Draft Water Resources Management Plan

Statement of Response – Appendix A

Prepared by the Water Resources Strategy Team
03 September 2018

WONDERFUL ON TAP

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Appendix A: Further detail on areas of change

We encouraged a wide range of stakeholders to respond to our draft WRMP. Whilst we did not receive any objections to our supply-side and demand-side proposals, there were some important topics where stakeholders challenged us to do more for our final WRMP. As described in our Statement of Response, we identified that these topics could be categorised into six key themes.

Our Statement of Response provides a summary of the clarifications and adaptations we have made to our final Plan in response to the consultation outcomes. This Appendix (Appendix A) provides more detailed information on our response.

The main themes that we are providing additional evidence on within this Appendix are:

- Customers & engagement
- Demand management – leakage
- Demand management – metering & water efficiency
- Water Industry National Environment Programme (WINEP)
- Water Trading
- Water supply options

A1 Customers & engagement

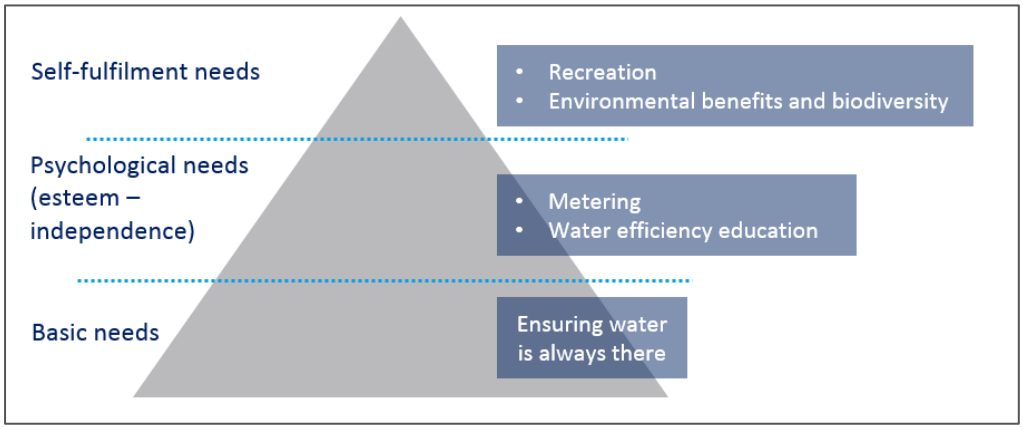
Our preferred programme of options included in our WRMP has been shaped, and is supported, by our customers. Since we published our draft WRMP we have continued to carry out customer research and engagement. During this engagement we held constructive, collaborative discussions with our customers about how we should approach delivering water supply demand improvements. To ensure we gained appropriate understanding of our customer views we used a variety of different approaches, including deliberative research. One of the biggest advantages of using deliberative research is that is allows for in-depth discussion with customers not just about needs and outcomes, but also in our approach. Customers also benefit from a gain in understanding as day-long workshops and sessions progress. This enables a more meaningful exploration of issues that could not be achieved using more traditional qualitative and quantitative approaches.

We have also used innovative techniques to gain insight from social media on our customers' views and priorities, as well as analysing comments from members of our online community, Tap Chat. We also commissioned some additional customer research in response to the stakeholder responses to our draft WRMP. As a result, we have expanded our explanation of how we have used customers' views to inform our WRMP.

At the heart of our strategic approach to customer insight is developing a more holistic understanding of the people and communities in our region, and understanding how we can make a positive contribution to their lives. As we have developed this understanding we have reflected on the fact that not all customer needs are equal. There is a hierarchy of needs and the tools which we use to understand these will be different at each level. Our categorisation of customer needs draws on Maslow's three levels – delivering basic needs, meeting psychological needs and creating opportunities for self-fulfilment, as demonstrated in Figure A1.1.

Our research consistently shows that customers take their water supply for granted, and ensuring water is always there is a basic need that, once met, is not given much further thought. Once this need it met, there are aspects within the delivery approach (in terms of how we balance supply and demand) which can meet higher needs. By giving customers information and choice we are able to ensure more psychological needs are met, for example by giving customers the tools to reduce their bills through water efficiency advice and metering. Customers and their families can also benefit from our public access sites, such as reservoirs, and river restoration projects. These can provide the opportunities for people to meet many different needs, for example basic needs in terms of promoting health and wellbeing whilst also providing opportunities for self-fulfilment through recreation and enjoying nature.

Figure A1.1 Hierarchy of customer needs – water supply



A1.1 Our approach to understanding customer views

Our Water Forum challenged us early on to be more strategic in our research design, taking into account:

- where the topic sits within the hierarchy;
- the extent to which the topic is conscious in customers' mind vs unconscious; and
- whether the topic/issue occurs today or could occur in the future.

Our insight into customers' views on water supply and demand is now even richer than at the time of writing our draft WRMP, and comes from a number of sources. Issues such as leakage tend to be top of our customers' priorities and our evidence sources include our analysis of customer contacts, social media scraping and numerous research projects. For other aspects such as metering and water efficiency we have used co-creation to work with customers to understand how they can be part of the solution.

The challenge to ensure there is sufficient water resource availability for the future is something customers do not consciously consider – only 7% of customers think that we won't have enough water in 10 years' time, with only 10% thinking we won't have enough water in 20 years' time (customer tracker, Q1, 2018/19). Our joint research with Thames Water and United Utilities on water trading corroborates this finding – little is understood about the scale of the water scarcity issue, and once informed the emotional reaction is one of surprise and disbelief. Around 7 in 10 customers are concerned, particularly those in the Thames Water region, and any lack of concern is largely due to disbelief. Interestingly, younger or future customers were concerned to a lesser extent than current or more senior customers.

Since customers are not necessarily aware of the future pressures on water availability we have used deliberative research to explore perceptions of water stress and the best way we can meet these challenges. It is only when prompted that customers recognise the challenges to ensure there is sufficient availability of water for future generations and understand that everyone has to play their part to make this happen. In our joint research on water trading we find that water scarcity is seen as a national issue, to be coordinated by water companies, the regulator and government. A minority of household customers believe water company regions should sustain their own supplies.

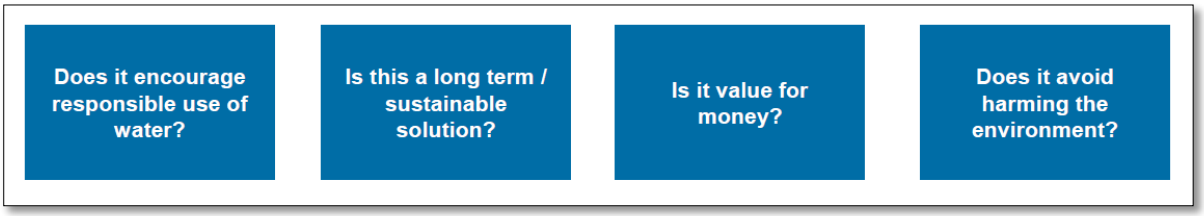
Our supply / demand deliberative research discussed a range of options to meet the projected future supply / demand balance deficit with customers. The research took participants on a 'journey' from obtaining their spontaneous reactions to a high level description of the options, through to more informed views when presented with a range of considerations for each supply-side and demand-side option, including relative cost, customer participation, certainty of outcome, environmental impact and lead time. The materials used to engage customers were both accessible and stimulating, and were designed by a leading research agency in deliberative research, with input from technical experts in the business.

A summary of what we have learned from customers is provided in the following sections.

Approach to balancing supply and demand

Our research tells us that customers tend to consider four specific questions, demonstrated in Figure A1.2 when considering supply demand options.

Figure A1.2 Core customer questions



- **Does it encourage responsible use of water?**
  We have found customers have a strong moral frame when thinking about water usage, resulting in an emphasis on personal and corporate responsibility to use less water. Because of this, they tend to favour demand management approaches over supply side approaches, but they recognise that any solution will need to include a blend of both. Customers say they want to be involved in securing the long term supply of water, but there is an appreciation that changing behaviour is difficult so they want us to play an equal part in ensuring water is always there, including an emphasis on reducing leakage.
- **Is this a long term / sustainable solution?**
  Customers don't want options which present a short term fix as they tend to be sceptical about how effective they will be for the long term challenge that our WRMP considers.
- **Is it value for money?**
  Customers want us to pursue the best value supply / demand options, not necessarily just the most cost effective ones. Questions of value and bill impact were particularly important to customers when thinking about options that will take a number of years to implement. While most customers are happy to contribute to the cost of long-term water security, they are clear this should be spread out over time, so as not to cause undue financial burden for customers.
- **Does it avoid harming the environment?**
  Customers value the environment and are concerned about options which might be perceived to have a strong detrimental impact. For example, the high energy costs and chemicals involved with effluent reuse are a concern despite initial 'warmth' for the idea because it recycling existing water. Customers want to be reassured that any new or increased abstractions from rivers would not cause harm.

Within the joint research on water trading, we asked customers to rank a number of factors in selecting supply-side and demand-side options. Sustainability emerged as their top priority, with 60% of our customers ranking it in their top two. The environment (whether an option has an environmental benefit or minimises any negative effects) is their second priority, followed by the volume of water produced and option resilience. The cost to build and customer acceptability were considered to be the lowest ranked priorities.

Support for investment and impacts on bills

There is a clear expectation from customers that we should have plans in place to ensure a continuous water supply, both now and in the future. As part of this, customers expect us to be prepared to address any long term challenges which could affect water supply, such as climate change or population growth. Customers also expect us to meet our statutory obligations, including those related to restoring unsustainable abstraction and ensuring no environmental deterioration.

As noted previously, customers are happy to contribute to the cost of long-term water security provided that this is spread out over time to lessen any acute financial burden for customers.

As part of our overall PR19 research programme, we have engaged customers on the bill impact of our proposed investment plan through our 'Choices' research and our final acceptability research. Our PR19 plan aligns with the preferred programme of options set out in our WRMP. We have taken care to present bill impacts in a meaningful way and where there is a choice, only present realistic options to customers. We have engaged customers on Tap Chat (our online community) about their preferred presentation of inflation and bill profiles. Our acceptability research shows that 80% of our customers find the proposed plan and bill impact acceptable.

We have also conducted deliberative research on how we deal with climate change uncertainty and the impact on bills. Customers were given a choice about investing now in all the supply-side options that we expect will be required, compared to an initial focus on design and feasibility or waiting for more certainty before triggering the need for investment. We found that the feedback from customers shows a clear principled support for investing only when we have greater certainty, whilst taking action now to minimise the time to respond. Avoiding detrimental impact on the environment is also a key consideration for not investing in potentially unnecessary options.

The results of our discussions with customers on bill volatility are also supportive of the use of our PR19 Real Options approach to manage uncertainty. One concern raised by the Water Forum about Real Options is that it might create volatility in bills at the end of the AMP and therefore it would be better to have a small reduction from 2020-2025. However, the research results indicate that bill impacts are only considered volatile if they are above £3-10 per month - this helps allay concern that even if all options were needed, customers would not find the change in bills volatile (noting that the overall affordability impact is the same as if all options were included)

Inter-generational fairness and future customers

We have used deliberative research as well as quantitative research with a representative sample on our online community, to explore how we ensure a fair balance of charges over time, and between generations.

We find that customers want bills that are stable, and charges to be set in a way which means each generation pays their fair share. Our proposed approach to longer term bill profiles received considerable support from customers, with 87% of those surveyed preferring a smaller bill reduction over the next five years, but a more stable profile over time.

We explored the views of future customers using a tailored and proportionate approach, focusing predominantly on those young people who live in their family home and are not currently contributing to the water bill, but who might be in the next 5-10 years. We focused on this group because they are the most immediate future bill payers

We found that the young people living in their family home group of future customers rarely consider the water service, and often lack the 'citizen' perspective seen in other customer groups. Friends, family, enjoying life, career and finances are all important to them, whereas the local community and the environment are less front of mind. These customers generally reported higher water usage and less concern and engagement with the environment, compared to our general customer base. Our research found that the main opportunity for engaging these audiences is when they become named bill payers and homeowners.

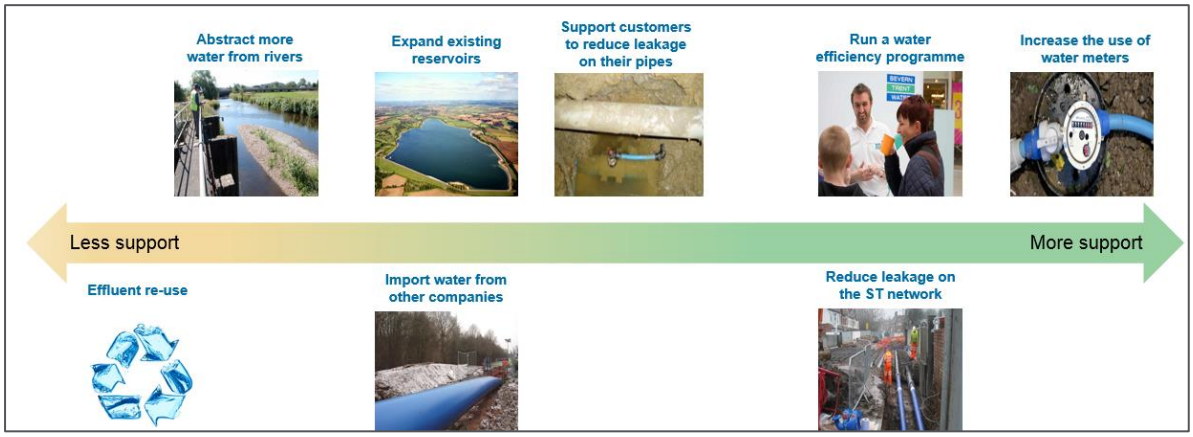
In addition to our engagement with this group, education with younger audiences (e.g. primary school children) as well as adults emerged as a key theme throughout our research programme. We are proposing an expanded education programme which will aim to inspire a generation of primary school aged children through experiential learning. This represents a step change compared to our current offering.

Options to manage the supply / demand balance

Our supply demand deliberative research discussed a range of options to meet the supply demand deficit with customers. The research took participants on a 'journey' from obtaining their spontaneous reaction to a high level description of the options, through to more informed views when presented with a range of considerations, including relative cost, customer participation, certainty of outcome, environmental impact and lead time.

As well as discussing each option independently, to understand customer views and perceived pros and cons of each approach, we also probed customer views on their preferred package of options, including the balance of supply-side and demand-side interventions. Figure A1.3 provides a visual representation of the relative customer support for different interventions and initiatives that we presented during the engagement process.

Figure A1.3 Customer engagement support for different intervention options



Of the supply / demand options presented to customers in the deliberative research, increasing the roll out of water meters was the option receiving the most support, followed by water efficiency and reducing leakage. Metering also received considerable support from our employees when discussing supply and demand challenges in our company wide roadshows. Supply-side options received less support, due to concerns about the level of promotion of responsible water usage and the potential for environmental damage.

In addition to these general discussions about the supply / demand balance, we used co-creation to 'deep dive' into some specific solutions, such as metering. The 'deep dive' process seeks to provide concerted and targeted considerations into the specific topic. Our discussions with customers have helped uncover some of the misperceptions and myths that customers associate with metering, and how we could dispel these in the future. We have also used co-creation to talk to customers about water efficiency, and through our online community Tap Chat we have tested water efficiency campaign materials with customers, uncovering valuable insight about their preferred creative images and messaging.

The findings from our customer research into supply and demand options were:

- **Increasing the coverage of water meters**
  As previously noted, of the supply / demand options presented to customers in the deliberative research, increasing the roll out of water meters received the most support. Customers felt that metering offers real benefits to both customers and ourselves. It was also considered to be the fairest way for us to charge for water. Customers found the possibility of saving money through a water meter highly motivating, and in addition to this, they welcomed the enhanced level of personal responsibility that water meters bring about. Not all customers supported metering and numerous research projects and our co-creation event explored the myths and uncertainties about meters. Customers with larger households tended to be especially fearful of a large increases to bills following installation of a water meter.

- **Helping our customers to use less water**
  Multiple sources of insight, including our deliberative research, our quarterly customer tracker survey and a review of twelve months' of social media discourse tell us that customers expect us to provide advice on water efficiency. This also demonstrated that many customers want us to do more in future to provide them with support and guidance on water saving behaviours.

- **Reducing leakage**
  Reducing leakage consistently emerges as customers' top priority for improvement, as it is seen as a pre-requisite to asking customers to reduce their consumption. Customers consider leakage reduction as non-negotiable and a moral responsibility for us, as the amount of water currently lost though leakage is perceived to be unacceptably high. Fixing leaks demonstrates a commitment to using the water resource responsibly. Analysis of social media also highlighted that leakage was a key metric dominating customer conversations. Primarily this was because most conversations relate to informing others about service issues experienced. Leakage also emerges as a key concern in discussions on Tap Chat.

  The extent of the leakage from customers' supply pipes shocked participants in our deliberative research. Many were unaware that these underground pipes (between their home and property boundary) are the customer's responsibility and there were concerns regarding the customers' ability to detect or be aware of any leak.

  Both our WRMP and PR19 plans have been tested with customers at a regional level, rather than at the water resource zone or county level. Our research tells us that customers are not spontaneously aware of water resource zones and that specific zones face greater water scarcity issues than others. We find that our customers are altruistic – for example they support investment to reduce repeat sewer flooding incidents, or targeting investment in socially deprived regions particularly if we can deliver multiple benefits. Concern over which part of the region benefits from particular investment does not tend to emerge spontaneously in our research.

  In our Choices research we found that the ANP7 15% leakage reduction target is seen as stretching, although some feel it should be more ambitious (without fully understanding the scale of the improvement proposed or required to provide further reductions). Customers across the region will also benefit from improvements in the speed of response to leakage. In response to feedback on our draft WRMP we are now proposing much more ambitious long term leakage reduction targets. More information on our latest thinking on long term leakage ambition can be found in Appendix A2.

- **More raw water storage**
  Initially in the deliberative research, the supply-side options weren't favoured as it was considered that they do not encourage the responsible use of water (from both consumers and ourselves). However, customers accepted that our preferred programme of options would be a combination of supply-side and demand-side options. Within our joint research on water trading we found that a minority of customers, with more technical knowledge, spontaneously mention supply-side options to address water scarcity. Overall, we find that preference for supply-side solutions is driven by a number of personal and social beliefs and experiences. However, customers are less certain about their preference for supply-side options compared to more familiar demand-side options. Customers want water companies to prioritise long term sustainability of supply when selecting the type of interventions to be implemented. Overall though, customers find it difficult to decide on the most appropriate supply-side solution and put their trust in water companies to choose for them.

  Reservoir expansion could provide a long term, sustainable, and potentially straightforward (compared to options such as effluent reuse) supply-side option type to implement. Customers also recognised the potential for wider environmental benefits such as creation of habitats for wildlife after the initial disruption of construction.

- **More trades between companies**
  Water trading into the region created some concern regarding creating a dependence on external parties, even though the principle of sharing was thought to be sensible. Water trading was also seen as potentially costly and disruptive, and when customers were made aware of potential environmental concerns, such as the introduction of non-native species, this further heightened concern.

  In our joint research on this topic we found that 74% of customers agreed that they would support water trading as part of a national solution to water scarcity – it's logical and necessary to share resources. Despite this, multiple concerns emerge, relative to security of supply, environmental impacts and the financial cost. Those in donor regions are concerned as to whether water trading will negatively impact their own water supplies over time, and non-household customers are concerned about the impact of a perceived 'unreliable' supply on their business.

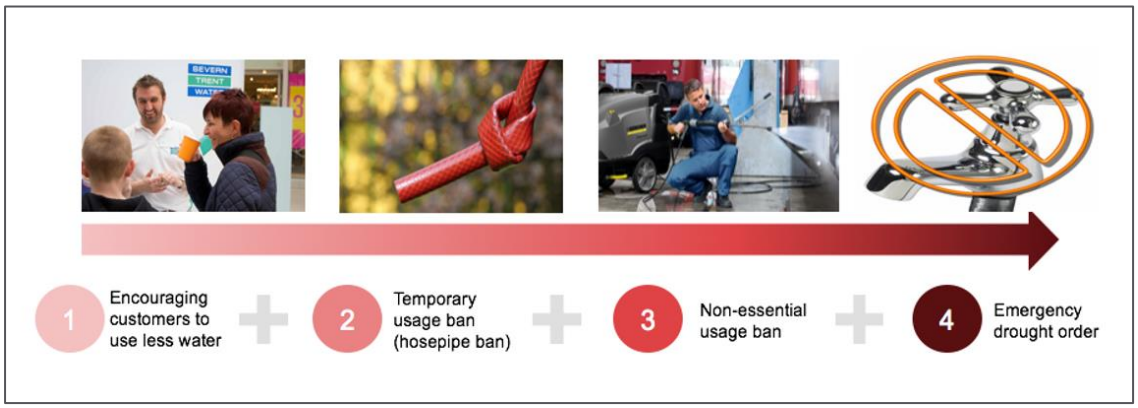
- **Abstracting more water**
  Abstracting more water from rivers caused some concerns amongst our customer groups, particularly around environmental impacts, although customers were more reassured on learning that abstraction is regulated. This option was considered to be relatively simple and certain.

A1.2 Responding to customer views on drought

As described in the previous section, customer awareness of the supply / demand challenge is very low. According to our customer tracker only 7% of customers think that we won't have enough water in 10 years' time and 10% in 20 years' time. Be inference, severe drought is therefore not something that customers anticipate will affect the UK.

Since drought is not something customers consciously consider, we used deliberative research to discuss and understand our customer's informed views (in line with our strategic research framework). We used a drought 'story board' to help customers imagine the development of a drought situation over time, with progressively more serious customer impact as outlined in Figure A1.4.

