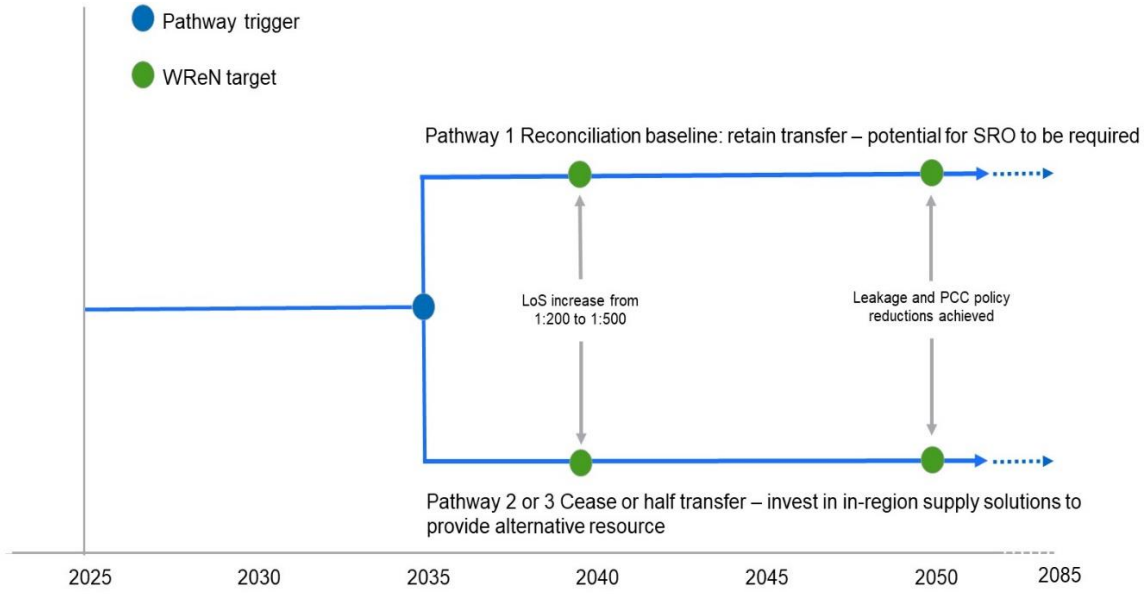
8.5. Summary of the WReN emerging plan and pathways

Although further work is required to confirm the options included in the final planning solution the work to date has produced an emerging plan and indicative pathways, summarised below:

- The initial 1:500 baseline supply demand balance deficit in the Yorkshire Grid will be met through leakage reduction to meet the policy requirement. At plan level we aim to meet the PCC and leakage reduction government policy aspirations (the regional reconciliation scenario).
- In the regional reconciliation scenario there will still be a risk of a deficit in the early years of the plan. As this does not allow any time to implement a best value solution, the risk will be removed by planning to a 1:200 level of service. The reconciliation baseline (which meets leakage reduction policy requirements) suggests we will meet the 1:500 level of service by year 2 of the plan. However, the stress testing discussed in **Section 8.2** highlights there is a risk the supply-demand deficit will be greater than the baseline. This creates uncertainty over the year in which the Yorkshire zone should plan for a 1:500 level of service.
- The uncertainty over the existing transfer from STW creates pathways in our plan. One pathway is to retain the transfer either under current operations or by raising the Derwent Valley reservoirs. The alternative is to invest in one of the solution programmes shown in **Table 8.2.** This creates an alternative pathway with two variations, either a full loss or partial loss of the transfer.
- Further investment could be required in the future if the impact of climate change is greater than forecast or if we experience the significant sustainability reductions included in the enhanced environmental destination. Our scenario testing indicates potential candidate options to meet such deficits but these would represent long-term interventions that are subject to change and further investigation. Any future investment would also be influenced by the Derwent pathway decision.

The pathways identified at this stage of the process are illustrated in **Figure 8.2**. The pathway trigger is related to the Derwent Valley risks discussed above and is dependent on ability for the transfer to be retained in the future. **Figure 8.2** also shows the WReN targets for a 1:500 level of service and to achieve the demand reduction policy requirements. These are currently based on the latest date for when we would achieve the targets, and further work is needed to confirm the date we will move from a 1:200 to 1:500 level of service.