Figure A1.4 Outline of drought consequences 'story board'



Our customer engagement established that the occurrence of a drought would be seen as exceptional and outside of the water company's control. Climate change and changing weather patterns give rise to some concern that droughts could become more common in the UK, and a feeling that this would have a negative impact on the water service. While 'hosepipe bans' were mentioned spontaneously, these are generally seen as quite common and linked to 'hot summers' and not 'droughts', which as a term is interpreted as an extreme scenario that is unlikely to occur. In the engagement quiz about Severn Trent Water that we ran on Tap Chat, and in our deliberative research, we found that most respondents mistakenly believed that there had been a hosepipe ban in the region since 1996.

Temporary Use Bans (TUBs) are considered acceptable in principle; customers describe them as a pragmatic approach in such circumstances, provided that we can demonstrate we are taking additional steps to limit own water loss. Some customers believed that they had experienced a TUB recently and were surprised to learn that it has been more than 20 years since one has been implemented in our region. Many customers noted that the likely impact on them from a temporary use ban was minimal.

Participants recognised that requiring the use of standpipes would only occur due to severe and exceptional weather conditions. Therefore they regard our response in those circumstances as proportionate to the seriousness of the situation. However, they are clear that support would need to be put in place for vulnerable customers. The predicted frequency of 1 in 200 years for these events is seen as acceptable by most customers. There was no willingness to accept a lower level of service in exchange for a bill reduction. Information on levels of drought resilience for other companies was discussed in the session and not found to influence our customers' view.

Overall, our deliberative research found little support for further investment for the purposes of reducing the risk of requiring TUBs from the current level. Likewise there was no support to reduce the risk of requiring standpipes. Our willingness to pay research also showed that reducing the risk of needing to use standpipes is a very low priority for customers. As part of our valuation research programme we did a survey which we have called the budget game. In the budget game we interviewed customers using a large "board game" to present them with different service levels (a current level and two improvement options). Each improvement option was costed in terms of a potential bill impact. Customers were able to select their preferred plan using tokens. The total 'cost' of the plan was then calculated and customers had the option of reviewing their choices. Using this approach we found that only 10% of customers selected an improved level of service for standpipe usage.

A1.3 Responding to customer views on Resilience

We have used our deliberative approach to talk to customers about resilience in general, as well as a specific focus on supply resilience. Resilience is a topic which is far from customers' conscious thought – for example

the majority of customers have no experience of an interruption to their water supply of any duration. We conducted extensive qualitative and quantitative research on supply resilience during development of our PR14 plan, when we proposed a large investment scheme to improve resilience of our supply to Birmingham. We have further advanced the intelligence we gained at that time during the course of developing our WRMP.

For our PR19 and WRMP19 plans, we were mindful of our strategic research framework and the lack of conscious considerations that our customers give to resilience. To give us the best opportunity to extract our customers views we used deliberative research to explore the subject more deeply. We found that low levels of service disruption have given rise to high levels of confidence in the resilience of our service, and an assumption that there are plans in place for disruptive events. It is only through raising awareness with customers that we were able to probe their views more deeply.

In terms of providing interventions specifically to increase resilience, we discussed with customers whether we should focus on anticipating the challenge or preparing a response when things go wrong. Instinctively customers can be risk averse and feel that we should pursue both aspects of resilience in all circumstances, focusing on both prevention (better than cure), but also being prepared for the rare occasions when things go wrong.

Initially customers did not think there were any circumstances where a reactive only plan for resilience could work. On reflection views changed, and customers accepted it might not be possible to prepare for every disruption eventuality (although this is an aspiration) and therefore a combined approach should be used to address the challenges facing the water system.

In addition to more general discussions on resilience, we have asked whether customers support the proposed investment on supply resilience through our Choices research on performance commitment targets, investment options and incentives. We found that customers are aware that essential infrastructure is old and therefore accept the need for investment. In fact there was some question on the timing of investment and why we were not intending on replacing these older assets as a matter of course. A total of 78% of customers supported the proposed investment, when presented with the bill impact and the context of future overall bill changes.

Figure A1.5 provides a visual demonstration of the wider challenges that customers consider are facing the water supply system in the future. Maintenance, supply, shortages and the price of water emerge as key themes.

Figure A1.5 Visual representation of customers view on challenges to the water supply system

When presented with more information about the future, customers are surprised by the challenges we face, but they do expect and trust us to be dealing with those challenges effectively. Overall we found that a large majority of customers (almost 80%) trust us to balance short and long term investment decisions and management of the network. A key theme that emerges across multiple research projects is that customers would prefer us to take a long term view and upgrade infrastructure now, rather than wait until there is a problem. This is despite the fact that such investments might not lead to visible immediate benefits.

Customers also perceive a joint responsibility about the long term security of the water supply, and spontaneously talk about the importance of education on water efficiency.

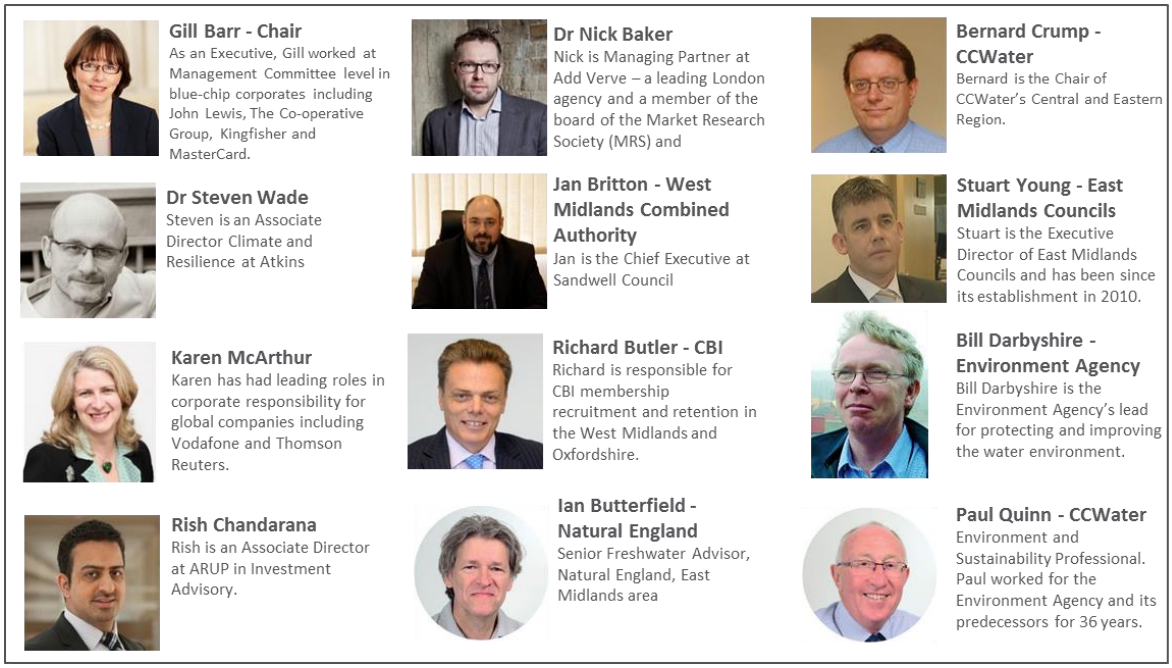
Further commentary regarding our approach to Resilience in our WRMP is provided in Appendix x of our WRMP and Appendix B7 of this document.

A1.4 Water Forums

We have worked with our Water Forum (our Customer Challenge Group) for over two years and have been actively debating and developing our proposals over that time. In 2016 we welcomed a new independent chair, Gill Barr, who has bought extensive executive level experience from leading retailers including John Lewis and The Co-operative Group, swiftly following by four new members with expertise that include market research (Dr Nick Baker), social responsibility (Karen McArthur), investment planning (Rish Chandarana) and climate change (Dr Steven Wade). A summary of the core team of our Water Forum is provided in Figure A1.6.

They joined our existing members from the Consumer Council for Water (Dr Bernard Crump and Paul Quinn), the Environment Agency (Bill Derbyshire), Natural England (Ian Butterfield), the CBI (Richard Butler) with a further two new members with expert knowledge of our region from the East Midlands Councils (Stuart Young) and the West Midlands Combined Authority (Jan Britton).

Figure A1.6 Our Water Forum core team



The Forum has been organised to focus on key issues associated with WRMP19 and PR19. As a result we have a number of separate sub-groups established to better understand and challenge particular areas. These sub-groups bring together a diverse range of expert skill sets.

Customer engagement and the proposals relating to our WRMP have been principally challenged by the Water Forum's investment sub-group (ISG) and market research sub-group. The ISG comprises members from: the Environment Agency; Natural England Consumer Council for Water (two members; one Chair of CCWater's Central and Eastern Region); Confederation of British Industry; the West Midlands Combined Authority; and two from industry leading engineering consultancies (one of which started his role on the Water Forum as Head of Scientific Consultancy at the Met Office).

Dr Nick Baker, the Water Forum's expert in customer research, also sits on the Board of the Market Research Society, the world's leading research association. Drawing on this depth of experience, he led the Water Forum's market research subgroup, which includes Dr Bernard Crump, Regional Chair CCWater, and has been extensively involved in the development and application of our customer engagement. The subgroup has dedicated hours of challenge – across the full spectrum of our research – design, intent, sampling, execution and interpretation.

A significant amount of work and challenge has taken place in the 18 month period. The Water Forum wanted to understand;

- the challenges we are facing;
- the options we have considered;
- the benefits we are seeking to deliver;
- how we have engaged our customers;
- the preferences of our customers and how our plan responds to them, and;
- the areas of support we had for our proposed plan.

A key challenge from the Water Forum was in design of our research approach and deployment of the various techniques, which we have responded to in our strategic insight framework. At the heart of our strategic approach to customer insight is developing a more holistic understanding of the people and communities in our region, and understanding how we can make a positive contribution to their lives.

Our research consistently shows that customers take their water supply for granted. Ensuring water is always there is considered to be a basic need that, once met, is not given much further thought.

Our Water Forum have challenged us to be more strategic in our research design, taking into account:

- where the topic sits within the hierarchy of customer needs;
- the extent to which the topic is conscious in customers' mind vs unconscious; and
- whether the topic / issue occurs today or could in the future.

The Water Forum attended our deliberative research activities and directly witnessed the engagement levels and interest at those sessions, as well as the quality of the materials used to explain the issues in an engaging and accessible way.

A1.5 Responding to customers view on managing uncertainty

One of the key themes that came through our research and our wider customer engagement is that customers expect that our services represent value for money, are efficient and that we are mindful of the bill impacts of our investment choices.

However, we recognise that this doesn't mean customers simply want us to pursue the cheapest option, as reflected in our deliberative research on supply / demand options. Customers explicitly want us to pursue best value options and, similarly, customers do not want us to ignore risks to future supplies. Our customer

engagement revealed a much more nuanced view that seeks to balance issues such as affordability, long term sustainability and resilience.

Our engagement on using a 'real options' approach to managing uncertainty occurred through both a deliberative workshop and engagement using our online community. Our Water Forum challenged us quite strongly on the need for the deliberative research to supplement the online community engagement. This is because the potential complexity of the issue and forward looking nature means it's important to explore whether the results are different when customers have a more informed understanding.

In the deliberative workshop we sought to understand customers' views on a range of issues, including:

- Water Framework Directive (WFD) – explore customers' views about how to manage uncertain schemes (those which are not certain to be progressed), with a preference for higher bills now with potential for a reduction in the future, or lower bills now with a risk of higher bills
- Explore customers' views about different supply-side and demand-side solutions
- Explore customers' attitudes about how we respond to uncertainty associated with climate change – including the balance between investing now versus investing later
- Understand how customers feel about variation in their bill, and their perceptions of acceptable levels of variation

Overall customers expressed strong support for finding a middle position to manage uncertainty. On climate change there was a clear desire to protect the environment through the use of demand side measures. Customers were not supportive of large scale supply-side solutions, despite the research occurring during the notable hot weather conditions of summer 2018. Instead there was strong support for taking action to prepare for climate change uncertainty but not undertaking significant investment now (i.e. prepare to move quickly). We used our online panel to test different options for how we might respond to the uncertainty associated with climate change.

This research was undertaken using detailed polling on our online panel with approximately 800 customers taking part. We followed the polls with a discussion thread on the panel to explore customers' views about the approaches to uncertainty, their preferences and why.

In relation to climate change, 69% of customers expressed support of our approach to prepare now but to avoid significant investment until further information is available. We also note that 13% of customers supported no activity (including feasibility and design work), whilst 18% supported investment irrespective of the uncertainty.

Key feedback from our customers included:

- *With the rapid changes in how water should be stored, managed and used, I think that it would be unwise to decide now what approach should be taken.*
- *As a customer and shareholder I am definitely not in favour of large scale investment in one 'lump' but feel looking into the requirements for future investment is suitable at this stage*.
- *I'm voting for research and project planning rather than leaping straight into solutions that may be outdated.*
- *I believe it is reasonable to assume the demand for water will increase, not least due to the increase in house building. It therefore makes sense to make a start on building a 'base' provision for anticipated future requirements, rather than being caught on the back foot playing catchup. Let's get on and make progress.*

The feedback from our customers shows that there is strong support in principle for managing uncertainty through a mechanism such as real options. Customers want us to balance a range of factors when making investment decisions, including:

- Protecting the environment;
- Promoting affordability by investing only in assets that required; and
- Promoting resilience by being able to respond to changes or new information quickly.

The results of the bill volatility engagement sessions also help to allay concern that even in the extreme event that all options are needed, customers would not find the change in bills volatile.

A2 Demand management – leakage

A2.1 Long term leakage targets

The long term 2020-2045 leakage targets set out in our draft WRMP were based on a least whole-life cost economic appraisal of supply and demand needs and the available intervention options. This approach has produced the long term leakage reduction profile illustrated in Figure A2.1 and A2.2, demonstrating a 15% reduction in AMP7 followed by modest reductions in subsequent AMPs.

The long term profile reflects our projected supply and demand outlook and the costs of our different investment options. Note that while the AMP7 overall leakage reduction target is 15%, the reductions are only targeted in the Water Resource Zones (WRZs) with supply / demand shortfalls (these being our Strategic Grid WRZ and Nottinghamshire WRZ), with leakage rates maintained at their current rate in all other WRZs.

Figure A2.1 Long term leakage profile (Company wide): Our draft WRMP

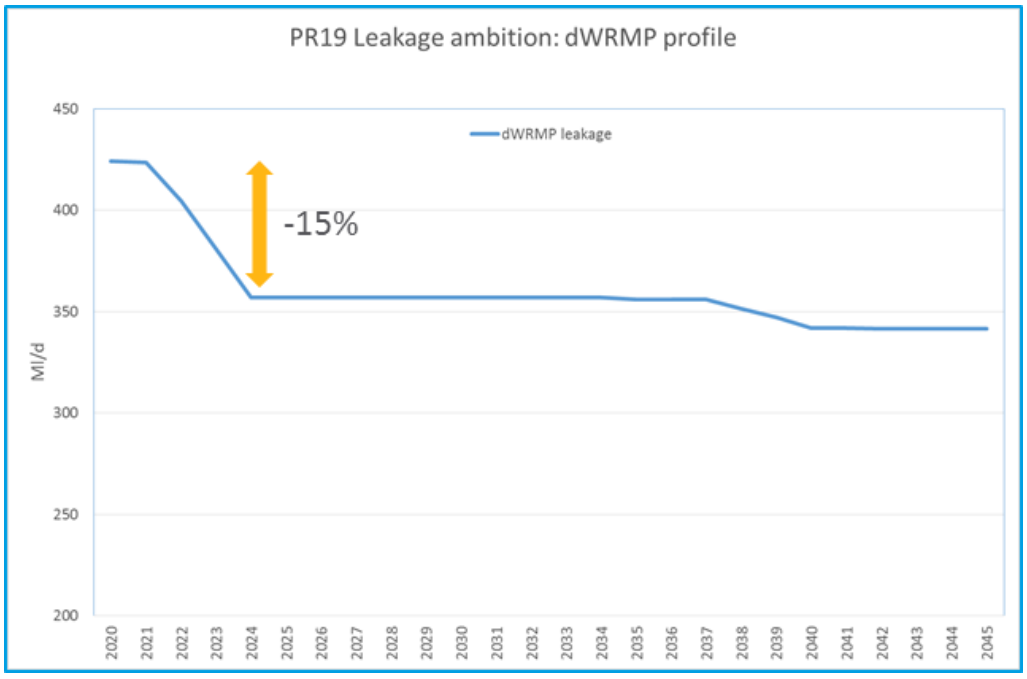
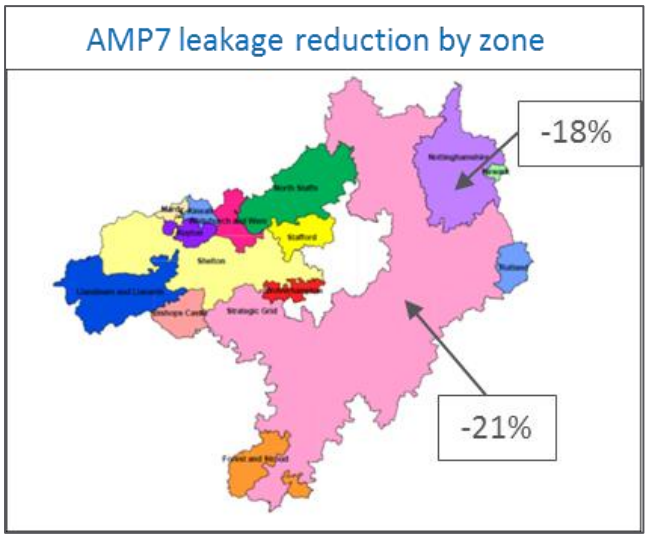


Figure A2.2 Long term leakage profile (by WRZ): Our draft WRMP



During the consultation process, customers and stakeholders challenged our long term leakage ambition and pressed us to continue with significant multi-AMP leakage reduction strategies. Also, since the draft WRMP we have compared our leakage ambitions with the long term leakage profiles proposed in other companies' draft WRMPs. Separately, the National Infrastructure Commission (NIC) has set out a challenge that the industry should reduce leakage by 50% over the next 25 years.

In response to these challenges, we have considered potential options for setting more ambitious long term leakage targets for inclusion in our final WRMP. The three options considered, and our chosen approach are explained in the following sections.

Option 1: continue with an economic approach using updated supply / demand appraisal

Since we published our draft WRMP in December 2017, we have made some minor updates to our overall supply / demand appraisal using the latest information. The main areas of update have been:

- The final list of sustainability reductions confirmed in the Environment Agency's WINEP3 in April 2018.
- Revised water resource option capex / opex estimates which reflect our ongoing engineering appraisal of supply-side and demand-side options.

The result of these updates is that there are some small changes to the supply / demand profiles for WRZs that are affected by long term sustainable abstraction pressures and there is a rebalancing of the costs and benefits of our different options. As a result of these changes, our assessment is that further AMP8 and AMP9 leakage reduction would become more cost effective than was modelled at the time of our draft WRMP.

Our latest assessment is that an updated 'least whole life cost' approach would mean no changes to the AMP7 reduction of 15%, but would increase the AMP8 leakage reduction rate to 6% and the AMP9 leakage reduction rate to 5%. However, the longer term supply / demand outlook would mean no further leakage reductions in subsequent AMPs. The resulting long term leakage profile generated by Option 1 is illustrated in Figures A2.3 and A2.4.

Figure A2.3 Long term leakage profile (Company wide): Option 1 Updated long term least whole life cost approach

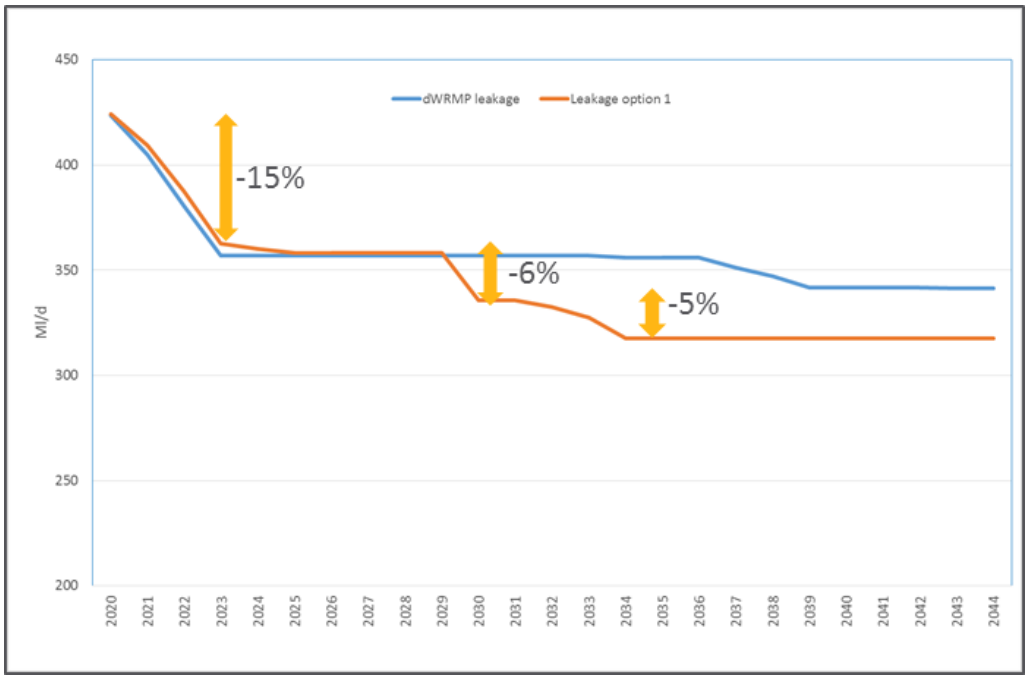
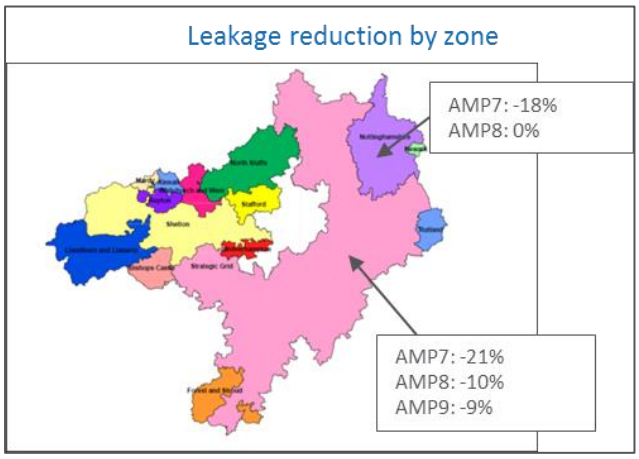


Figure A2.4 Long term leakage profile (by WRZ): Option 1 Updated long term least whole life cost



We recognise that using this approach, reductions would still only be targeted in the two WRZs with a supply / demand balance deficit, with no reductions in the remaining WRZs. The long term profile also implies that our leakage targets become less challenging in the long term. Therefore, we have explored further options to go beyond the least whole life cost approach.

Option 2: Extend AMP8 / AMP9 leakage reduction into zones with no SDB deficit.

This option builds on the revised supply / demand economic appraisal described in Option 1. The Option 2 approach requires us to continue delivering the least whole life cost leakage reductions targeted in the two zones with a supply / demand balance deficit. However, we would also extend AMP8 / AMP9 leakage reduction into the remaining zones to maintain an overall AMP by AMP target reduction of 15%. The additional AMP8 and AMP9 reduction zonal targets would not be set based on supply / demand balance need, but would be distributed across all WRZs based on short-run costs and ease of finding and fixing leaks.

This approach means that we prioritise leakage reduction activities to benefit customers in the WRZs with the greatest needs to meet the supply / demand balance, but longer term we will extend our ambition into WRZs with a lower supply / demand risk. Beyond AMP9, once the supply / demand balance deficit has been addressed, the least whole life cost approach would mean no further leakage reductions are required as demonstrated in Figures A2.5 and A2.6.

Figure A2.5 Long term leakage profile (Company wide): Option 2 Extending the least whole life cost approach to achieve an overall 15% AMP reduction target.

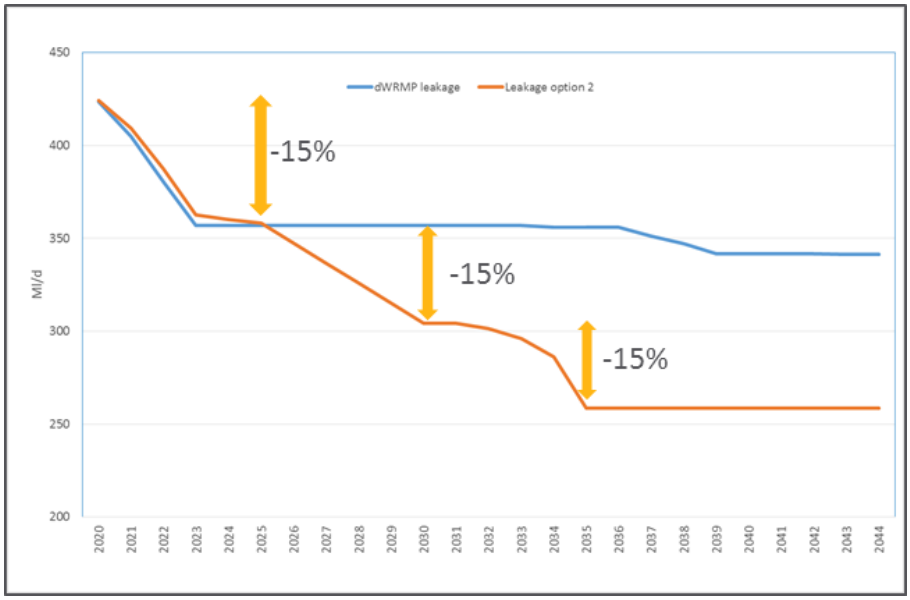
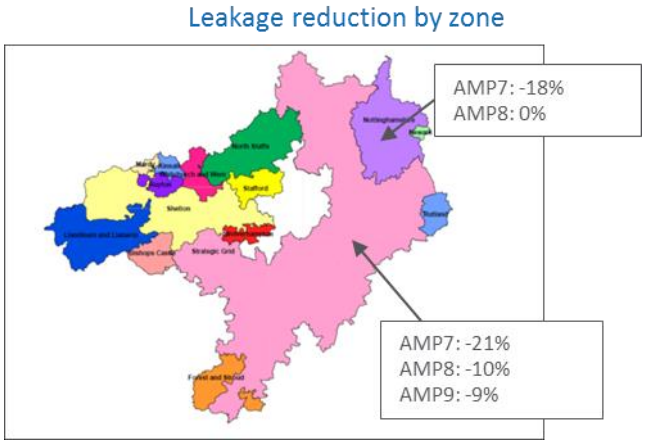


Figure A2.6 Long term leakage profile (by WRZ): Option 2 Extending the least whole life cost approach to achieve an overall 15% AMP reduction target.



Option 2 seeks to balance overall leakage ambition with bill impacts, security of supply and meeting customers' priorities. However, Option 2 does not address the long term leakage reduction challenge that was set by the National Infrastructure Commission.

<u>Option 3: Beyond AMP8 we adopt the NIC 50% target, and use it to set our innovation ambition</u>
This builds on the expanded leakage reduction targets described in Option 2.

Option 3 would set top down AMP9, AMP10 and AMP11 reduction targets based on achieving the 50% leakage reduction challenge set by NIC. Our current least cost modelling suggests that based on existing leakage reduction technology, costs and performance it would not be cost effective to reduce to these levels. However, we recognise that stakeholders and regulators expect us to prioritise long term leakage reduction and to find innovative ways to drive future performance. Option 3 will require us to increase investment in the leakage technology and innovation required to achieve these levels of performance. Beyond AMP7, these longer term reductions would be distributed across all zones regardless of supply / demand balance needs as demonstrated in Figure A2.7 and A2.8.

Figure A2.7 Long term leakage profile (Company wide): Option 3 – Achieving the NIC's 50% leakage reduction target over 25 years.

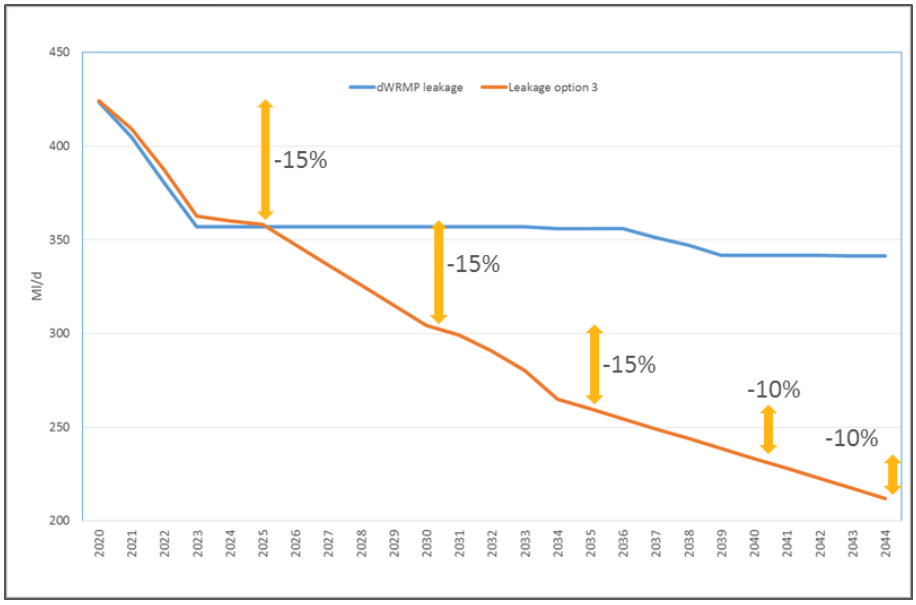
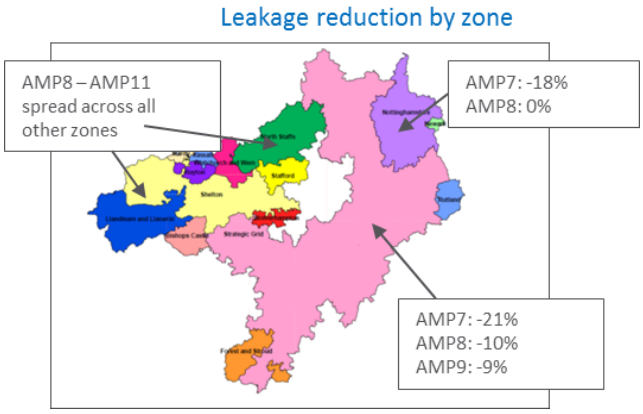


Figure A2.8 Long term leakage profile (by WRZ): Option 3 – Achieving the NIC's 50% leakage reduction target over 25 years.



Option 3 presents an ambitious approach to leakage reduction that is not limited to WRZs with a projects supply / demand balance deficit.

Option Selection

Based on the feedback from stakeholders and our ongoing engagement with regulators, Option 3 is our new recommended long term leakage reduction profile and will be included in our final WRMP. These leakage reduction targets will drive our leakage innovation thinking and mean we need to find new ways of delivering a step change in leakage performance. Our new AMP by AMP leakage reduction numbers are shown in Table A2.1. Note these numbers are pre-leakage convergence data changes, and are annual average targets.

Table A2.1 Recommended leakage targets for our final WRMP & PR19 performance commitment.

	2020	2025	2030	2035	2040	2045
Total Leakage (Ml/d)	424	360	306	260	234	210
Percentage Reduction	-	15%	15%	15%	10%	10%

A2.2 Our future approach to leakage management

Our long term leakage ambitions and our customers' wider expectations mean that innovation in leakage reduction will be crucial to our ability to deliver these reductions. We believe that in a world of rapid change and increasing uncertainty, innovation is critical if we are to drive better outcomes for our customers, our people, our investors and society. In AMP6 we've embraced new opportunities from an outcomes based regulatory framework and made a step change in our approach to innovation – the model we use, the resources we dedicate to it, and a culture that inspires our people to innovate every day.

We understand that challenges posed by such stretching leakage targets mean that traditional leakage management techniques are unlikely to offer cost effective ways of delivering the required reductions. We also understand that with any new innovation there is an inherent risk involved in the new approach being able to deliver the expected benefits. We have, therefore, developed a balanced approach to leakage reduction that embraces new technologies whilst maintaining some more traditional leakage management approaches.

We will continue to prioritise proactive renewals of the asset base, pressure management and network optimisation as ways to prevent increases in leakage. We will use a combination of more traditional activities such as Pressure Management Valve (PMV) installation and optimisation along more innovative activities, such as addressing transient pressure waves.

The biggest contributor to our current leakage performance is our ability to prevent and become aware of network failure. We have developed initiatives that will focus on reducing network bursts and improve our awareness time to allow for faster intervention on the network before customer are impacted. To address this challenge we are planning to adjust our current operational model and techniques through a combination of increasing our operational effectiveness by introducing new technology (such as fixed acoustic networks and high density pressure logging) and continuous improvement in our processes.

Both fixed acoustic networks and high density pressure logging technology are being implemented to reduce the time for us to become aware of a leak and improve the localisation of the leak – thereby reducing both the lifespan of a leak and the time needed to pinpoint before remedial interventions can be implemented. We believe that a combination of both of these approaches will allow us to gain these benefits across our mixed material pipe network in both urban and rural areas by exploiting the strengths of each technology. Case Study A2 demonstrates one of our proactive initiatives to research and mitigate leakage at the root cause level.

We are continually running trials on new leakage technologies such as satellite leak detection and in-pipe detection and repair technology. We assess each technology for both potential benefits and any associated risks. Our openness and experience of evaluating new technologies will allow us to quickly implement new leakage reduction technologies into our leakage reduction strategy in a controlled and measured way. This will ensure our customers are protected alongside delivering our ambitious leakage reduction program.

Case Study A2 – Reducing Transient Pressure Waves

Pressure transient waves are short-lived pressure spikes on water companies' networks. They can cause bursts, asset damage and risk contamination from ingress - resulting in water quality issues. Pressure transients are generated by sudden, significant changes in the velocity of flow in the network. They are usually caused by the operation of valves and pumps or large surges in customer demand of water. Research has indicated that 15-20% of bursts on our network are caused by pressure transients. These waves have until relatively recently gone unquantified within the network.

This work was instigated via an Eng.D funding programme with Imperial College and has evolved from the development of a model to prove that a relationship between transient waves and bursts could be established. Now, with a start-up company rolled out from Imperial College, we aim to develop a metric to enable even better quantification and understanding of the relationship between dynamic pressure variability and bursts. This will allow us to assess the risk at each site and the predicted reduction in burst rates.

We have already seen significant benefits of our approach at one of our pumping stations since 2015. Following a £15,000 investment in pump improvements at this station, pressure transient occurrences have been eliminated, resulting in approximately 70% reduction in burst rate. The avoidance of repairs in this case translates to an opex saving of £60,000 per year, providing a three month return on investment as well as reduced risk and a positive impact on customers.

A2.3 Leakage modelling assumptions

Four our latest WRMP, we have followed a similar leakage modelling process to our previous WRMP14 and previous business plan PR14, albeit with updated base data and updated best practice methodology where appropriate. Since we published our draft WRMP, our Active Leakage Control (ALC) cost curves have been further updated. While these represent the base costs for achieving our targets, through our PR19 process the final unit costs that we have used in the plan have had further efficiencies applied to them as a result of benchmarking against the industry and PR19 cost efficiency. This will be assessed by Ofwat, the economic regulator, as part of our PR19 Business Planning submission.

A range of options for leakage reduction were considered as part of the WRMP planning process, including:

- Active leakage control (ALC)
- Mains renewal
- Pressure management
- Supply pipe leakage reduction as a result of metering

The costs within the ALC cost curves includes:

- Detection costs
- Detected repair costs
- Leakage savings

We used our Water infrastructure Supply Demand Model (WiSDM) to select the most beneficial programme as described in Appendix E of our WRMP. When WiSDM was operated, the tool had free ability to select a combination of active leakage control, mains renewal and supply-side options to solve any supply / demand balance deficits across our WRZs (after having accounted for the benefits of metering and water efficiency).

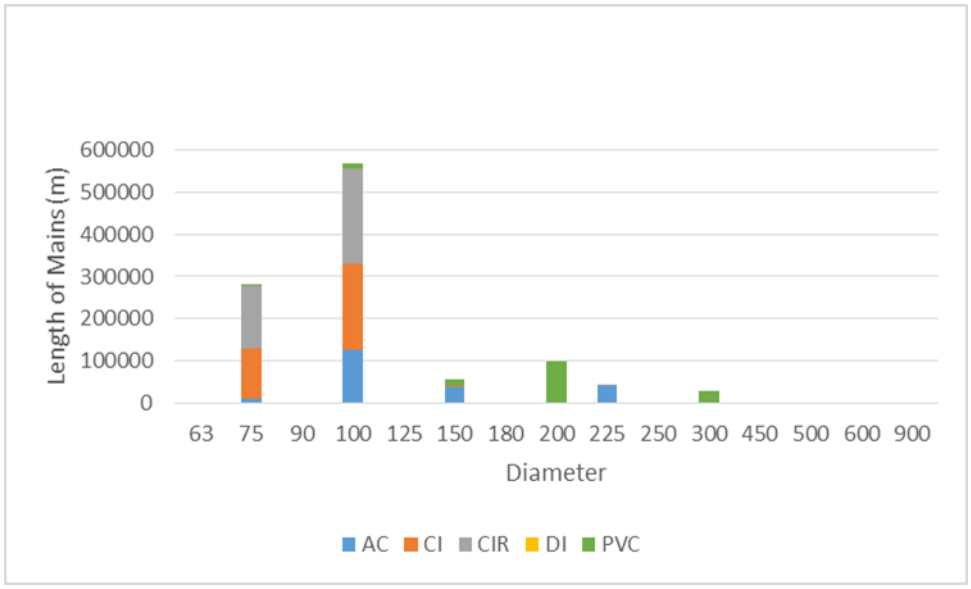
Our WiSDM tool selected a 15% leakage reduction target for AMP7 (pre convergence leakage definition), which was predominantly driven by ALC. Our WiSDM model also selected 1,122km of mains renewal for AMP7.

WiSDM creates an optimal solution to the problem it is presented with using a genetic algorithm; the problem being solved is non-linear. This makes it difficult to identify the driver for specific lengths of mains renewal. The minimum constraints that the WiSDM model must achieve include; maintaining the supply / demand balance; maintain supply interruptions rates, and; maintain burst rates. The burst rate to be maintained is modified to account for 1 in 10 year extreme weather events.

The 1,122km of main renewal selected by WiSDM will, as a minimum, offset the Natural Rate of Rise (NRR) in the network and contribute to maintaining supply interruptions and mains bursts performance commitments. The mains renewal program will prevent the deterioration of NRR, and other activities (Pressure management, ALC, metering) will deliver the leakage improvement, in combination with enhanced monitoring of the network and new technologies.

The WiSDM model was able to test a larger mains renewal program, for example to reduce leakage rather than using ALC, but this was not found to be a cost beneficial solution. The length of mains recommended for replacement is congruent with historic renewal length, giving confidence around deliverability. There is a small, long term risk that a top down decision to reduce the mains renewal program could lead to a growth in the NRR. Figure A2.9 shows the recommended blend of materials and diameters for replacement in AMP 7. Note that the specific mains to be replaced will be identified by our delivery teams using these parameters as a starting point, but with the ability to calibrate for up to date information.

Figure A2.9 AMP7 mains renewal length by diameter and material



All costs used for mains repairs, mains renewal activity and additional repairs are based on our latest unit cost data. The same PR19 cost efficiency and benchmarking has been used on these interventions.

Environmental and social costs of leakage interventions have been included in the optimisation of our WRMP, and the specific values are reported in the WRMP data tables for each water resource zone (WRZ). These tables includes the AIC and AISC of the leakage interventions in each WRZ, and so the materiality can be assessed. These costs include:

- Congestion
- Additional repairs
- Ongoing costs
- Carbon ALC cost.

The methodology remains consistent with the work that we completed for PR14 and WRMP14.

A2.4 Supply pipe leakage

Household metering is part of our demand management strategy, through which we expect to realise benefits in the form of reduced consumption and reductions to Underground Supply Pipe Losses (USPL). Our draft WRMP detailed the consumption benefits of household metering but not the USPL reduction benefits. For the final WRMP tables we have adopted and implemented the recently published EA data tables that contain corrections for capturing USPL benefits in WRMP data Table 6.

The USPL benefits are calculated based on our preferred meter location policy under which the majority of new meters will be externally fitted. Consistent with our annual water balance reporting, we expect to achieve, on average, a lower per property USPL for external meters. Table A2.2 and Table A2.3 demonstrate our expected metering locations and average 'per property' USPL assumptions.

Table A2.2 Metering location assumption:

Metering location split	
Internal	10%
External – existing boundary box	23%
External – without boundary box	67%

Table A2.3 USPL per property:

Metering location split	
Externally Measured Household	24.09
Internally Measured Household	26.91
Unmeasured Household	26.91

Table A2.4 shows the reduction in household USPL from metering by water resource zone that will be included in the final WRMP data tables. The WRZ saving aligns with the number of meters fitted in the WRZ each year.

Table A2.4 Forecast USPL Reduction by WRZ

USPL REDUCTION Ml/d	2020 -2021	2021 -2022	2022 -2023	2023 -2024	2024 -2025	2025 -2026	2026 -2027	2027 -2028	2028 -2029	2029 -2030	2030 -2031	2031 -2032	2032 -2033	2033 -2034
Bishops Castle										-0.01				
Forest & Stroud						-0.06	-0.06	-0.03						
Kinsall										-0.01				
Llandinam & Llanwrin											-0.04			
Mardy										-0.01				
Newark					-0.05									
North Staffs			-0.09	-0.23	-0.23									
Nottingham	-0.23	-0.31	-0.26	-0.18	-0.16									
Rutland						-0.02								
Ruyton										-0.01				
Shelton								-0.09	-0.18	-0.16				
Stafford						-0.07								
Strategic grid					-0.06	-0.50	-0.50	-0.51	-0.51	-0.51	-0.79	-0.57	-0.36	-0.14
Whitchurch & Wem										-0.02				
Bishops Castle							-0.10	-0.10	-0.04					

A3 Demand management – metering & water efficiency

A3.1 Water metering

In response to the comments on our draft WRMP, we have reviewed our metering strategy and the underlying assumptions. We have reviewed the learning from other water companies' recent experiences of metering and we have benchmarked the costs and benefits used to inform our approach. We have also initiated an extended metering trial to gain even more confidence in our proposals.

We have not changed our ambition to achieve 100% metering coverage by the end of AMP9. However, recognising the need for innovation for us to reach 100% meter penetration we have assessed the materiality of the risks to our supply / demand balance should we not achieve our 100% meter coverage ambition. When assessing the benefits of a persuaded optant strategy we have taken a precautionary approach to the demand management impact of an average 10% demand reduction. Based on the benefits reported by other companies, we believe that achieving full meter coverage could deliver up to an 80Ml/d demand benefit. This is less than the 16.5% demand reduction reported by Southern Water, reflecting the fact that customers would not be forced to adopt measured charges. Our current thinking is that to secure the full 80Ml/d reduction would require us to adopt an external metering policy and combine this with a policy of helping customers tackle supply pipe leakage on their properties.