Figure 8.2 WReN indicative pathways



9. Next Steps

The reconciliation process in autumn 2021 set the foundation not only for development of our own emerging in-region plan but allowed reiteration and alignment between the plans of other regions and provides a key output for this consultation.

Through the consultation period, we will actively seek feedback from our customers, stakeholders and regulators on our emerging plan and the key choices that remain through a number of informal and formal channels. We will use this feedback to further shape and define our emerging plan. We will refine our draft best value plan and plan inputs as current areas of uncertainty are addressed, particularly those associated with potential loss or reduction of the WRW import. This will culminate in a revised draft regional plan which will be reflected into Company draft WRMP24 plans in summer / autumn 2022.

9.1. Consultation on the emerging regional plan

There will be a 6-week consultation period with stakeholders and regulators from 17 January 2022 to 28 February 2022. Consultation and feedback on the emerging plan and the key questions presented will be sought through a number of informal and formal channels including a national launch webinar, regional forums and structured surveys.

We will review the feedback and further engage with consultees to discuss the way forward on specific comments if necessary. We will communicate key messages received from the consultation and how feedback through this process is used to update, shape and improve the draft regional plan that will be submitted in summer / autumn 2022.

We will continue to work with other sectors through our regular WReN Stakeholder Steering Group meeting and with more targeted forums as is necessary in order to understand if there are tangible other sector resource needs or opportunities that can be addressed in the plan, or where other sector options or joint solution development may deliver greater value in the plan.

A part of the strategic planning process, regional plans allow greater space for dialogue and interaction between regions as both WRMP and regional plans are developed. We will continue to consult and work closely with regional groups, water companies and other relevant parties through consultation and beyond, and in particular with Severn Trent Water and Water Resources West on the Derwent Valley strategic resource option.

9.2. Towards the draft WRMP24, regional plan, and beyond

The outcomes of the autumn 2021 reconciliation process (as described in **Section 1.2**) are based on the work undertaken to date by the respective regions and their constituent companies/organisations. Ongoing technical work (see Appendix 2) may result in refinements to the emerging plans, and most critically, the impacts of testing these through consultation needs to be taken into account. In WReN, like other regions, we have continued to engage on the evolving plan prior to this January 2022 publication, but there is no substitute for the fully documented and structured exploration of our candidate plan based publication at this key milestone. The consultation process will help shape both our draft regional plan and WRMP24 submissions.

Further reconciliation rounds, spring 2022

To develop each of the January 2022 regional plans for consultation each regional group has participated in a national reconciliation process during autumn 2021. With five regions all working to the same timescales to develop their plans, the potential complexities involved in iterating and aligning the plans have been significant. Despite this, a relatively clear national narrative has emerged from this process, with key specific strategic transfer options emerging as a focus of the various plans.

There is evidently the potential from all the forementioned factors of a ‘material change’ following consultation. From a WReN perspective, we believe this risk is most likely driven from a potential change in the needs or options of the other regional groups,

that may require plans to be re-aligned and assessed. Where certain predefined materiality criteria are triggered, the regions will undertake a further round of reconciliation in spring 2022. The RCG working group has defined under what conditions a repeat reconciliation is required in terms of materiality. This is focussed on strategic planning implications, and could include:

- Changes affecting the need for options, i.e., changes to the supply-demand balance.
- Changes affecting the transfer options being considered.
- Changes affecting other options, which may have knock-on consequences for the selection of the transfer options.
- Changes causing the selection of new schemes, which had not previously been consulted on.

On the current agreed timeline, this would be expected to take place through April 2022, following the current consultation periods.

Draft WRMP24 and regional plan timeline

The outcomes of consultation, plus any further subsequent reconciliation will be reflected in the draft Regional Plan expected to be published in summer / autumn 2022. This would in turn be formally consulted upon in tandem with Company draft WRMP24 submissions, once Defra provide permission to publish the draft WRMPs. At this stage, this would be anticipated to take place over autumn / winter 2022.