We know that our historic approach to metering growth will not achieve our ambition to reach 100% coverage, proactively help customers reduce demand for water or support our leakage reduction targets. We have continued to explore the costs and benefit of a range of different metering growth strategies that could accelerate the required pace of meter coverage. Options included:

- continue current free meter optant programme,
- change of occupier metering,
- proactive metering and,
- compulsory metering.

When assessing these future options to accelerate coverage we took account of our Change of Occupier initiative from AMP5, which experienced high abort rates (refusal of fitting, refused access and missed appointments) and subsequently high costs (23% higher unit costs than a comparable free meter optant programme). If applied fairly to all customers, change of occupier metering does not allow us to prioritise or maximise delivery in the areas of greatest deficit.

We do not currently have the legal power to implement a compulsory metering programme as we are not classified by the Environment Agency as a seriously water stressed area. However, in our cost / benefit assessment the costs and delivery of compulsory metering are the same as our proposed proactive metering programme. The difference is under a compulsory metering approach, customers would be forced to adopt measured charges rather than our proposed approach for 'persuaded optants'.

Our ambition to increase meter coverage has been directly informed by our customers' views. They told us that metering, in their experience, encourages behaviour change, through more personal responsibility and creates the opportunity to save money. They have told us they strongly support interventions that encourage responsible use of water, are sustainable in the long term, offer value for money and are good for the environment. When presented with the options to help manage the supply / demand balance challenge, metering was the most favoured intervention. Customers also told us that metering is fairer and in line with other utilities they receive and pay for. Our customers were also very clear about the need for choice, which is why we are proposing a persuaded optant strategy, rather than pursuing compulsory metering.

We have also listened to our stakeholders, and have taken account of the broader Government ambition for reducing demand for water and per capita consumption as set out in the 25 Year Environment Plan in 'A Green Future: Our 25 year plan to Improve the Environment'. We believe full meter coverage will support our wider demand management programme and help customers understand and manage their water use. Full meter coverage will be key to increasing our knowledge and understanding of changing water use across our network which is essential if we are to meet our stretching leakage targets.

We acknowledge that by using existing technologies and methods, no company has achieved this level of meter coverage (Southern Water have achieved 93% meter coverage, Anglian Water have achieved 88% meter coverage with 92% ambition by 2020 and 95% ambition by 2040). However, given the timeframe for delivery we also recognise the potential for innovation in more advanced metering technology, including non-intrusive metering and flow measurement that will provide additional options and opportunities to enable us to install meters in currently challenging locations. Advanced metering and flow measurement technology is already developing to the point that low cost non-intrusive flow measurement devices are a realistic opportunity over the timescale for our programme to help us reach the 100% ambition.

In terms of aspiration, our proactive metering plan is no different from other multi-AMP plans where we don't yet have the full delivery tactics because it is simply too early to establish these. Our new proactive metering trial to help us fine tune our AMP7 implementation tactics and prepare for the significant increase in metering activity – particular areas of focus are; demand impact; communications; meter and meter reading technology; leakage impact; meter location, and; existing pipe material 'hot spots'.

Our innovation team is also investigation options associated with advanced metering technologies. Assessing a range of meter technologies is a key component of our proactive metering trial. This insight will be used to refine our delivery plans and ensure we are selecting the right level of meter technology to maximise the demand management benefits.

Both through our trial in AMP6 and through the yearly phase of the programme in AMP7 we will closely monitor installation rates and progress with the roll out. Based on current technology and processes, and the metering programmes already delivered (93% Southern Water) or planned by other water companies (95% Anglian Water) we believe that ambitions beyond 95% are realistic with innovation. A shortfall of 5% would only equate to a 4 Ml/d deficit in our forecast demand savings, which, when spread across our entire region would represent an increase of 0.4% on household demand, or the equivalent of 1.06 litres per household. Close monitoring of the programme will allow us to continually assess the likely impact and develop to mitigate any shortfall. One example may be bespoke in home audits, advice and devices including leak alarms for properties we are unable to meter.

In our PR19 Business Plan we have included an AMP7 Outcome Delivery Incentive (ODI) around our metering proposals. This ODI is designed to protect customers from the uncertainty of achieving the increased meter installation rate described in our WRMP. The design of the ODI means that customers' AMP7 bills will reflect investment for around two-thirds of the 2020-25 meter volumes included in the WRMP. The remaining one-third will be reflected in bills at the end of the 2020-25 period (i.e. effectively customers will be paying for these meters in arrears rather than upfront). We will report annually on progress with delivering our meter installation target.

The metering ambition described in the WRMP is not affected by the ODI mechanism. The leakage and demand management strategy described in our WRMP is based around delivering our enhanced metering programme. Our performance commitments around leakage and per capita consumption also reflect the outcomes of the full metering programme. However, the ODI mechanism means that our PR19 plan will not

include the up-front investment associated with the full metering programme. As we report on annual progress, we will build the learning into our adaptive planning.

In developing our final WRMP, we will be separating our plans for England and Wales into a Severn Trent Water WRMP and Hafren Dyfrdwy WRMP respectively. Based on the views of customers and stakeholders we intend to align the metering strategies for the two plans, proactively installing meters in Wales and England. The Chester WRZ, which was previously within the Dee Valley Water draft WRMP, will be included in the final WRMP for Severn Trent Water, our English plan. As there is no projected supply / demand deficit forecast in that zone, proactive metering will take place toward the end of programme in AMP9. Similarly, for customers in the Powys area who will move to our Welsh business, Hafren Dyfrdwy, along with former Dee Valley customers in the Wrexham WRZ, proactive metering will take place toward the end of the programme in AMP9.

A3.2 Water efficiency and Per Capita Consumption (PCC)

Stakeholders gave us a mix of recognition and challenge around our target our long term PCC ambition. We note that our forecast position for PCC at 2045 is 113 litres per person per day (l/p/d) during a 'normal year', outperforms the target proposed in the 2018 National Infrastructure Commission report of 118 l/p/d.
We know that achieving this level of reduction is already ambitious and will require significant partnership working with a wide range of stakeholders. Whilst we welcome the desire for further ambition, we also have to recognise the challenges of influencing consumer behaviour. We are currently actively engaging with the wider industry and DEFRA to explore what longer term national targets for PCC may be, in line with the proposals in the Government's 25 year Environment Plan in in 'A Green Future: Our 25 year plan to Improve the Environment'.

The demand management benefits of metering and water efficiency have been modelled as part of our assessment of the supply / demand balance. Our expected demand reduction benefits are based on data from our own activities as well as taking the lessons learnt from other water companies who have already delivered extensive metering programmes.

We are offering water efficiency 'Home Checks' to all customers during the WRMP planning period. The plan is based on what we currently observe as the deliverable volumes based on customer acceptability. This may improve over time (especially as a result of targeted offers linked to our metering programme, and we will revise forecasts accordingly in future WRMP's, however we have to reflect customers views around choice, as we cannot force customers to participate.

As part of our ongoing programme we are working to educate and reduce demand on an area by area basis and will be offering water efficiency 'Home Checks' to every customer as we move around the region. We continue to develop options to support our more vulnerable customers. We welcome offers from a number of stakeholders to publicise the programme and look forward to working with them as move the programme around each county area across the region.

We also continue to explore water re-use technologies and innovation. We are continuing to explore both rain water and grey reuse opportunities as part of our innovation programme including a community rainwater harvesting trial in 20 homes in Llys Rhysnant in Powys.

When setting out even more stretching ambitions for PCC we need to recognise current customer choices. For example, during the hot, dry weather in summer 2018 customers chose to use extremely high volumes water, with the peak use equivalent to 100 l/p/d additional demand. We recognise that achieving our draft WRMP normal year forecast target for 2045 of 113 l/p/d will require significant multi-stakeholder cooperation and enablers:

- Metering to help target activity and engage customers on usage
- Requires national shift in attitudes and behaviours
- Will require legislative / regulatory change (e.g. current Building Regulations permit houses to be built to 125 l/p/d (even optional standard is 110 l/p/d))
- Water labelling will be essential – we are working with DEFRA on this.

Driving towards even lower PCC targets cannot be achieved by the water industry in isolation. We need the participation of a wide range of stakeholders (such as Local Authorities, Housebuilders, Non-Governmental Organisations, Product Manufacturers) and customers.

Since we published our draft WRMP we have continued to engage with retailers to gain an understanding of their plans to deliver water efficiency initiatives with their non-household customers. However it is clear that this is considered as an added value activity for retailers. As a result there is very little activity in this area with non-household demand projected to remain constant. The lack of Retailer participation and activity is a UK-wide, national issue, and not limited to our region.

A4 WINEP

A4.1 WINEP3 update

Our draft WRMP includes short and long term measures to remove or offset the impacts of environmentally damaging abstractions, and to help the associated water bodies achieve Water Framework Directive (WFD) objectives. We have worked closely with the Environment Agency throughout AMP6 to understand where our sources of abstraction could be contributing to low flow problems in hydraulically connected watercourses, and which of our sources have the potential to cause any future deterioration.

During development of our draft WRMP, we based our plan on the list of abstraction changes and water body priorities that we expected to see in version 2 of the Environment Agency's Water Industry National Environment Programme (WINEP). Since we published our draft WRMP, the Environment Agency have updated their list of priorities and objectives in version 3, known as WINEP3. Information associated with WINEP 3 made available by the Environment Agency in April 2018.

Since we published our draft WRMP, we have completed our AMP6 investigations into the potential environmental impacts of abstraction. The conclusion of these investigations in February 2018 included agreement with the Environment Agency on our priority sites for reducing unsustainable abstraction along with a range of agreed solutions for helping the associated water bodies improve their WFD status.

We have also continued to update our understanding of WFD deterioration risk, taking account of the Environment Agency's latest guidance on investigating the risk of WFD water body deterioration that was issued in January 2018. As a result, we have improved our understanding of WFD deterioration risk at our river abstractions that are subject to Hands Off Flow (HOF) restrictions. Through this additional modelling, we have explored how the timing of any variations to our Egginton abstraction licence on the River Dove could impact on our final WRMP.

Finally, we have continued to develop our thinking on how we can use environmental measures and river restoration techniques to help improve habitats and ecological resilience to low flows. We have also continued to assess the potential environmental impacts of our proposed new supply-side options.

The conclusions of our investigations and WFD risk assessments, along with any agreed actions were incorporated by the Environment Agency into WINEP3. We have included the WINEP3 changes into our development of our final WRMP.

A4.2 Restoring sustainable abstraction (RSA)

In the preparation of our previous PR14 business plan, the Environment Agency's National Environment Programme (NEP) for AMP6 set out the waterbodies and protected sites where it was suspected that our abstractions were unsustainable and causing detrimental environmental impact. Throughout AMP6 we have worked with the Environment Agency to complete environmental investigations and solution appraisals at these sites. When we published our draft WRMP we had not completed these AMP6 solution appraisals. This options appraisal process has now complete and the EA have incorporated our results into WINEP3 that was released in April 2018. The outcomes of these appraisals have also been reflected in our final WRMP.

Where the investigations have concluded our activities are having a damaging impact, then our WRMP includes the solutions we have agreed with Environment Agency to remove or mitigate these effects. These solutions take the form of:

- 'Local' solutions, such as changes to our compensation flows at surface water sites or environmental improvement measures such as river habitat restoration.
- 'Strategic' new supply-side solutions that will allow us to reduce abstraction from a number of our unsustainable groundwater sources.

Where we need to reduce unsustainable abstraction, we have agreed with the Environment Agency that we will make changes to the associated abstraction licences by end of AMP7 (2025). However, we have also agreed with the Environment Agency that in some cases we may take an 'upfront permitting' approach to these licence changes. This will mean that in some cases the changes will not take effect immediately, allowing us time to complete the required engineering changes to our water supply network and protect our customer's security of supply. In such cases, we will implement local schemes in AMP7 to mitigate for the effects of ongoing abstraction by making improvements in stream habitat. All licence reductions and our required interventions will come into effect and be applied by 2030.

Where our AMP6 low flow investigations had SSSI drivers in the NEP, and our options appraisal indicated a solution was required, these schemes will be fully implemented in AMP7.

RSA timing

When we published our draft WRMP, there was uncertainty regarding the scale and timing of any abstraction changes required from the WINEP process. We sought to manage this uncertainty by using scenario analysis in our draft WRMP. However, the uncertainty made it difficult for us to explain our approach in our draft WRMP and many consultees commented that this part of our draft WRMP was complex and confusing. We also acknowledge that there was a lack of clarity and explanation between figures reported in different parts of our draft WRMP.

The investment modelling scenarios used to determine our approach to RSA in our draft WRMP were completed in April 2017 and were based on our best estimate of the potential scope of RSA reductions that might be required based on our AMP6 investigations to that point. We generated a range of high, medium and low impact scenarios based on the following assumptions:

- A low scenario which equated to a 13Ml/d reduction in site deployable output by 2025.
- A mid scenario which equated to a 40Ml/d reduction site deployable output by 2025.
- A high scenario equated to a 65Ml/d reduction site deployable output by 2025.

For our final WRMP, we have moved away from this scenario analysis and we have instead used WINEP3 as our central planning scenario. Our WRMP deployable output forecasts have been updated to include this information. The final WRMP data tables, Appendix 4, Table A5.2 and the figures used in our WRMP narrative have been changed to reflect this information.

WINEP3 includes the agreed sustainability changes for each individual site. These site level changes have been modelled in aggregate using our Aquator water resources model to derive the WRZ deployable output impact. This value is reported in the data tables accompanying our WRMP. Based on feedback on our draft WRMP, we recognise that we should have made clearer this distinction between individual source changes and zonal deployable output changes. In our final WRMP narrative we have clarified that these site based reductions have been used as input to our central best estimate to assess the combined impact of both RSA and WFD No Deterioration impacts on our deployable output.

To improve clarity in the final plan we have removed the content of the table listed in our draft WRMP as A4.2. Instead we have included the RSA notional solution and any associated abstraction reductions as an additional column in tables A4.1 and A4.3 of our final WRMP.

Table A4.1 to A4.6 below lists those sources where our AMP6 Restoring Sustainable Abstraction investigations concluded that abstraction reductions or other environmental solutions may be required. The sites listed in this table were included in the Environment Agency's April 2018 WINEP3 and carried an 'implementation' driver. A short description of the nature of the solution has been added for clarity.

Table A4.1: WINEP RSA groundwater schemes (measure and status taken from WINEP3 - April 2018) – Forest & Stroud WRZ

WRZ	RSA Investigation Site	Measure	Description of scheme
Forest & Stroud	Cinderford Brook	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration Measures (see p.33 of main WRMP) Sustainability change to prevent risk of future deterioration.

Table A4.2: WINEP RSA groundwater schemes (measure and status taken from WINEP3 - April 2018) – North Staffs WRZ

WRZ	RSA Investigation Site	Measure	Description of scheme
North Staffordshire	Aldford Brook	Sustainability Change	Catchment/River Restoration Measures(see p.33 of main WRMP) Sustainability change to prevent risk of future deterioration

Table A4.3: WINEP RSA groundwater schemes (measure and status taken from WINEP3 - April 2018) – Nottinghamshire WRZ

WRZ	RSA Investigation Site	Measure	Description of scheme
Nottinghamshire	Dover Beck and Oxton Dumble	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration Measures in waterbodies (see p.33 of main WRMP) Combined sustainability reduction of up to 23.5 Ml/d off 15 year recent actual abstraction.
Nottinghamshire	Rainworth Water	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	
Nottinghamshire	Bevercotes Beck	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	
Nottinghamshire	Vicar Water	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	

Table A4.4: WINEP RSA groundwater schemes (measure and status taken from WINEP3 - April 2018) – Shelton WRZ

WRZ	RSA Investigation Site	Measure	Description of scheme
Shelton	Lower Worfe - Stratford Brook, Albrighton Brook & River Worfe	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration Measures(see p.33 of main WRMP) Sustainability reduction of up to 3Ml/d off 15 year recent actual
Shelton	River Strine (multiple waterbodies)	Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration and local flow support measures (see p.33 of main WRMP)
Shelton	Upper Worfe - Burlington Bk	Sustainability Change	Continuation of WRMP 14 Scheme
Shelton	Upper Worfe- Neachley Bk	Sustainability Change	Continuation of WRMP 14 Scheme

Table A4.5: WINEP RSA groundwater schemes (measure and status taken from WINEP3 - April 2018) – Strategic Grid WRZ

WRZ	RSA Investigation Site	Measure	Description of scheme
Strategic Grid	Batchley Brook	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration Measures(see p.33 of main WRMP) Sustainability reduction of up to 1.5Ml/d off 15 year recent actual.
Strategic Grid	Confirmed (Amber)Coventry Coal Measures (River Sowe and Sherbourne)	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration or local flow support measures (see p.33 of main WRMP) Revoking a disused licence Sustainability reduction of up to 4.4 Ml/d off 15 year recent actual
Strategic Grid	Hartlebury Common SSSI	Sustainability Change	Local flow support measure (small associated sustainability reduction of up to 0.5Ml/d off 15 year recent actual abstraction.)
Strategic Grid	Battlefield Brook	Sustainability Change	Continuation of WRMP 14 Scheme

Table A4.6: WINEP RSA surface water schemes (taken from WINEP3 - April 2018)

WRZ	RSA Investigation Site	Measure	Description of scheme
Strategic Grid	Carsington Reservoir (Henmore Brook)*	Sustainability Change & Land Management/ Habitat Restoration/ Physical Improvement	Catchment/River Restoration and small change to local flow support measures (see p.33 of main WRMP)
Strategic Grid	River Dove at Egginton	Sustainability Change	Solution to be agreed with EA following further assessment.
North Staffordshire	Tittesworth Res (R. Churnet)	Sustainability Change	Local flow support measures (see p.33 of main WRMP). Solution to be agreed with EA following further assessment.
Strategic Grid	Stanford Reservoir	Sustainability Change	Continue local flow support measures
Strategic Grid	Quorn Brook (Cropston and Swithland Resrs)	Sustainability Change & Adaptive Management	Local flow support measures (see p.33 of main WRMP). Compensation volume of up to 4Ml/d.
Strategic Grid	River Ashop*	Sustainability Change	Change to local flow support (see p.33 of main WRMP)
Strategic Grid	River Noe*	Sustainability Change	Change to local flow support (see p.33 of main WRMP)

* These sites are listed in WINEP3 with a no deterioration driver. They have been included in table A4.2 of our WRMP as they are AMP6 RSA investigation sites and scheme was agreed though RSA options appraisal.

These site based sustainability changes arising from the RSA schemes outlined in Table A4.1 to A4.6 have been included in the zonal deployable output reductions listed in Table A4.9. The loss of deployable output at a WRZ level is listed in Table A5.2 and includes both RSA and WFD No Deterioration reductions due to the way we have combined these in our central best estimate modelling. The change to our central best estimate between our draft and final plan from completing the RSA options appraisal has not been a material change.

A4.3 Preventing WFD status Deterioration - Groundwater

Our WRMP includes measures that to protect waterbodies against the risk of deterioration occurring from unsustainable abstractions, both under normal conditions and under drought conditions. Similar to the assumptions made around RSA drivers, our draft WRMP assumptions around preventing WFD Deterioration were based on the best available information and reflected what we expected the Environment Agency to include in WINEP3.

We received a number of comments requesting clarification of our explanation of WFD scenarios and how these impacts were mapped to the data tables. We have improved this explanation for our final WRMP including a summary of how our approach to WFD No Deterioration assessments has evolved from our early scenario modelling stages up to our modelling of WINEP3.

In summary, we do not believe that the new information within WINEP3 leads to any overall significant change to our WRMP. The sustainability changes in WINEP3 are defined against recent actual abstractions for all lines where a 'sustainability measure' is identified. Appendix A5.1 of our WRMP clearly states the assumptions we have made to quantify the assumed deployable output (DO) losses. Our assumptions were made around potential DO loss for each source depending on recent actual abstractions and on the WRMP category the groundwater sources falls in (Adaptation, Prevention/Mitigation, Investigation). For example, all sources within in our 'Adaptation' category have sustainability changes defined against recent actual abstractions. This

means we have assumed a loss of 'spare capacity' from the source, assumed to be the difference between the modelled DO and recent actual abstractions.

The modelling scenarios listed in Table A5.1 of our draft WRMP were completed in April 2017 and were based largely on WINEP1. Our approach to assessing WFD Deterioration risks evolved and became clearer as we progressed towards WINEP2. The transition from WINEP1 to WINEP2 involved several significant steps:

- We defined our Adaptation, Prevent/Mitigate and Investigation approach (i.e. our WFD No Deterioration strategy) and categorised our sources accordingly. Section A5.1 in our draft WRMP provides a description of our approach.
- While all our sources were under an 'Investigation' driver in WINEP1, a significant proportion (c. 60%) of our sources were moved to various WFD No Deterioration implementation drivers in WINEP2.
- We incorporated our medium WFD No Deterioration scenario (broadly consistent with the total of the Medium Scenario in Table A5.1 of our draft WRMP) and our RSA DO losses into our central best estimate for our baseline scenario (line 8.2BL+) in the data tables accompanying our WRMP.

The transition from WINEP1 (scenario modelling stage) to WINEP2, did not result in significant changes to deployable output at a company level. When we published our draft WRMP, we felt we had a good understanding of the potential extreme scenarios for WFD No Deterioration scenarios. Consequently, we did not feel that further scenario modelling was needed for WFD No Deterioration at WINEP2 stage. We felt that the size of the problem had been well defined by our central best estimate and this was well within the range of our scenarios extremes for WFD No Deterioration. In our final WRMP we will provide further commentary and clarification on the process we have followed from WINEP 1 to WINEP 3, particularly around the timings of our scenario modelling and how we combined the WFD No Deterioration and RSA impacts into a single line in the WRMP data tables.

In line with our approach to RSA described in Section A4.2, in April 2017 we used three investment modelling scenarios for both surface and ground water sources to determine our approach to WFD in our draft WRMP. These scenarios were:

- A lower scenario:
  That accounted for a 50% loss of deployable output above recent actual abstraction values; losses of deployable output would occur from 2030 onwards.
- A middle scenario:
  That accounted for an 80% loss of deployable output above recent actual abstraction values; similarly to the low scenario, losses of deployable output would occur from 2030 onwards.
- An upper scenario:
  That assumed that our sources are capped at recent actual abstractions from 2020 onwards (recent actual abstractions are calculated using the average of the last 5 or 15 years of abstraction figures, depending on the geological nature of the aquifer for the groundwater sources).

The extent of the deployable output impacts to our WRZs by 2035 arising from WFD No Deterioration alone are shown in Table A4.7. These reflect the early stages of our thinking (early 2017) around our WFD No Deterioration strategy when all of our groundwater sources had an Investigation & Options Appraisal (OA) driver in WINEP1.

Table A4.7 Range of DO losses considered in our scenario modelling for our draft WRMP (WINEP1 impact)

WRZ	Low Scenario DO loss (Ml/d	Medium Scenario DO loss (Ml/d)	High Scenario DO loss (Ml/d)
Nottinghamshire	20	10	20
Shelton	10	23	33
Forest of Stroud	2	3	4
Strategic Grid	11	97	105
North Staffordshire	0	8	11
Bishops Castle	0.69	1.1	1.38
Kinsall	0	0	0
Mardy	0.54	0.86	1.08
Llandinam	0	0	0
Newark	0	0	5
Ruyton	0	0	0
Staffordshire	0	0	0
Wolverhampton	0	2	3
Whitchurch & Wem	1.09	1.75	2.19
TOTAL	**45.3**	**146.7**	**185.7**

Note this is provided as Table reference A5.1 in our draft WRMP

As we progressed towards WINEP2, the Environment Agency provided further guidance around WFD No Deterioration and we were able to better define our strategy around this challenge. The timing of WINEP2 information release meant that we could not incorporate the small changes relating to WFD No Deterioration into our draft WRMP in time for publication. These changes included an abstraction reduction at our intake on the River Wye, which is no longer required as this source was removed from WINEP2. The subsequent release of WINEP3 include the addition of the Caunton source in our Nottinghamshire WRZ, which slightly increased our assessment of DO losses in this zone.

Almost all our groundwater sources had an Investigation & OA driver in WINEP1. Many of our groundwater sources in Shropshire (in our groundwater only WRZs such as Bishops Castle and Whitchurch & Wem) have had an Investigation driver throughout the various WINEP stages and the assumptions have not changed for this. This means that the DO losses provided in the WRMP data tables for those WRZs align with the 'low' modelling scenario shown in Table A4.7 above (Table A5.1 of our draft WRMP). However, the WINEP drivers for most of our remaining sources were changed between WINEP 1 and WINEP2. Consequently, the assumptions underpinning our DMU scenario modelling would have been different to those underpinning the data in our draft WRMP tables.

In our final WRMP, we have included WINEP3 WFD requirements in our best central estimate of future deployable output. The total deployable output impact across all WRZs broadly coincides with our draft WRMP Medium Scenario shown Table A4.7. However, in the modelling for our final WRMP, we combined the WFD No Deterioration losses with RSA sustainability reductions discussed in Section A4.2 and reported the output of this modelling as combined DO losses in our final WRMP data table lines 8.2BL+.

The best central estimate of DO for our final WRMP is based on the following assumptions and deployable output losses:

- A 100% loss of deployable output above recent actual abstraction for all sources in the Adaptation category, associated with licence changes set to recent actual abstractions.
- An average 50% loss of deployable output above recent actual abstraction for all sources in the Prevent/Mitigate category to account for the lack of detailed feasibility around possible measures.

- An average 50% loss of deployable output above recent actual abstraction for all sources in the Investigation category to reflect the uncertainty around the outcome of the investigations (i.e. one in two sources would not cause environmental deterioration based on predicted growth figures).
- In our calculations, we have considered the 15 year (2001-2015) recent actual abstraction for our Permo-Triassic sandstone sources and 6 year recent actual abstraction for all other sources. The above WRMP assumptions are aligned with WINEP 3 drivers and measures.

A4.4 Preventing WFD status deterioration – Surface Water

During the consultation phase of our draft WRMP, the Environment Agency requested clarification regarding our WFD deterioration risk assessment of surface water abstraction licences, particularly those with a hands off flow (HOF) condition. In our draft WRMP, for our surface water abstractions with potential to cause WFD deterioration, we chose to analyse the effect of licence reductions for category 1 and 2 sources using a similar methodology as we used with groundwater reductions. We used this approach because we had not at that point received guidance from the EA on the preferred methodology to use with surface water abstractions. Due to the timing, our modelling was also conducted prior to WINEP3 and before the AMP6 RSA investigations and options appraisal conclusions were finalised.

The methodology we used assessed the recent actual annual average abstraction and compared this with the modelled source deployable output. In line with the ground water methodology we looked at three different potential scenarios for our sensitivity modelling for the draft WRMP. These were the Low, Medium and High impact set of scenarios.

For our draft WRMP we used the medium scenario from this earlier sensitivity modelling as our central estimate of the surface water abstraction reductions required to ensure no future WFD status deterioration. These were built into a combined model run with groundwater WFD no deterioration reductions and our assessment of the likely RSA licence reductions. These reduced abstraction licences were entered into our Aquator water resources model as annual constraints on the amount of water available to abstract. Specifically for our Egginton abstraction site on the River Dove, we modelled the potential effect of the WFD no deterioration licence reduction rather than the RSA removal of the lower HOF. We considered that modelling both changes at the same time would have been double counting of the risk and effect.

During the Medium scenario for our draft WRMP we assumed that for WINEP1 category 1 and 2 surface water abstractions (Egginton, Ambergate & Mitcheldean) there would be no abstraction licence changes implemented before 2030. This is because the impact on zonal deployable output was so significant it would require strategic scale water supply investment to offset the effects on drought security of supply.

Our WFD No Deterioration approach for surface water abstraction was changed for our final WRMP. In January 2018 we received updated guidance from the Environment Agency regarding WFD No Deterioration in the EA publication *'Guidance on water resources investigations into the risk of WFD water body deterioration'*. This guidance for the first time explicitly included information for analysing surface water abstractions in relation to compliance with the Environmental Flow Indicator (EFI). Consequently, it was clear that our draft WRMP methodology for modelling surface water reductions was unsuitable for certain sources e.g. Egginton, as it did not fully consider the EFI. Following the new guidance issued, in February 2018 we updated our process for assessing WFD no deterioration at surface water sites.

For our final WRMP we have categorised our surface water abstractions into five classifications:

1. **River abstraction with HOF > EFI**
   Where an abstraction is on a river, if the river has a HOF for that abstraction which is above (or the same as) the EFI then the HOF will stop our abstraction causing deterioration. Therefore these abstraction licences do not need to be changed.
2. **Regulated river abstractions**
   Where our abstractions are on a regulated river such as the River Severn, we believe the regulation on the river will stop the abstractions causing deterioration. Therefore these abstraction licences do no need to be changed.
3. **Abstraction from source subject to RSA/HD assessment**
   Where an abstraction is on a river/ reservoir which has recently had an RSA or Habitats Directive (HD) assessment, if this assessment has considered the full impact of the licences, the abstractions will not cause a risk of deterioration. Therefore these abstraction licences do no need to be reduced.
4. **Reservoir abstraction with compensation > EFI or reviewed by an RSA assessment**
   Where an abstraction is on a reservoir with a compensation, if the compensation is either above the EFI or has been recently reviewed and actions put in place through an RSA assessment this will stop the abstraction causing deterioration. Therefore these abstraction licences do no need to be changed.
5. **Other**
   If none of the above are true, then the source/abstraction needs to be assessed to see whether there is likely to be a higher abstraction in the future.

The most material impact of our revised approach is seen at our Egginton abstraction on the River Dove. As stated previously, we concluded that the method of modelling reduced annual licence used in our draft WRMP was unsuitable and specifically for Egginton and that this should be modelled as a removal of the lower HOF condition, stopping any abstraction below the upper HOF.

Since our draft WRMP was published, we have carried out a number of modelling assessment with and without the lower Egginton HOF removed. We have additionally tested the effect of adding temporary use ban (TUB) and non-essential use ban (NEUB) curves to the Dove reservoirs (triggering a level of service demand reduction earlier) with the lower HOF removed.

The removal of the lower HOF causes very large reductions in deployable output across all scenarios, with zonal reductions between 61 – 98 Ml/d. The use of the lower HOF is triggered by the joint reservoir storage in the two River Dove reservoirs dropping below a prescribed storage levels curve. Abstraction between the upper and lower HOFs only occurs in seven years in the 95 year baseline model run. Out of these, three years have abstractions for longer than 20 days. In total out of the 34,700 day model run, there is abstraction below the upper HOF for 283 days, with the longest abstraction in a single drought year being 91 days.

Overall, our final WRMP incorporates our updated WFD No Deterioration methodology for surface water sources and is consistent with the Environment Agency guidance released in 2018. Our new methodology ensures surface water sources with HOFs that may be insufficient to achieve the EFI are appropriately prioritised according to potential growth in abstraction. Our final WRMP includes for the effect of removing the lower HOF at Egginton by 2030.

A4.5 Managing the risks around WFD Deterioration

Our approach to managing WFD deterioration risk has always been to target environmental investigations where the uncertainties are greatest. This is what led us to categorise our sources into Adaptation, Prevent/Mitigate and Investigation. In January 2018, the Environment Agency issued its guidance '*Guidance on water resources investigations into the risk of WFD water body deterioration*'. This guidance sets out clear principles upon which water companies, including us, should prioritise no deterioration investigations. Focus should be given and prioritised to high risk waterbodies and we are developing a technical framework based on this guidance. We are using this framework to prioritise investigations and we have shared the framework and the resulting prioritisation with the Environment Agency.

During consultation of our draft WRMP, we received some stakeholder comments expressing concern about the potential use of alternative flow targets to the EFI when assessing our WFD Deterioration risk. As indicated in our draft WRMP, we were still developing our strategy around WFD No Deterioration when our draft WRMP was published. As part of the initial work, we wanted to better understand the range of potential sustainability changes that could arise from WFD No Deterioration. In July 2017, we proposed a range of possible sustainability changes to the Environment Agency for WINEP2, under '*Sustainability Change (to Daily Licence Volume) Ml/d'*. This ranged from precautionary '*capping licences to recent actual abstractions'* to less precautionary, more risk based approach, based on historical datasets and predictive tools. The less precautionary approach was based around what we felt was a sustainable abstraction relying on data and evidence collated to date.

The Environment Agency released version 3 of WINEP (WINEP3) in April 2018. Our final WRMP is now aligned with WINEP3 and the sustainability changes are defined against recent actual abstractions for all sources where a 'sustainability measure' is identified, rather than our sustainable abstraction figures.

At the time of publishing our draft WRMP, we were also in discussion with the Environment Agency around the use of our hydro-ecological model as a tool to inform the risk of deterioration. Since our draft WRMP was published, we have also initiated a collaborative project with the Environment Agency to further develop our hydro-ecology model and understand when it can be used as a supporting tool for assessing WFD No Deterioration in the Permo-Triassic Sandstone. When this work is complete, we feel it will better inform how we assess the risk of deterioration from our groundwater sources.

In July 2018, we shared with the Environment Agency our draft '*No Deterioration Technical Framework*' that we propose to follow in AMP7. In the document, we confirmed that our WFD No Deterioration investigations have been prioritised based on the EFI.

We recognise that we are required to determine whether our existing abstractions are meeting River Basin Management Plan (RBMP) sustainability objectives. Where there is a risk of not meeting these we need to identify the required changes to our abstractions in order to meet those objectives. For WFD No Deterioration purposes, the sustainability changes presented in WINEP3 are calculated against the recent actual abstractions for the sources affected. We are carrying out an ongoing collaborative project with the Environment Agency to improve our predictive tools. We will use the results from this project to inform our approach to future abstractions from sources under investigation, subject to agreement with the Environment Agency.

We received stakeholder comments expressing concerns specifically around the resilience of the Permo-Triassic Sandstone aquifer in the Nottinghamshire area. As reflected in our WRMP, we are committed to reducing unsustainable abstraction from current groundwater sources in the Nottinghamshire WRZ. We have an ongoing programme to understand how our groundwater assets are impacted during various different climate change scenarios as described in our WRMP and we provide further commentary in Appendix B2 of this document.

In our WRMP we committed to reducing our impacts from current groundwater abstractions under RSA by 23 Ml/d in the Nottinghamshire WRZ. We also committed under WFD No Deterioration, to not take up spare licence capacity by up to 88 Ml/d at our groundwater sources abstracting from the Sherwood sandstone aquifer. Through our WRMP, we have also committed to ambitious demand management and leakage reductions in the Nottinghamshire WRZ. These measures alone will improve the long term resilience of the aquifer.

However, we acknowledge that more work will be required to support a more holistic understanding of the aquifer resilience. To this end, we are committed to working with other stakeholders in the Nottinghamshire area as we want to improve our understanding of such a complex problem like groundwater resilience. We believe that further assessments will be required and that these should be carried forward in collaboration with existing stakeholder groups like the CaBA groups. The recent announcement by the Environment Agency to focus on the Idle and Torne priority catchment for the Abstraction Plans will represent a good opportunity to:

- Improve our understanding of aquifer resilience.
- Provide a platform to launch initiatives and studies around complex catchment issues, such as current land use and catchment pressures.
- Provide an understanding of how land use and catchment specifics might change in the future and how these would change under different climate change scenarios.

The outcome of such collaborative initiatives will provide a common understanding around the medium to long term water quality and water quantity issues in the zone. We will use these outcomes to guide our future WRMP and business plans.

A4.6 WFD No Deterioration and drought

We have followed industry best practice for drought planning purposes and our approach is summarised in our Drought Management Plan (DMP). The programme for preparing DMPs is slightly different to the WRMP process. Our current DMP for period 2014-2019 is available on our website. We have recently published our draft DMP for period 2019-2024 for consultation on our website and the final version of the DMP 2019-2024 is expected to be published in 2019. Referring to our draft DMP 2019-2024, we have measures in place to prevent or mitigate for the environmental impacts of drought actions. Most raw water sources included in our DMP have a WFD assessment which appraises the risk of deterioration occurring from abstractions during drought conditions. For our groundwater sources, particularly those drawing from the Permo-Triassic aquifer, the inter-annual fluctuations arising from a drought is likely to be buffered by the storage of the aquifer.

We accept that if the emergency sources listed in our DMP were to be used during a drought event, the effects of the abstraction would be compounded to those already in place under normal, average conditions within the waterbody. This may potentially lead to unsustainable abstractions in these waterbodies. We would mitigate for any long term effects of any short term abstraction changes.

While the emergency sources listed on our DMP are not specifically listed on our WINEP programme, some groundwater sources are located on waterbodies that are listed on WINEP. Any compounding effects arising from the additional abstraction from the emergency sources would be considered through our WFD No Deterioration work. As an additional consideration, we have a responsibility to ensure that deterioration of waterbodies is prevented from abstraction at all our surface water and groundwater sites regardless of whether there is an entry listed in the WINEP programme.

Our DMP states that for emergency sources, we will consider the need for assessments against waterbody deterioration if there was a likelihood that these sources would be required during a drought event. This is justified due to the long lead in time before we may need to use these sources (refer to our draft DPM 2019-2024, Table 12, available on our website). However, we will further consider within our technical WFD No Deterioration framework whether the sources most likely to be required during a drought should be investigated as part of our wider AMP7/8 WFD No Deterioration programme. We will continuously liaise with the Environment Agency regarding the need to undertake further work at our surface water and groundwater sources, regardless of whether they are listed in the WINEP programme.

A4.7 Modelling the effects of WINEP3 on deployable output

As already described, the timing misalignment between our draft WRMP and the Environment Agency's release of WINEP information meant that we based our draft WRMP on the best available understanding of what was likely to be included in the final WINEP programme. During development of our draft WRMP, we worked with the Environment Agency to ensure the RSA schemes likely to be included in WINEP were incorporated into our best central estimate for our draft WRMP. We also included our best assessment of the likely impacts of abstraction licence changes needed to prevent future WFD status deterioration.

Since we published our draft WRMP, we have confirmed with EA the conclusions of our AMP6 RSA investigations and we have updated our assessment of WFD deterioration risks. The licence changes associated with these updates were included in the Environment Agency's WINEP3 release and are now included in our final WRMP.

These updates mean some changes to the assumptions used in the draft WRMP. For example:

- The conclusions of our RSA investigation and options appraisal into the impact of our sources on Cinderford Brook and Aldford Brook indicated that we should focus on in-river and habitat improvement measures to help improve the status of these Brooks rather than make long term reductions in abstraction. We should also reduce the abstraction licences to limit future abstraction growth and prevent future deterioration of WFD status.

- Potential schemes for the River Maun, Rudyard Reservoir and River Blythe pumped intake were removed from WINEP between version 2 and 3 based on the outcome of our impact assessment. However, only one of the schemes (Rudyard Reservoir) was included as a potential sustainability reduction in our draft WRMP central best estimate. The Options Appraisal process concluded that this was not required and was not included in WINEP3. The outcome of the removal of the Rudyard Reservoir scheme has slightly reduced our estimated deployable output loss in North Staffordshire Water Resource Zone.

- Our draft plan assumed an abstraction change related to WFD No Deterioration at our intake on the River Wye, however this is no longer required as this source was removed from WINEP.

- Other WFD changes between WINEP2 and WINEP3 include the addition of our Caunton source in our Nottinghamshire WRZ, which slightly increases our final WRMP assessment of DO losses in this zone.

Overall, these changes have resulted in some small changes to the modelled impacts on zonal deployable output. However, the sustainability reductions listed in WINEP3 are within the bounds of the scenarios we used to develop our draft WRMP and they align closely with the medium scenario we used for our best central estimate in our draft WRMP.

Tables A4.8 and A4.9 provide a comparison of the WINEP related deployable output changes between draft and final WRMP. Table A4.8 shows the total loss of the individual groundwater licence changes that were used as an input to the Aquator zonal deployable output modelling for draft and final WRMPs. The tables summarise both the water resource modelling inputs and outputs respectively for both RSA and WFD No Deterioration combined.

Table A4.8 Comparison between our draft WRMP model inputs and our final WRMP input (for groundwater sources only)

	Model inputs for our draft WRMP (Ml/d)			Model inputs for our final WRMP (Ml/d)		
WRZ	**2025**	**2030**	**2035**	**2025**	**2030**	**2035**
Bishops Castle	0	0.7	0	0	0	0.5
Forest and Stroud	0	3.5	0	0	2.8	0
Kinsall	0	0.5	0	0	0.5	0
Llandinam and Llanwrin	0	0	0	0	0	0
Mardy	0	0.5	0	0	0.5	0
Newark	0	1.6	0	0	1.8	0
North Staffordshire	0	25.9	4.4	17.8	8.1	2.5
Nottinghamshire	0	84.8	0	0	88.5	0
Rutland	0	0	0	0	0	0
Ruyton	0	0	0	0	0	0
Shelton	0	18.6	0	7.6	12.5	0.2
Staffordshire	0	0.7	0	0	1.2	0
Strategic Grid	0	23.3	4.6	2.0	14.4	5.4
Whitchurch and Wem	0	1.1	0	0	1.1	0
Wolverhampton	0	3.9	0	0.5	2.6	0
Company	**0**	**165.1**	**9**	**27.9**	**134**	**8.6**

Table A4.9 Comparison between our draft WRMP modelled output and our final WRMP outputs (all sources).

	Model inputs for our draft WRMP (Ml/d)			Model inputs for our final WRMP (Ml/d)		
WRZ	**2025**	**2030**	**2035**	**2025**	**2030**	**2035**
Bishops Castle	0.0	0.5	0.5	0	0	0.5
Forest and Stroud	0.0	6.0	6.0	0	0	0
Kinsall	0.0	0.5	0.5	0	0.5	0.5
Llandinam and Llanwrin	0.0	0.0	0.0	0	0	0
Mardy	0.0	0.5	0.5	0	0.5	0.5
Newark	0.0	0.0	0.0	0	0	0
North Staffordshire	36.0	36.0	36.0	36	36	36
Nottinghamshire	0.0	30.0	30.0	1	38	43
Rutland	0.0	0.0	0.0	0	0	0
Ruyton	0.0	0.0	0.0	0	0	0
Shelton	2.0	14.0	14.0	2	11	11
Staffordshire	0.0	0.0	0.0	0	0	0
Strategic Grid	35.0	85.0	95.0	5	90	95
Whitchurch and Wem	0.0	1.1	1.1	0	1.1	1.1
Wolverhampton	0.0	0.0	0.0	0	0	0
Company	**73.0**	**173.6**	**183.6**	**44**	**177.1**	**187.6**

Both water resource modelling input and output figures show how the impacts of source output reductions in one water resource zone (e.g. Nottinghamshire) are shared across to other linked zones (e.g. Strategic Grid) by the model. The modelled water resource output columns in Table A4.9 can be directly mapped to the data in WRMP table 8.2BL.