9.3. Assurance

The Water Resources North programme is being delivered by a number of workstream groups, which are formed from, and led by, water resources planning experts from within the three water companies. In developing this emerging plan for consultation, these workstream groups have followed methods that are consistent with the Environment Agency's Water Resources Planning Guidelines and other industry water resources guidance, such as that published by UKWIR.

Data presented in report has been subjected to internal checks, including peer review across individual company data sets. These checks have been carried out proportionately to the level of risk, maturity of data, and materiality of changes since WRMP19. Water company directors have been briefed on the content of this submission and were updated periodically through the autumn 2021 reconciliation process. A further, more formal, assurance process including oversight from both external assurance providers and water company boards, will be completed prior to publication of the summer / autumn 2022 draft plan for consultation.

This emerging plan has been developed by using the most up to date requirements and data available at the time of preparation. However, as noted elsewhere within this document and supporting appendices, the regional plan will continue to develop through consultation and further reconciliation, as supporting data is further updated and refined, and also as required through 2022 in order to ensure that we maintain alignment between the WReN regional plan and individual company WRMPs.

Glossary

Abstraction Licences	An abstraction licence gives you a right to take a certain quantity of water from a source of supply (inland water such as rivers or streams or an underground source).
Adaptive plan	An adaptive plan is a framework which allows you to consider multiple preferred programmes or options and sets out how you will make decisions within this framework. It responds to future uncertainties by setting out a sequence of manageable steps or decision-points, when these are required and how it will be monitored.
Adaptive pathways	Adaptive pathways indicate how the plan would change within an adaptive plan according to the decisions and steps that could be taken over time. Each pathway is a portfolio of options with a schedule of dates for when each option will be implemented.
AISC	Average Incremental Social Cost
Alternative plans	Several plans (as selection of options with an implementation schedule) may be developed through the water resources management planning process. Different or 'alternative' plans can be compared against a 'preferred plan'.
AMP	Asset Management Period (5-year price review period)
AMP7	Planning period 2020-21 to 2024-25
Baseline	A description of the present and future state, before any the adjustments due to changes or losses (e.g. due to development).
Best Value	An approach that considers other factors alongside costs when comparing different options e.g. other factors such as the environment, resilience and customer preferences
Catchment Based Approach (CaBA)	The Catchment Based Approach (CaBA) is a community-led approach that engages people and groups from across society to help improve our precious water environments: **https://catchmentbasedapproach.org/**
CAMS	Environment Agency's Catchment Abstraction Management Strategies (local licensing strategies that set out how water resources will be managed within a catchment area)
Catchment Plan (CP)	A catchment plan identifies the main issues within a catchment and prioritises work which will improve the catchment as a whole. This puts the catchment in a better position to achieve Water Framework Directive (WFD) targets, as well as other environmental and social goals: **Catchment Planning | The RRC (https://www.therrc.co.uk/catchment-planning)**
Decision-making metrics	Decision-making metrics are associated with, and sit beneath the overarching objectives to be achieved in the plan and might include measures of cost, environmental, social and supply-demand benefits. Each metric is a criterion used to appraise option programmes or portfolios, towards identifying an overall best-value plan. They describe wider aspects of interest to regional water resources planning, beyond simply meeting supply-demand at least cost as in traditional water resources planning.
Defra	Defra is the Department for Environment, Food and Rural Affairs and is the UK government department responsible for water resources in the UK.
Deployable Output (DO)	Deployable output is a building block in determining water supplies available for use and is defined as the output for specified conditions for a water resources system as constrained by; hydrological (source) yield; licensed quantities; abstraction assets; raw water transfer assets; treatment; water quality; and levels of service.
Dry Year Annual Average (DYAA)	Represents a period of low rainfall and unrestricted demand and is used as the basis of a water company's resources management plans.

Environmental Destination	Describes a long-term destination (to 2050 and beyond) for environmental improvement and sustainable abstraction considering factors such as climate change impacts and future demand.
Environment Agency (EA)	The Environment Agency (EA) is an executive non-departmental public body, sponsored by the Department for Environment, Food & Rural Affairs. They are responsible for environmental regulation in England and includes producing and updating River Basin Management Plans.
Feasible options	A set of options that are suitable to assess for inclusion in the preferred plan. Feasible options are identified from a longer list of options by a process of *screening* to remove options with constraints that make them unsuitable for further promotion.
Habitats Regulations Assessment	A competent authority must decide if a plan or project proposal that affects a European site can go ahead. A European site is protected by the Conservation of Habitats and Species Regulations 2017 as amended (known as the Habitats Regulations). A habitats regulations assessment (HRA) under the Habitats Regulations, is applied to test if a plan or project proposal could significantly harm the designated features of a European site in England and Wales and their inshore waters (within 12 nautical miles of the coast).
Headroom	The difference between water available for use and demand at any given time.
Level of service	Frequency with which the different types of specified actions would need to be taken during dry weather periods to help maintain the water supply.
Multi-criteria analysis (MCA)	Multi-criteria analysis is a structured technique for assessing options against a number of distinct objectives whose performance can be measured against a number of distinct objectives. It can also be used to explicitly explore the trade-offs between different candidate plans to inform the selection of preferred or alternative plans.
National Environment Programme (NEP)	The NEP outlines the improvements which water companies are required to undertake in order to comply with new or amended environmental legislation over the next planning period and includes identifying investigations to be undertaken that will inform potential investment requirements in subsequent planning periods.
National Framework	The Environment Agency's National Framework explores England's long-term water needs and sets out the scale of action required for a resilient water supply that meets the needs of the future generation. It sets out a greater level of ambition for restoring, protecting and improving the environment that is the source of supply.
Natural Capital	The environment's stock of natural assets that support life including water, soil, air, minerals and ecosystems.
Non-Governmental Organisations (NGOs)	NGOs are typically voluntary groups of individuals or organizations that are not affiliated with any government and are formed to pursue purposes of public interest.
Non- Households	Properties receiving portable water supplies that are not occupied as domestic premises.
Non-public water supply (non-PWS)	Non-public water supply is any water supply that is not provided by a water company.
Ofwat	The Water Services Regulation Authority, or **Ofwat**, is the body responsible for economic regulation of the privatised water and sewerage industry in England and Wales. The Environment Agency is responsible for environmental regulation, and the Drinking Water Inspectorate for regulating drinking water quality
Per Capita consumption (PCC)	The amount of water typically used by one person per day.
Preferred options	The set of water resources options included in the preferred plan.
Preferred Plan	A set of options that has been selected through the water resources planning process which are shown to perform better against the objectives of the plan.