Table A4.8 demonstrates that at the time of preparing our draft WRMP, the total combined RSA and No Deterioration licence reductions that informed our central best estimate amounted to 174.1 Ml/d (combined total of all losses from all our WRZs). In our final WRMP, the total combined RSA and No Deterioration losses combined across all of our WRZs is 170.5 Ml/d.

Table A4.9 indicates that our modelled DO losses for 2030 and 2035 are comparable for both our draft and final WRMP. The difference between our draft and final WRMP for year 2025 is explained with the different timings of sustainability reductions to surface water abstractions. We do not consider the small changes to be a material change and so the release of WINEP3 is not a major driver for changes to our programme. Further explanation of the details surrounding the timings and scale of changes to our preferred programme of options between our draft and final WRMP is provided in Appendix A6.

A4.8 Environmental measures

In our draft WRMP we explained how we intend to use environmental measures and river restoration techniques to help improve habitats and ecological resilience to low flows. All responses relating to our environmental measures were supportive of our approach, however a number of comments reflected a need for us to provide more information on:

- The scale of our ambition and our decision making around when and where to mitigate.
- Detail on where we will be implementing these measures.
- Our approach to working with CaBAs, other organisations and landholders.

When we published our draft WRMP we had not completed our RSA programme options appraisal process, so we could not list the waterbodies where we would implement catchment or river restoration measures. Now that our investigations and options appraisal conclusions have been finalised with the EA, we have updated our WRMP to ensure it is clearer in terms of our intent. In our revised plan we have:

- Included a map of waterbodies were we plan to include catchment and river restoration as part of an RSA scheme.
- Clarified in what circumstances we would use local measures as mitigation for WFD deterioration.
- Provided more detail around ambition to work with CaBA and other stakeholders.
- Widened the scope of our thinking on what types of measures we could consider within the programme.

However, as it is our ambition to consult with landholders and stakeholders, including the relevant Catchment Based Approach (CaBA) groups (as well as other partners, landowners and other stakeholders) in the development, planning and delivery of these measures then we have avoided being too prescriptive in our WRMP before we have undertaken the consultation process in each of the waterbodies. Similarly we are widened the scope of our thinking on what types of measures we could consider within the programme to include, where supported by our catchment partners and evidence, other types of wider catchment environmental improvements if they will improve instream flow or water quality such as creation or restoration of wetland habitats or woodland/other plantings. For these reasons, we have not listed any specific projects or measures in the WRMP, although where we have received suggestions we will consider them as part of our local consultation process.

We acknowledge and agree comments received from WWT and Worcestershire Wildlife Trust that as part of the planning for AMP7 delivery for our programme of our Catchment/ River restoration measures it will be important to develop a framework to guide our investment and decision making. We are developing our framework and principles to help guide the level and scope of our activities. We plan to involve the local CaBA groups and other organisations working on environmental projects in the planning and delivery of the works. We would be happy to share our principles and will seek input into our decision making process where appropriate, however it is important to note and respect commercial sensitivities.

In most of the waterbodies where we plan to undertake river restoration measures we have already completed an extensive investigation to assess the scale of ours and others' impacts. To ensure the scale of our solutions match the impact we undertook an options appraisal process, assessing a range of different options in terms of cost and benefit. The Environment Agency has input into our investigations and the options appraisal and subsequently agreed the outline schemes we propose to undertake, ensuring we are undertaking a type of solution that is commensurate with our impact.

To get the best environmental outcome and value for our customers, we will need a flexible approach to ensure we take account of existing local plans and strategies. This will allow us to select the most appropriate measures for the pressures impacting the waterbody in conjunction with the CaBA groups and other organisations working already working in the area. In some cases this may mean undertaking more intensive works over a smaller reach. We will also need to listen to the concerns and ideas of stakeholders and landowners, which may affect the length of river available of us to work on.

We will build on the learning from our AMP6 scheme to improve the Battlefield Brook. The Sanders Park scheme was chosen as it has been identified in environmental plans for the area, so we could build on planning work that been done locally. The scheme also provided multiple benefits other than WFD improvement as it is on land our customers can access for recreation and has the potential for biodiversity improvements by extending the habitat available for the population of water voles in the stream. Our AMP6 river restoration scheme also complements the work we are undertaking to improving flows in the stream in AMP7 as part of our wider reconfiguration of our water resource in the area.

We are developing a detailed framework for our catchment and river restoration programme separately to our WRMP, and so stakeholders' comments will assist us in this process.

Following the consultation of our draft WRMP, we will be making the following addition to the narrative of our final WRMP:

> *Our plan includes short and long term measures to remove or offset the environmental impacts of abstractions, and to help the associated water bodies achieve Water Framework Directive objectives. In the short term we propose localised environmental protection measures that will allow us to continue to abstract from some sources until we can put longer term solutions in place to reduce or stop abstraction.*
>
> *In water bodies where local environmental protection measures could work as mitigation for abstraction impacts, our aim is to engage with local stakeholders and landowners and build on the networks that already exist, such as CaBA partnerships. We will also work with these networks throughout the planning and delivery these measures. The localised environmental measures that we propose include:*
>
> *<u>Local flow support measures</u>*
> *These types of options involve providing additional water to localised river reaches in times of low flow. This can be achieved in river reaches below reservoirs by releasing water into the river to ensure flow does not get too low and by providing some variation in the amount released through the year. In rivers that are not downstream of a reservoir water can be added from another source, such as groundwater if available.*
>
> *<u>Catchment and river restoration improvements</u>*
> *Many streams suffer from a range of problems that exacerbate the impacts of low flow, such as modification of the channel, lack of instream habitat, pollution, sedimentation and barriers to the movement of fish. Reducing abstraction without also addressing other issues in the waterbody will only provide limited benefit, whereas improvements in stream habitat it will improve the stream in the short term and also enhance the environmental benefit of the longer term reduction in abstraction.*
>
> *Our aim to plan and develop a package of improvement measures in each of the waterbodies in collaboration with the relevant CaBA group, landowners and other organisations working in the area.*

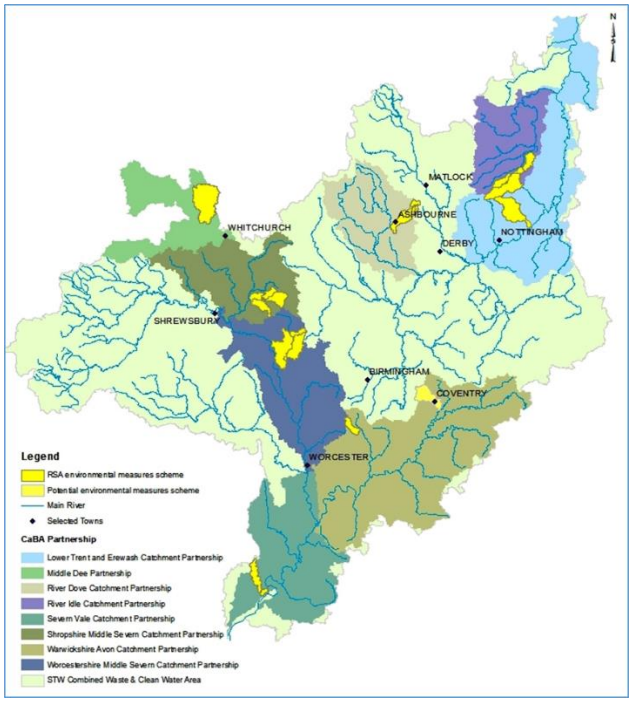
Our aim is to ensure we build on programmes that are already being planned or are underway to avoid duplication and enhance environmental outcomes. We will also look for opportunities to achieve multiple benefits such as biodiversity and public amenity where possible.

The main types of environmental improvements that could be made to waterbodies include realignment and changes to make the shape more natural, instream measures to improve the diversity of habitat types, riparian management such as fencing and buffer strips to reduce nutrients and sediments entering rivers, fish passes and removal of instream barriers. Where supported by our catchment partners and evidence we will also consider other types of wider catchment environmental improvements if they will improve instream flow or water quality such as creation or restoration of wetland habitats or woodland/other plantings.

During AMP6 we investigated a number of waterbodies as part of our Restoring Sustainable Abstraction investigations. The learning from these investigations has informed the development of a notional solution for these waterbodies where required, many of which include local measures. Figure A4.1 [Figure 9 in our final WRMP] shows the waterbodies where river restoration improvements will form part of our AMP7 solution. Improvements to existing localised flow support measures are also planned for some of our surface water sources which are not shown in Figure 9. Appendix 4 provides a summary of all RSA schemes

We also plan to undertake local environmental measures in additional waterbodies in AMP7 to prevent future deterioration as part of a package of measures to mitigate for the effects of our ongoing operation, however we would plan these schemes as required in AMP7. We aim to operate in a way that prevents the need for mitigation in the first instance. In cases where is this is not possible until we put longer term solutions in place to reduce or stop abstraction we will implement mitigation measures.

Figure: Waterbodies where catchment or river restoration measures will be implemented in AMP7 as part of an RSA solution. CaBA partnerships are also shown on this map.



A4.9 Abstraction Incentive Mechanism

Several respondents wanted to know more about our intentions to use Ofwat's Abstraction Incentive Mechanism (AIM) as one of the tools that can help us reduce unsustainable abstraction.

We have not previously adopted AIM because the sandstone nature which dominates our aquifers means there is a long-term response time between changes in groundwater abstraction and experiencing realised impacts on surface water flow. However, for our PR19 business plan we are committing to utilise AIM. We have used Ofwat's AIM methodology to devise a version that is suitable and applicable for our region and still follows many of the guiding principles so that we commit to reduce abstraction at selected environmentally sensitive sites. The methodology that we have proposed to Ofwat has been discussed and approved with our Customer Challenge Group.

The approach we are using for our PR19 business plan utilises the results of WINEP3 to select our AIM sites, as per the Ofwat AIM guidelines. Following our WINEP prioritisation work, we identified a total of 33 sites that were potential AIM sites. These were then reduced to 17 sites once we removed sites that where abstraction could not be reduced due to their supply criticality. Further sites were removed by assessing each site using Ofwat's criteria. Any sites where the abstraction licence was a compensation licence were removed as this abstraction already takes place for environmental benefit. Any source where AMP6 interventions were already taking place to change the abstraction licence to a compensation source were also removed.

Our operational teams were consulted to understand any supply issues in relation to water quality that may affect site selection. This resulted in removing any sites with interdependency to other site, for example where blending water from more than one source is required to enable us to meet water quality requirements. Ultimately, we screened our initial 33 sites to a total of four sites that are suitable for AIM, however only two of these sites have suitable observation boreholes close to their sites that could be used to set trigger thresholds based on groundwater levels. These two sites are:

- Highgate borehole
- Dunhampton borehole

Managing abstraction at these two sites have been included in our PR19 business plan as AMP7 performance commitments.

The AIM threshold will be based on groundwater level trigger points instead of surface water flow trigger levels. We will monitor the water level within an identified observation borehole that is close to the AIM site and within the same groundwater management unit from which the source abstracts. Once the groundwater level in the observation borehole falls to below the trigger threshold, we will reduce our abstraction in line with the baseline average daily abstraction value for the site. The AIM calculation will work exactly the same as if the trigger level was a surface water flow.

We have adopted the full Ofwat definition of the Abstraction Incentive Mechanism (AIM) as per the guidelines released by Ofwat in February 2016. Our monitoring metric will be the difference in abstracted volume (measured in Megalitres, Ml) between the set baseline daily average abstraction value and the actual abstraction at our identified AIM sites during periods when the AIM threshold has been crossed. A negative number will signify our average abstraction is less than the baseline and hence an improved performance.

A4.10 Representing WINEP3 in final WRMP tables

In our draft WRMP we used Table 7 (final plan) of the Water Resource Planning tables to demonstrate how we proposed to implement sustainability reductions. Table 2 (baseline) showed the baseline sustainability reductions, as outlined in WINEP2, with licence reduction implementation dates commencing in AMP7. We added a new row to Table 7 to show how in the final plan scenario we would use 'up front permitting' to delay the impact of these sustainability reductions until AMP8. This formula change in Table 7 was only made in our Strategic Grid WRZ.

In response to the consultation feedback we received from the Environment Agency, in our final planning tables we have removed this change to the calculation in Table 7 and have shown the reductions we are planning, based on WINEP3, in Table 2 row 8.2BL for all WRZs. This ensures consistency with other water companies. For WINEP3 we have specifically modelled the removal of the Egginton lower HOF from 2030, as this causes a very large drop in deployable output which we would not be able to be accommodated by 2025.

Table 4.10 shows the updated planning table lines for WRMP Table 2 line 8.2BL for each WRZ. These are the updates for the final WRMP for WINEP 3 for each zone. The numbers also now align to table 5.2 in our final WRMP narrative.

Table 4.10 Updated planning table lines for WRMP Table 2 line 8.2BL for each WRZ

WRZ	Row Ref	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Bishops Castle	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest and Stroud	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kinsall	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Llandinam and Llanwrin	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mardy	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Newark	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
North Staffordshire	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-36.00	-36.00	-36.00	-36.00	-36.00
Nottinghamshire	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	-1.00	-1.00	-1.00	-1.00
Rutland	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ruyton	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shelton	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.00	-2.00	-2.00	-2.00	-2.00
Staffordshire	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Strategic Grid	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5.00	-5.00	-5.00	-5.00	-5.00
Whitchurch and Wem	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wolverhampton	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WRZ	Row Ref	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43	2043-44	2044-45
Bishops Castle	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46	-0.46
Forest and Stroud	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kinsall	8.2BL+	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51
Llandinam and Llanwrin	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mardy	8.2BL+	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54
Newark	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
North Staffordshire	8.2BL+	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00	-36.00
Nottinghamshire	8.2BL+	-38.00	-38.00	-38.00	-38.00	-38.00	-43.00	-43.00	-43.00	-43.00	-43.00	-43.00	-43.00	-43.00	-43.00	-43.00
Rutland	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ruyton	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shelton	8.2BL+	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00	-11.00
Staffordshire	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Strategic Grid	8.2BL+	-90.00	-90.00	-90.00	-90.00	-90.00	-95.00	-95.00	-95.00	-95.00	-95.00	-95.00	-95.00	-95.00	-95.00	-95.00
Whitchurch and Wem	8.2BL+	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09	-1.09
Wolverhampton	8.2BL+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

A4.11 Site specific comments

We received stakeholder queries on some of the specific sites included in our sustainable abstraction programme, namely impacts to the Aldford Brook and Tittesworth reservoir. We address these in turn in the following sections.

Aldford Brook

During the development of the Peckforton Group borehole option (GRD18) we acknowledged the link to the Restoring Sustainable Abstraction (RSA) Options Appraisal process for the Aldford Brook that was progressing in parallel. At the time our draft WRMP was published we had not yet completed our Restoring Sustainable Abstraction (RSA) Options Appraisal process with the Environment Agency.

The notional solution for Aldford Brook we have now agreed through the WINEP3 process is a reduction in our abstraction licence for sources in the area and environmental measures such as river restoration in Aldford Brook. The RSA solution will be implemented in AMP7. We will agree the detail of our environmental measures package in conjunction with the local CaBA group and local stakeholders, including the Sandstone Ridge Trust.

For the purpose of the WRMP option, it is envisaged the reduction to the group abstraction licence will be accommodated in the form of a longer term (5 year) rolling average abstraction licence. This enables us to meet short term high demands in our water supply system whilst also being able to reduce the long term average abstractions to the benefit of the Aldford Brook. The WRMP proposal GRD18 will improve the site and treatment infrastructure of the Peckforton group that will give us an increase in yield without causing detriment to the Aldford Brook.

Additionally, by carrying out WRMP option GRD18, there are significant gains within the North Staffordshire WRZ in excess of the volume of water produced by the sites improved by the option. This is due to the WINEP implications on the Peckforton control group which effectively divides the overall North Staffordshire WRZ and causes a reduction to the achievable deployable output in the WRZ. By carrying out option GRD18, the integrity of the North Staffordshire WRZ can be maintained following WINEP implementation thereby creating wider benefits in terms of deployable outputs from our sites.

Tittesworth reservoir

Our supply-side option UNK07 enables Site L water treatment works to continue treating water when the abstraction rate is reduced to less than 16Ml/d. The proposal would mean that the minimum throughput of the site to allow it to remain operation will be in the region of 8Ml/d. This provides a deployable output benefit by enabling Site L WTW to operate at a reduced output capacity further into dry seasons than is currently possible.

We have been investigating changes to the compensation flows from Tittesworth reservoir as part of our ongoing RSA studies. This has considered both decreases and occasional increases to the flow-rate of the compensation flow alongside the potential merits of each arrangement. However it is recognised there is a need to consider the impact of any change to compensation on the Mid/lower Churnet. We are continuing to work with the Environment Agency to discuss the outputs of these considerations and agree the study outcomes.

A5 Water trading

Our central location in the midlands of England means that we have interfaces with most other water companies and have therefore been active participants in all associated regional groups; Water Resources East (WRE), Water Resources South East (WRSE), Water Resources North (WRN) and most recently West Country Water Resources. We have initiated two multi-sector working groups on the primary river transfer routes that pass through our region; the River Severn Working Group and the River Trent Working Group. The purpose of these groups is to understand the potential in-combination impacts of transfer and new abstractors on the rivers. Environmental regulators (Natural Resources Wales, the Environment Agency and Natural England) are members as well as abstractors.

In addition to participating in these collaborative groups, we set up and led a multi-sector catchment based approach in the Idle and Torne rivers catchment in Nottinghamshire (one of our most water stressed areas). This group has successfully identified new local water trades, resource development opportunities and enhancements to our Severn Trent Environmental Protection Scheme (STEPS) catchment management programme to incentivise water efficiency. We are pursuing co-development of water resource schemes with the local agricultural community. We believe that these local approach to water resource planning are highly beneficial and we intend to adopt this approach in AMP7 on a targeted basis. Further discussion regarding our STEPS scheme and other catchment management activities is provided in Appendix B1.

The Idle and Torne rivers catchment has now been selected as an Initial Priority Catchments (IPCs) within Defra's Abstraction Plan. We are in discussions with the Environment Agency on how to build on our work to further develop innovative solutions to abstraction issues.

We have also met all neighbouring water companies and companies from other sectors multiple times to identify potential inward and outward transfer options. We have proposed major trades to companies in the south and east of England. This included joint development work with United Utilities and Thames Water on the River Severn to River Thames transfer and major transfers to Anglian Water.

We will continue to provide leadership in this area in AMP7.

Our draft WRMP included several potential options to increase trading of water between us and neighbouring companies. These options were shared between companies for consideration in their draft WRMP thinking. Now that all companies' draft WRMPs have been published, it has become clear that there are water trading options included in other Plans that did not align with our draft WRMP. For example, Anglian Water included a new scheme that would require additional treated water and South Staffordshire Water included a new pipeline transfer from our supply network to theirs. Thames Water's draft WRMP stated that the potential River Severn to River Thames transfer scheme was not needed.

The preferred programme of options in our draft WRMP included an option to increase the output from our water treatment works at the Derwent Valley reservoirs and reduce the current raw water export arrangements to Yorkshire Water. Our draft WRMP also highlighted our ongoing discussions with Thames Water and United Utilities regarding the potential future development of the River Severn to support Thames Water's long term plans.

We have resolved these disparities in water trading options during the Statement of Response process and this has resulted in some changes to our preferred programme of options as described in Appendix A6. Our discussion with third parties regarding water trading are ongoing and the final plan will include an updated narrative to make this position clearer. At this time, we are not expecting there to be any material change

between our draft and final WRMPs. However, if material change were to occur then we will carry out the necessary and stakeholder and customer engagement as appropriate.

A5.1 Updates on water transfer options

Appendix D of our draft WRMP describes the full list of potential water trading options that were considered alongside potential new water resource, treatment and distribution options in our investment modelling. Our draft WRMP included an option that would make more use of our Derwent Valley Reservoir sources and would require a variation the existing export agreement with Yorkshire Water. For our final WRMP we have updated our assessment of potential options and have aligned our assumptions with neighbouring water companies. Associated with the transfer of raw water between catchments is the risk of Invasive Non Native Species (INNS) transfer. We have considered and complied with all relevant environmental legislation including that relating to INNS in our assessments of water transfers.

Following publication of our WRMP we have continued to meet all neighbouring water companies to discuss the water transfer options named in our WRMP and seek new opportunities. The outcome of these discussions is to fully align our WRMPs. We are disappointed that none of these discussions has resulted in an active trade in AMP7. However, we remain committed to the concept of water trading and will continue to work hard to develop viable water transfers. Further commentary on our discussion with neighbouring water companies is provided in the following sections.

South Staffordshire Water

Since we published our draft WRMP, we have met with South Staffordshire Water and clarified that the proposed transfer shown in their draft WRMP is for resilience and planned maintenance use only. This scheme will therefore no longer be reflected in the WRMP tables for either company.

We agreed this position with South Staffordshire Water at a meeting on the 8th June 2018.

United Utilities

Since we published our draft WRMP we have discussed with United Utilities the possibility of utilising water released from Lake Vyrnwy into the River Severn for use at our treatment works in the Midlands. Further joint analysis with United Utilities has revealed that this option does not represent best value and it will therefore not be in our preferred programme of options. The primary reason for exclusion is an erosion of our Birmingham resilience capability. The complex interaction with a possible River Severn to River Thames transfer scheme would need more detailed analysis to ensure that we properly consider the wider national interest. We have agreed to work with United Utilities on further modelling in AMP7 to fully understand whether the scheme could work conjunctively with the River Severn to River Thames Transfer.

We agreed this position with United Utilities at a meeting on the 9th May 2018.

Yorkshire Water

In the preferred programme of options in our draft WRMP we proposed increasing our share of the raw water in the Derwent Valley Reservoirs to help support our needs and facilitate an eastwards transfer to Anglian Water. Discussions with Yorkshire Water and Anglian Water since we published our draft WRMP mean that we now intend to progress a different option for the Derwent Valley reservoirs. This alternative option enables us to improve resilience and increase our take within the current agreement without varying Yorkshire Water's licence share. The primary reason for this is that Yorkshire Water are unable to accommodate a variation of the Derwent Valley agreement within the timeframes that we had assumed without threatening their customers' level of service. Furthermore the size and timing of Anglian Water's needs since our draft

WRMP was published have changed. This has reduced our need for additional raw water to be made available from Yorkshire Water's share of the Derwent Valley reservoirs.

The Derwent Valley option that we have now included in our preferred programme will facilitate future variation in the agreement between Yorkshire Water and us at a mutually agreed volume and date in the future. We have committed to working together with Yorkshire Water to investigate options for varying the agreement in the wider context of the Water Resources North group. This joint work will involve water resources modelling of the Derwent Valley system, and developing options for the Derwent Valley and wider Yorkshire Water and our own water supply systems.

We agreed this position with Yorkshire Water at a meeting on the 5th June 2018.

Anglian Water

We developed five viable water transfer options for consideration in Anglian Water's draft WRMP. The potable water bulk supply to an Anglian Water WTW near Oakham was included in their preferred programme of options. However, subsequent analysis factoring in changes to the timing of Anglian Water's need mean that the Wing transfer is no longer able to resolve their deficit due to its relatively long construction period. We have continued dialog with bi-weekly conference calls and offered a further transfer option involving the transfer of final effluent from our Wanlip site to Rutland Water for their consideration.

Anglian Water have confirmed that none of the transfers we offered are to be included in the revised preferred programme of options in their final WRMP. We have committed to working together to develop an optimised transfer taking in the wider context of the Water Resources East needs. This joint work will involve water resources modelling of the River Trent system.

We agreed this position with Anglian Water at a meeting on the 28th June 2018.

Thames Water

We have worked closely with United Utilities and Thames Water to develop the River Severn to River Thames transfer scheme, the purpose of which is to augment the flows in the River Severn for transfer to the River Thames near Oxford. The scheme would be used only during periods of dry weather in the Thames catchment. Our principle contribution to the scheme involves improving tertiary treatment at our Minworth Wastewater Treatment Works. With appropriate associated infrastructure, this would enable final effluent to be transferred to the River Avon (a tributary of the River Severn) and then abstracted by Thames Water near Tewksbury on the River Severn.

We met with Thames Water in December 2017 to understand underlying cost assumptions used to assess the River Severn to River Thames transfer scheme and as far as we were able to determine, ie without breaching any aspects of Competition law, are content that it was handled fairly. We also agree with Thames Water that, given the long-term supply nature and the lead times to build strategic infrastructure that any trade agreement entered into would need to be for significantly longer than
25 years.

The scheme was not included in Thames Water's draft WRMP. Since then the requirement for a transfer from water companies in the WRSE has reduced which means that the transfer is likely to be selected very far into the future, if at all, in Thames Water's revised preferred programme of options.

We continue to actively engage with Thames Water, United Utilities and Regulators on progressing the technical aspects of the scheme prior to the final WRMPs being submitted to Defra. Given the national

strategic importance of the River Severn to River Thames transfer scheme, as recognised by the National Infrastructure Commission report 'Preparing for a Drier Future', we remain committed to ensuring that momentum is maintained.

To this end, we will continue to work on appropriate technical and environmental aspects in AMP7 in partnership with United Utilities and Thames Water, regardless of whether the scheme is included in Thames Water's final WRMP. This work is expected to include carrying out studies into ecological aspects, water losses and reliability, water quality, regulation, and river temperature.

We agreed this position with Thames Water on the 19th June 2018.

We have included a mechanism in our PR19 plan to manage the uncertainties around this nationally significant trading option and ensure that our customers are protected from any unnecessary expenditure.

A5.2 Update on regional water resource planning groups

We have actively participated in all regional working groups and national studies. Our activities include:

- **Water Resources East.**
  As a core member of the Technical Steering Group we have helped shape the modelling process and offered seven large scale transfer options into the process.
- **Water Resources South East.**
  We participated in the steering group to ensure that the River Severn to River Thames transfer scheme was appropriately represented in the WRSE water resource models. Unfortunately we are unable to include scheme details in the public version of our WRMP due to security and commerciality concerns.
- **Water Resources North.**
  We are founder members and have brought our experience in developing our own trades and membership of other groups to form the terms of reference.
- **West Country Water Resources Group.**
  We are helping to bring experience from other groups and help shape opportunities for transfers involving the lower river Severn
- **WaterUK Water Resources Long Term Planning Framework (WaterUK).**
  We are members of the steering committee and providing data on need and options.
- **Preparing for a Drier Future (National Infrastructure Commission).**
  We provide a peer review of technical elements.
- **River Trent and River Severn Working Groups.**
  We initiated these groups with others to help understand and manage in-combination impacts of new water resource schemes and transfer. The River Severn Working Group met on 11 June 2018 and the River Trent Working Group on 9 July 2018 to review and help align draft WRMPs between different water companies.

A5.3 Update on discussions with other third parties

During the development of our WRMP and since our draft WRMP was published, we have engaged in further communication with other organisations regarding water trading. These organisations are:

- Third party organisations who abstract from the River Trent
- Canal and Rivers Trust

The following sections outline the nature of our communications and our response to concerns that have been raised.

Third party organisations who abstract from the River Trent

During the consultation of our draft WRMP we received comments from other large abstractors on the River Trent seeking reassurance that our future plans would not put their ongoing operations at risk. We believe that the preferred programme of options that we are presenting in our final WRMP will not impact the ability of River Trent abstractors to continue to take the water that they are entitled to for the following reasons:

- The net impact of our new supply side options is minimal as water will return to the River Trent as final effluent.
- The new restrictions at our Egginton intake on the River Dove will increase water available at times of low flow by approximately 70Ml/day.
- The Trent Witham Ancholme scheme and power station licences are not constrained by hands off flows.
- The proposed final effluent transfer to Thames Water (115Ml/day) was not selected in their preferred programme of options and therefore is not being progressed as any part of our WRMP.

We have worked with other abstractors in the multi-sector Trent Working Group to determine the in-combination aspects of our options and those of Anglian Water. We believe the initial River Trent study indicated no impact on other abstractors. We will update this report in September 2018 and periodically thereafter. We will comply with all environmental and licencing regulations so that existing abstractions and rights will not be affected.

Canal and Rivers Trust

In response to the consultation comments made by the Canal & Rivers Trust (C&RT) we are committed to developing partnerships with third parties that can support us to meet the challenge of providing a cost effective and sustainable water supply into the future.

We engaged extensively with the Canal and Rivers Trust (C&RT) during our draft WRMP development process. We established two options utilising surplus water from the canal network. These two options were at geographically diverse locations in our region and corresponded to two separate areas of our operational grid in different Water Resource Zones. Both WRZs that the options could benefit have predicted future supply / demand balance deficits, however the C&RT options were not selected in our preferred programme of options. We met with the C&RT in May 2018 to discuss their concerns, explain our cost assessment process and the reasons that they were not selected.

We explained that;

- **We carried out further scoping of the options**
  We further developed the C&RT options to include additional investments to include treatment capacity and pipelines that are necessary to deliver drinking water to our customers.

  The scale of these works was based on assumptions around water quality and abstraction locations provided by C&RT. In developing the associated work needs, we assessed our current infrastructure at the two locations of the option. Wherever possible, we sought to maximise the use of existing assets including pipelines, pumping stations and water treatment facilities. For one of the C&RT associated options, a new water treatment facility was required as we estimated that the existing plant could not be adjusted to address the change in source water quality.

  However, for the other option, we estimated that an existing treatment facility can be adapted for the source water quality change thereby making best use of our existing assets. Other new assets included in the proposal for each option, mainly associated with conveyance and storage of raw or potable water, were selected following an option appraisal process to ensure advantage was taken of

any efficiency opportunities arising from any variation to the options. This process is in accordance with the way we developed all other feasible options that were considered in our WRMP.

- **We used C&RT's cost estimate within our cost estimate of the options**
  For all of our supply-side options we adopted a consistent cost estimation methodology to enable robust economic comparisons of options to be made. This approach was applied to our internal options as well as options involving third parties.

  In the case of the two C&RT associated options, the C&RT provided estimated costs to facilitate the transfer of the Birmingham Canal Network surplus raw water to the two locations specified; Milford, Staffordshire, and; Rugby, Warwickshire. Our development of the option scope to include the infrastructure required to deliver drinking water to our customers meant that there were further costs associated with the options that had not been included in the C&RT cost estimate. The estimated costs provided by C&RT were combined with our cost estimate of the other activities to provide a deployable output benefit to customers.

- **Assessment of deployable output benefits**
  The benefits of the two C&RT options (in terms of deployable output) were assessed using the same methodology as that for other WRMP Options. Further commentary is provided in Appendix D of our WRMP and Appendix A6 of this document.

- **Capital renewal costs**
  We developed and implanted a consistent methodology for estimating the capital renewal costs for all options. Our approach considered the different asset life periods associated with different types of asset. The repeat capex observed in the WRMP data tables for the C&RT associated options was consistent with our standard whole life costing methodology and is applied to all options regardless of origin.

- **Decision Making**
  The Solutions including the C&RT proposal have been derived through a defined methodology that provides a consistent approach to developing other non-C&RT related Solutions. The merits of the two C&RT options were understood and assessed using the same methodology as that for other WRMP feasible options. This ensures consistency in approach and enabled our WiSDM and DMU decision making tools to derive our preferred programme of options in a comparable and repeatable manner.

The outcome of our analysis was that there are more favourable options were available closer the supply / demand deficit areas than the C&RT associate options. Therefore, neither of the C&RT supply options were chosen as part of our preferred plan.

C&RT also raised concerns over our proposed new supply-side option WIL05, which would abstract and treat water from the River Trent, In our draft WRMP we proposed supporting this abstraction by diverting Barnhurst sewage treatment works final effluent into the river Penk (a tributary of the river Trent) rather than the Staffordshire and Shropshire Union canal. Specific concern was raised regard the impact on the River Penk, Staffordshire and Shropshire canal and Aqualate Mere SSSI.

We have considered carefully the points they raised and have re-designed the option so that it does not rely on diverting Barnhurst final effluent. We have several alternative options to support the WIL05 additional

abstraction, including an alternative C&RT option to deliver 15Ml/day surplus to Fradley. Our analysis of the alternatives and the discussions with potential suppliers will be concluded by March 2019. We will update the option description in the final WRMP document to reflect this.

A5.4 Water trading and Wales

Our WRMP does not feature any active trading options to accept additional water from Wales. We will continue to explore opportunities and will consult NRW and the Welsh Government if we progress any options which involve the deployment of water from Wales and/or affect sites in Wales. We will ensure that all necessary environmental assessments including Strategic Environmental Assessment and Habitat Regulation Assessment will be completed as appropriate. Appendix B1 provides additional commentary on how we align our approach to water management with the Well-being of Future Generations (Wales) Act 2015.

We have been in communication with Network Rail regarding the use of water from the River Severn Tunnel. The options is not in our preferred programme of options as it is very remote from our area of need in England and therefore more expensive than alternative options. Should the nature of our needs change we will revisit the option in future WRMPs.

A5.5 Customer views on trading

We have completed customer research with United Utilities and Thames Water and have shared this research with our Customer Challenge Group and the Consumer Council for Water.

On principle we will not enter into any trade will adversely impact the level of service that our customers receive. We will also ensure that customers share the benefits through bill reductions in the long term.

As described previously, given the potential national importance of the River Severn to River Thames transfer scheme we remain committed to ensuring that momentum is maintained and will continue to work on appropriate technical and environmental aspects in AMP7 in collaboration with Thames Water and United Utilities.

A6 Water supply options

A6.1 Overview of changes to the programme

In our draft WRMP, we described that our latest supply / demand challenge is larger than in any of our previous WRMPs. Our draft WRMP also explained how our ability to respond to these challenges has been further constrained by statutory requirements to prevent future ecological deterioration, as required by the Water Framework Directive, thereby limiting our options for developing new sources of supply.

To meet these future challenges, we need to improve our supply capability by investing in expanding our water treatment and strategic distribution capacity, prioritising solutions that make use of existing water supply assets. Our draft WRMP described the supply / demand investment options that we have considered and gave more detail on our options appraisal and decision making process.

Chapter 6 of our draft WRMP described the options that we recommended, with further information provided in Appendix D of our draft WRMP. The accompanying Strategic Environmental Assessment report provided additional insight into the environmental impacts and considerations of these options.

We received comments on many different aspects of the supply side options we recommended in our draft WRMP. Most comments were seeking more detailed explanation of the preferred options, asking for further supporting information on Water Framework Directive assessments, local environmental impacts and option delivery risks. Stakeholders also asked us to make sure that our recommendations took account of the changes made to WINEP3 and water trading.

The Canal and Rivers Trust along with RWE and Uniper energy companies requested reassurance that our proposals to develop abstraction on the River Trent along with any associated water trading would not impact on their existing operations. A number of consultees also asked us to widen the range of environmental considerations used in the accompanying Strategic Environmental Assessment (SEA).

Since we published our draft WRMP, we have continued to investigate and develop all of the options considered in our draft WRMP. We have also expanded our Strategic Environmental Assessment to include a number of recommendations made through the consultation responses. This has resulted in an improved understanding of the costs, deployable output benefits, delivery risks and environmental impacts of all of the options. In turn, this improved understanding has influenced our understanding of the preferred options and informed the accompanying PR19 Business Plan with the best available cost data. During this update process we have updated our assessment of long term supply / demand need based on the outputs from WINEP3. We have also removed any options that have the potential to conflict with the water import and export proposals that are set out in the draft WRMPs of other water companies.

We have used this improved understanding of costs and benefits to update our appraisal of the supply / demand challenge and the investment required to satisfy different projected future scenarios. This allowed us to review the suitability of our preferred programme of options that we had outlined in our draft WRMP. Our review established that there is no need for any material change to the overall programme of new supply side options set out in our draft WRMP. However, we will be proposing some changes to the scope and delivery timeline for inclusion in our final WRMP in order to meet WINEP3 objectives and to prevent conflicts with the WRMPs of neighbouring water companies. We have also introduced a mechanism to manage the risks and uncertainty around delivering a number of these options.

Figure A6.1 illustrates the changes to the programme of options between our draft and final WRMP. The figure shows all of the proposed supply side options that featured in our draft WRMP and compares them with the options which now feature in our final WRMP. The figure shows the option name, deployable output benefit and the delivery timing of each option in the preferred programme. The blue bars represent the preferred programme of options in our draft WRMP whilst the orange bars represent the revised preferred programme of options in our final WRMP.

Figure A6.1 Comparison of our preferred programme of options between our draft and final WRMPs

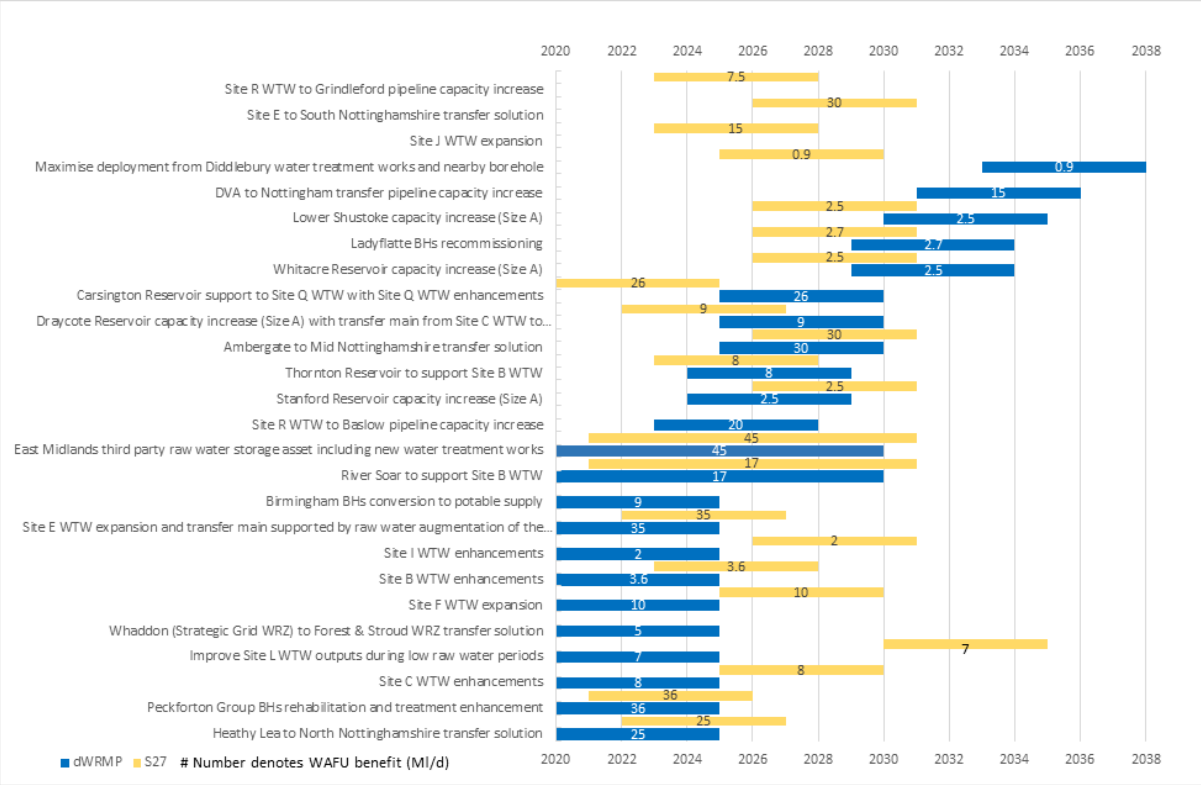


Figure A6.1 demonstrates that while the majority of the options remain unchanged, we have made revisions to the timing and sequencing of these options. The figure also illustrates that there are three options that were not within the preferred programme of options in our draft WRMP, but have been brought into our preferred programme of options for our final WRMP. The three options being introduced to our preferred programme do not present a material change from our draft WRMP as they are variations to the scale and scope of previously preferred options that featured in our draft WRMP. Similarly, two options have been removed from the preferred programme. These revisions to the preferred programme of options between our draft WRMP and our final WRMP are:

Revision 1: Option – Site E to South Nottingham transfer solution replaces DVA to Nottingham transfer

Our draft WRMP included consideration of four feasible options to increase our capability to transfer treated water from our Strategic Grid WRZ to our Nottinghamshire WRZ. These were:

- GRD19: DVA to Nottingham transfer pipeline capacity increase
- NOT01: Ambergate to Mid Nottinghamshire transfer solution
- NOT04: Heathy Lea to North Nottinghamshire transfer solution
- NOT05: Site E to South Nottinghamshire transfer solution

All four options were variations of a similar theme with the aim of increasing the strategic link capacity between the surface water treatment capacity on the Strategic Grid and the groundwater supplied areas of the Nottinghamshire WRZ. This is to support the reductions in WFD led groundwater deployable output in the Nottinghamshire WRZ. In our draft WRMP we recommended proceeding with a preferred programme containing options NOT01, NOT04 and GRD19 over AMP7, AMP8 and AMP9.

For our final WRMP, the revisions to WINEP3 and its implications for our groundwater sources in Nottinghamshire, alongside the updated option costs and benefits appraisal has led to a revision to the recommended strategic transfer options. We are recommending replacing option GRD19 with option NOT05. This is not a material change from our draft WRMP and is simply a revision to the recommended route and size of upgraded capacity for transferring treated water.

Revision 2: Option – Site R WTW to Grindleford pipeline capacity increase replaces Site R WTW to Baslow pipeline capacity increase

As described in section 3.5 of our Statement of Response, since our draft WRMP was published we have worked with our neighbouring water supply companies to better align our future water trading plans. Three of our options involved variations to the way we operate the Derwent Valley reservoirs:

- BAM03: Site R WTW to Grindleford pipeline capacity increase
- BAM04: Site R WTW to Baslow pipeline capacity increase
- BAM05: Site R WTW to Ambergate transfer solution

In our draft WRMP we included option BAM04 for implementation by 2028. This option would provide an increase of up to 20Ml/d output from our Derwent Valley reservoirs into our Strategic Grid WRZ, and would likely require a reduction in the current export arrangements to our neighbour, Yorkshire Water.

Since we published our draft WRMP we have worked with Yorkshire Water to better understand the impacts this would have on their WRMP and to better align our assumptions around future changes to way the Derwent Valley reservoirs are utilised. As a result, we have amended the preferred programme of options in our final WRMP to reflect the needs of both Companies. In the preferred programme of options in our final WRMP we have now included the smaller scale option BAM03 to replace BAM04. Option BAM03 is expected to achieve an additional deployable output benefit of 7.5Ml/d from the Derwent Valley reservoirs into our Strategic Grid WRZ. Our water resources modelling shows that we can sustain this increased output without impacting on our current arrangements with Yorkshire Water. This is a change in scope to the option recommended in our draft WRMP.

Revision 3: Option – Site J WTW expansion

In our previous description for Revision 2, above, we outlined that due to the impacts on Yorkshire Water, we have needed to reduce the scope and deployable output benefit achieved from the Derwent Valley reservoirs related options. To ensure that we can balance our supply/demand needs, we have substituted an alternative option into the preferred programme to make up for the resulting capacity shortfall. The driver for requiring additional treatment capacity is the need to provide sufficient supply into the Strategic Grid WRZ to support the Nottinghamshire WRZ via the new strategic transfer links proposed within the preferred programme of options.