Regulators' Alliance for Progressing Infrastructure Development (RAPID)	RAPID was formed to help accelerate the development of new water infrastructure and design future regulatory frameworks and is a joint team is made up of the three water regulators Ofwat, Environment Agency and Drinking Water Inspectorate.
Regional Climate Model (RCM)	A regional climate model is a numerical climate prediction model forced by specified lateral and ocean conditions from a general circulation model (GCM) or observation-based data set that simulates atmospheric and land surface processes, while accounting for high-resolution topographical data, land-sea contrasts, surface characteristics, and other components of the Earth-system. **https://glossary.ametsoc.org/wiki/Regional_climate_model**
Regional plan	A long-term multi-sector adaptive water resource plan.
Representative Concentration Pathway (RCP)	A greenhouse gas concentration trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). Different pathways were used for climate modelling representing different climate futures which could arise depending on the volume of greenhouse gases emitted over time.
River Basin Management Plan (RBMP)	River basin management plans (RBMPs) describe the challenges that threaten the water environment and how these challenges can be managed and funded. The plans are based upon a detailed analysis of the pressures on the water bodies within the river basin district and an assessment of their impacts They set out the environmental objectives for the water bodies and a summary of the programme of measures that will be taken to achieve them.
Screening	The process where options are filtered using a set of screening criteria that determines whether they have constraints that make them unsuitable for further promotion. Defined screening criteria are used to ensure options are screened consistently. There may be several iterations of screening before a feasible list of options is determined.
Strategic Environmental Assessment (SEA) European Directive 2001/42/EC	'An assessment of the effects of certain plans and programmes on the environment'. Transposed into UK law via The Environmental Assessment of Plans and Programmes Regulations 2004
Strategic choices	Strategic choices are the key decisions to be taken in developing the plan and maybe regional or company or zone specific.
Strategic Resource Options (SROs)	Large-scale, inter-region strategic transfers of raw water being considered by companies and regional groups and supported by *RAPID* (see above).
Stress Testing	A process to test the resilience of a plan against future uncertainties.
Supply demand balance (SDB)	Supply minus demand and target headroom. An annual average presented for each year of the planning horizon (2025-2085).
Sustainability reduction	A sustainability reduction is the reduction in water company deployable output due to a sustainability change to a licence, driven by environmental legislation or need. A sustainability reduction is calculated by the water company and included in its WRMP, and would be linked to expected or possible interventions to be included in the WINEP.
Target headroom	This is a quantified *headroom* based on statistical analysis of uncertainties which is factored into the supply and demand balance estimates.
Unconstrained list of options	A list of possible water resource options that could reasonably be used in the plan before they are filtered (screened) using a set of defined screening criteria which will determine those that are unsuitable for further promotion.
Water Framework Directive (WFD) 2000/60/EC	A piece of EU legislation that requires all member states to make certain steps to protect and improve the quality and quantity of water within water bodies such as lakes and rivers.
Water Resources Management Plan (WRMP)	WRMPs are developed and published by water companies. They set out how water companies intend to achieve a secure supply of water for their customers and a protected and enhanced environment. The plan forecasts supply and demand over

	at least the statutory minimum period of 25 years. If a deficit is forecast, then the plan should consider supply-side options to increase the amount of water available and demand-side options to reduce the amount of water required. These plans are prepared every 5 years and reviewed annually and the two numbers following 'WRMP' indicate the year the plan is published.
Water Resource Zone (WRZ)	The WRZ is the principal building block used by companies to develop forecasts of supply and demand and produce a supply-demand balance (SDB). UKWIR/Environment Agency defines the WRZ as: "The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers will experience the same risk of supply failure from a resource shortfall."
What-if scenarios	This approach is applied to test proposed plans and explores what would happen if the future was different to that assumed in the forecast. For example, what if the impacts of climate change were more than assumed for the forecast or population growth was lower than forecast
WINEP (Water Industry National Environment Programme)	WINEP represents a set of actions that the Environment Agency have requested all 20 water companies operating in England, to complete between 2020 and 2025, in order to contribute towards meeting their environmental obligations. **https://data.gov.uk/**

APPENDICES

A range of supporting appendices have been additionally supplied by WReN to complement this summary report. The list of appendices planned was previously presented and discussed with the EA and other regions for WReN in RCG weekly meetings for August 2021 pre-reconciliation report. These have continued to be developed and refined and incorporate feedback received from stakeholders and regulators. We will continue to develop and refine them incorporating feedback from consultation as necessary and as we progress towards the draft Regional Plan in summer / autumn 2022.

The following documents are available as standalone files to go alongside this January 2022 emerging plan for consultation:

- Appendix 1. Meeting the needs of the National Framework
- Appendix 2. Data input assumptions & commentary
- Appendix 3. Drought resilience and climate change
- Appendix 4. Objective and metric development
- Appendix 5. Option identification and appraisal
- Appendix 6. Environmental destination
    - Catchment dashboards – *Available on request*
- Appendix 7. WReN specific customer research: independent report by Turquoise
- Appendix 8. Stakeholder engagement and collaboration
    - Env Assessment Scoping Comment Log_051021– *Available* on request
- Appendix 9: Regional reconciliation process [Version 7.0 RCG].

Interim SEA environmental report (ER) and appendices.

How to find out more

More information about Water Resources North, including our publications and how you can contact us, is available on our website, www.waterresourcesnorth.org.

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