For this additional supply and transfer mechanism to be most effective, the treatment capability needs to be located upstream of the new transfer links, thereby utilising our capability to abstract from the River Derwent. In the light of constraints at the Derwent Valley reservoirs our preferred way of generating this additional

capability is to expand our existing water treatment works at Site J. This option is in keeping with our other preferred options to increase treatment capacity at Site F and Site E treatment works.

Revision 4: Option - Birmingham boreholes conversion to potable supply

The preferred programme of options in our draft WRMP included an option to convert a number of existing flow augmentation boreholes into public water supply assets. Our intention was to improve deployable output capability in the Birmingham area and our Strategic Grid WRZ. Since publishing our draft WRMP we have updated our supply / demand assessment to reflect WINEP3, updated the costs and benefits of our supply options and revised our long term leakage ambition. Upon re-optimising our long term investment plan as a result of these changes, the Birmingham borehole conversion option is no longer in our preferred programme of options and our final WRMP has been adjusted accordingly.

However, this option remains feasible and whilst we do not have any plans for it to be progressed, it forms part of our contingency planning as a well formed and viable alternative in the event that our other preferred options benefiting the Strategic Grid WRZ are found to be unsuitable during subsequent design development stages.

Revision 5: Option - Whaddon to Forest and Stroud transfer

Our draft WRMP included this option to increase the transfer of treated water from our Strategic Grid WRZ to our Forest & Stroud WRZ to offset an expected reduction in deployable output at our Buckshaft groundwater site. Since we published our draft WRMP the Environment Agency have issued WINEP3 information which confirmed the scale of the required environment programme in that area.

WINEP3 confirmed the conclusions we arrived at in 2018 during our ongoing environmental investigations into the impact of our Buckshaft source on the neighbouring Cinderford Brook. Those conclusions were:

- We should focus on in-river and habitat improvement measures to help improve the status of the Cinderford Brook rather than make long term reductions in abstraction form Buckshaft.
- We should reduce the Buckshaft abstraction licence to limit future abstraction growth and prevent future deterioration of WFD status.

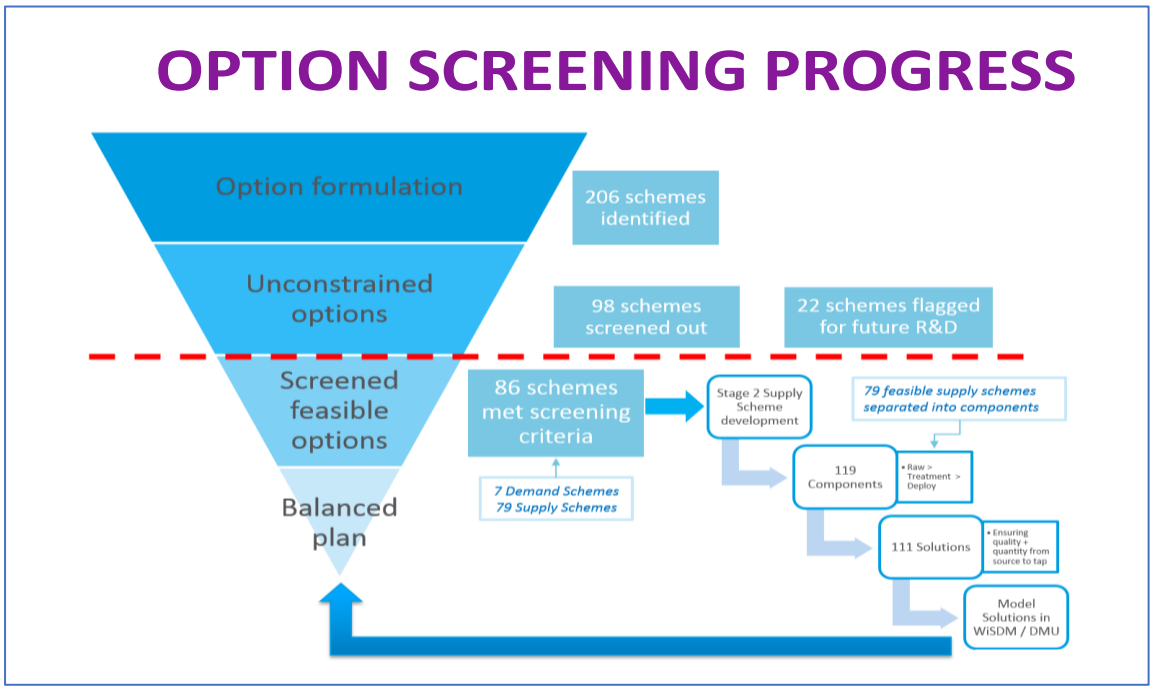
Therefore we no longer require options to offset a reduction in output at our Buckshaft site meaning that the Whaddon to Forest and Stroud transfer is not included in our preferred programme of options in our final WRMP.

A6.2 Options appraisal process

Several of our stakeholders asked for further explanation of the appraisal process that we have followed. Appendix D of our WRMP describes the screening process and screening criteria that we have employed in our options appraisal process for supply-side option, demand-side options and water trading opportunities. Appendix E of our WRMP described the techniques we have used to assess the challenges and determine the most appropriate investment approach.

Our options screening and appraisal process is demonstrated in Figure A6.2 and described in the following sections.

Figure A6.2: Option screening process



From our option formulation stage, we identified and assessed a wide range of strategic options to balance supply and demand, known as 'unconstrained options'. Option formulation considered the potential to derive benefit from interventions categorised in one or more of the following areas:

- Leakage
  - Universal leakage reduction.
  - Targeted leakage reduction.
  - Do nothing new.
- Demand management
  - Improved water accounting through metering options (e.g. universal, change of occupier, incentivised, passive).
  - Water efficiency measures (e.g. incentivised, passive).
  - Financial measures (e.g. tariffs).
  - Do nothing new.
- Making more use of existing strategic assets and abstractions, for example:
  - Increasing capacity of sustainable existing abstractions (e.g. by modifying assets or abstractions, by changing the operational regime).
  - Developing transfers from areas of surplus to areas of deficit (e.g. with neighbouring water companies or within our water supply region).
  - Where improvements in wastewater quality could augment river flow and improve abstraction potential.
  - Transferring abstraction from unsustainable to more sustainable locations – e.g. by moving the abstraction point down-catchment to a location with greater flow.
  - Do nothing new.
- New supply options.
  - Develop new water resources.
  - Water trading outside of the water industry.
  - Do nothing new.

From these target categories, we collated a list of 206 initial options which had the potential to improve the supply/demand balance. We had not assessed the feasibility, costs, benefits or environmental impact of these initial options at that stage, merely identified that they warranted consideration in the option screening and appraisal process.

In line with the water resource planning guidance, we carried out outline feasibility assessment on our initial options. This included assessment of programme constraints and the likely benefit to the supply / demand balance. Any options where there was a clear indicator towards the option not being feasible were screened out from the process at an early stage. The screening criteria used in this assessment are described in Appendix D3 of our WRMP, which states:

> *"Having identified the long, unconstrained list of potential options, we then took these through a screening process to identify those that should be excluded from the final plan. Our 2014 WRMP (WRMP14) used a series of high level questions that were used to screen out the least feasible options. These WRMP14 screening questions were based on technical guidance issued at the time by the Environment Agency, and they were developed with input from our stakeholders. For our latest options appraisal exercise, we used these WRMP14 questions as the starting point for our screening process, but we also derived a more detailed sub-set of questions that would help us to understand the likely issues, risks and concerns. Where there was an overall negative response to any of the four key questions, the option was screened out, unless there was a compelling reason to take it through to the feasible list.*
>
> *We shared these updated screening criteria with the Environment Agency and Natural Resources Wales at an early stage and we made some minor adjustments to the screening criteria on the basis of their feedback. At our September 2016 water resources stakeholder forum we shared our options screening approach, the screening criteria we proposed to use and the scope of our Strategic Environmental Assessment. We held breakout discussions on the proposed screening criteria and we sought views on our decision making framework. Following this engagement with regulators and stakeholders, we confirmed the screening criteria shown in Table D3.1 below, and we proceeded with the unconstrained options screening process."*

Table D3.1 in our WRMP demonstrates the screening criteria and the qualitative assessment of Y/N responses. This also includes commentary on the screened options and the key reason for rejection in the free text comment column. As described in Appendix D3:

> *"We assessed each of the options on the unconstrained list against these screening criteria, and we recorded our decisions as we progressed through this list. We engaged the Environment Agency and Natural Resources Wales during the screening process to seek confirmation on our interpretation of possible environmental constraints, particularly with regard to the questions on abstraction licensing risk and potential Water Framework Directive impacts.*
>
> *In January 2017 we issued the Environment Agency and Natural Resources Wales with our first iteration of a constrained list of options and our supporting assumptions. We then continued to work with the Environment Agency through 2017 to get their thoughts on the environmental or abstraction licensing considerations we need to give to the more feasible options. Environment Agency teams fed comments back through spring 2017, and their comments and data was used to inform our ongoing options screening and scoping process. As a result of Environment Agency input, six of these schemes were rejected / screened out, and a we refined the scope and design of a further 28 schemes to reflect*

concerns such as abstraction licence considerations, non-native species risks, Water Framework Directive requirements and fish migration.

Using this screening and engagement process, we created our scheme rejection log, which summarises the reasons for excluding any scheme options from our list of feasible options. The log also shows the list of feasible options that we took forward for more detailed cost / benefit and SEA appraisal and that were then used in our investment modelling to inform this draft WRMP… The high level scheme rejection log can be found in table D3.1. and the full list of feasible options can be found in table D3.2."

Options remaining in the process following this screening exercise were suitable for detailed assessment and cost-benefit analysis, considering:

- Long-term totex.
- Willingness to pay for the option.
- Benefits of the option (following the benefits assessment guidelines).
- Climate change mitigation impacts including the cost of carbon.

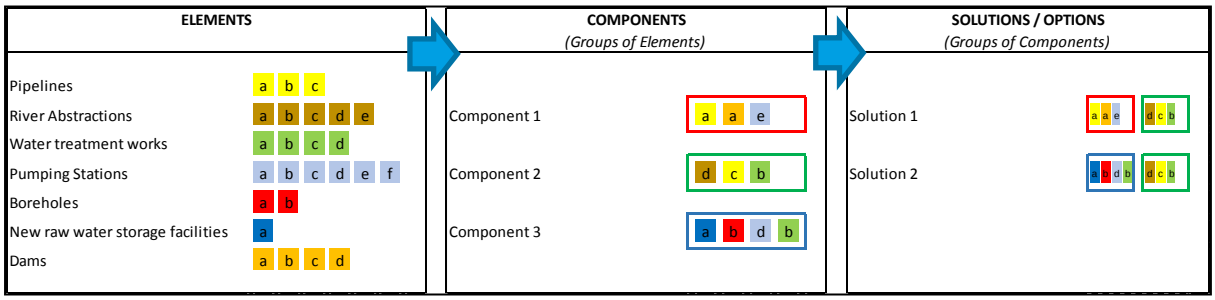
During development of our WRMP we adopted a standardised process for establishing what work each option would entail to ensure that options remained comparable and any common items of work existing in multiple options was considered in a consistent manner. This formed our strategic level feasibility assessment of the options.

The concept of our approach to this feasibility assessment was to disaggregate the intervention activities required for each option into constituent parts, based on asset type. These parts were known as Elements and consistent of modifications, renewals or new provision of assets within the following element types:

- Pipelines
- River Abstractions
- Water treatment works
- Pumping Stations
- Boreholes
- New raw water storage facilities
- Dams

These elements of our options were closely aligned to the cost assessment process, mapped to our unit cost curves and clearly identified items requiring bespoke cost estimates as described in Appendix A6.3. Once our feasibility exercises had been completed at element level, we carried out two stages of re-aggregation to form the option (or solution) following the approach represent by Figure A6.3. This staged approach allowed us to ensure that our feasibility outputs remained appropriate as the elements were grouped together.

Figure A6.3: Standardised Planning Approach – Elements, Components and Solutions/Options



(this figure is diagrammatic only and does not intend to reflect actual components or options)

This process helps to reduce cost uncertainty by allowing a level of confidence to be assigned to each cost at an element level. Our approach has led us to develop a suite of options that are modular in nature, meaning that we do not need to commit to very long term construction projects and we can adapt our preferred programme as necessary over time.

Where appropriate we also sub-divided elements to provide the granularity necessary to derive detailed high-quality estimates of the operating costs. For example, water treatment process costs may be formed from:

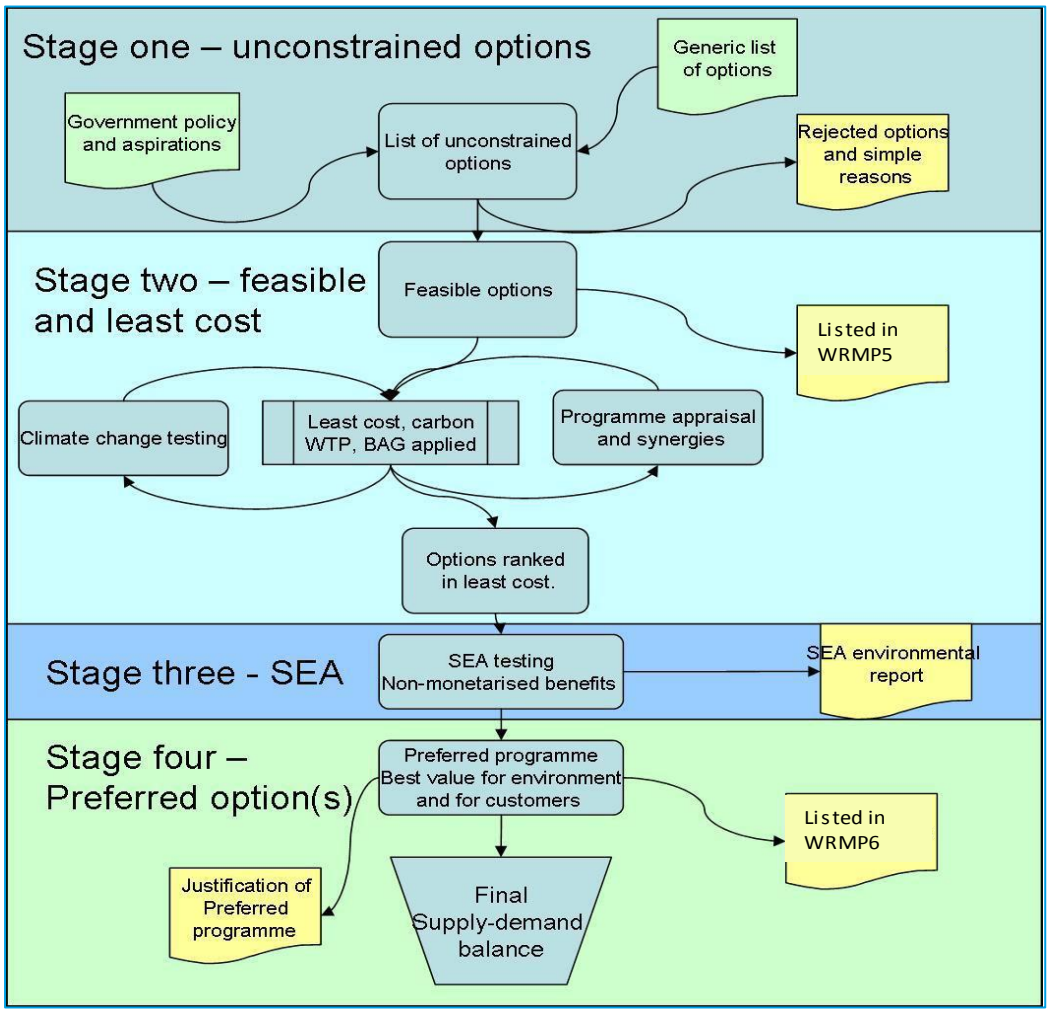
- Non-variable operating cost
  For example: abstraction licence, bulk import availability fees, trading retainers, etc.
- Variable costs dependent on flow
  For example: power, sludge recycling, disinfection, ozonation, organics removal, metals removal, plumbosolvency treatment, UV treatment, etc.
- Variable, dependent on asset size but not flow
  For example: staffing, water quality analysis, hired and contracted services, routine inspection and maintenance, GAC regeneration.

Our standardised approach also included assessment of the deployable output from each options using our Aquator water resources model. The approach to modelling was to ensure that existing licences were not exceeded and that existing Hands-Off Flows (HOFs) were unaffected.

The resulting outcome from our standardised planning approach was a series of options which we are confident are assessed appropriately in terms of viability, cost and benefits. These option parameters were then incorporated back into our option appraisal process.

Figure A6.4 shows the main stages of our option appraisal process. The process includes a Strategic Environmental Assessment (SEA) of the options and overall programme, willingness to pay (WTP) studies and economic appraisal using tools such as the EA's benefits appraisal guidelines (BAG).

Figure A6.4: The stages of an option appraisal process



The focus of our options appraisal is a repeated assessment of costs, benefits and environmental impacts. We also considered the lifetime of each option, so that interim options could be used if necessary.

In formulating our preferred programme of options we have prioritised demand side measures over supply options. We have taken this approach even further for our final WRMP with our revised leakage targets as described in Section A2 of this document.

During development of our WRMP, we used a variety of methods to understand the new and emerging future water supply / demand challenges and explore the available options to provide a sustainable and secure water supply to STW customers into the future. This process included:

- Using our in-house expertise in hydrology, hydrogeology, ecology, engineering and economics to define and quantify risks and future supply / demand scenarios.
- Involving a number of specialist consultants and partners to help us develop the recommendations set out in our draft WRMP.
- Shared our emerging thinking with technical specialists at the Environment Agency,
- Engaged with expert stakeholders to understand their views.

A staged approach was carried out to progress options from conception through to development and subsequent appraisal. This has involved studying the individual asset areas (Elements) that each option

involves. As the options are developed further there will be greater detail and design information for each option available.

We recognise the inherent value of our current assets and there has be considerable effort spent establishing ways of achieving even greater value from existing assets by carrying out appropriate modifications.

In the assessment of all available options, we have invested in SEA, Habitats Directive Assessments and WFD compliance assessments to ensure environmental and sustainability aspects were understood. We are appreciative that this has been acknowledged by some of our consultees including the RSPB.

If any future material changes were to occur to our options then we will carry out the necessary and stakeholder and customer engagement as appropriate.

Managing option uncertainty and risk

Since we published our draft WRMP we have continued to develop our understanding of the supply side options, prioritising the options that were either in our preferred programme or were close alternatives for the selected options. These activities have improved confidence in the deliverability of the options as well as providing an assessment of engineering viability. Each option has been assessed and assigned a risk rating across the following areas:

- Engineering
- Water Quality
- Environmental Assessment
- Land & Planning
- Constructability & Operation
- Legal
- Security

The risk rating for each parameter was combined and converted into a technical viability confidence rating for the options.

Each option has been assessed for confidence in:

- Technical Viability
- Stated Deployable output benefit
- Time to benefit (Delivery programme)
- Cost

A standard methodology was applied to all options to assess confidence ratings and a confidence score and parameter tolerance level derived in accordance with the guidance 'Assurance Framework APR16 for OfWAT (Annex 5 confidence grades)'. These tolerance bands were then applied in our DMU model to derive the preferred programme of options as described in Appendix E of our WRMP.

Our WISDM investment modelling and the DMU sensitivity analysis considered many different future scenarios and different outputs from the options based on the confidence scoring. This allowed us to test how robust the selection decisions were to uncertainty around the delivery costs, the construction time and the deployable output benefit of each option. The sensitivity around these parameters were considered in the selection of the preferred programme of options for our WRMP alongside the future needs of our customers. In this manner, and balancing risk, we have prepared a preferred programme of options that we believe is achievable and will meet the needs of our customers.

A6.3 Ensuring robust and efficient costs

Since we published our draft WRMP, we have continued to develop our understanding of the different feasible supply side options. These activities have improved confidence in the deliverability of considered options as well as an assessment of engineering viability. As a result of this we have been able to better refine and improve confidence in the costs and deployable output benefits of each option.

Maintaining a consistent approach to the cost estimation across all options and option types is imperative to enable our decision making tools make appropriate and informed investment decisions. Our approach to generating our best central estimate of option costs has been carried out using one, or a combination, of the following cost datasets:

- **Standard options and asset model solutions:**
  Core to our cost estimation process is the Severn Trent Unit Cost Application (STUCA). This is our central cost repository which has, and continues to capture outturn project costs for all capital works that we carry out. We use this data to derive programme level average unit costs for the implementation of new assets and intervention activities. The unit costs, reduced to reflect the future cost efficiency challenges, are used to set target prices as part of our AMP6 procurement strategy. This provides consistency between AMP6 costs, our cost adjustment proposals and projected AMP7 delivery. Our process is well established having been used consistently for over a decade and previously reviewed and/or assured by third party specialists including Atkins, EC Harris, and Efficio. In addition, our unit costs and cost curves were used for our PR19 Business Plan and these were validated and benchmarked with proprietary cost information by Jacobs in early 2018.

- **Bespoke cost estimates:**
  In instances where our unit costs, cost curves or equipment lists are not available for certain assets that we have proposed within options, for example when proposing new innovative technologies, we have sought alternative methods of cost estimation. For these assets, direct costs have been estimated using frameworks, standard rates or 'bottom up' estimates obtained from our Asset Creation (delivery) teams and supply chain partners.

We have prepared our option cost estimates from the constituent parts of the option. As described in Section A6.2, options have been arranged from Components and in turn Elements. Elements represent individual asset units for the purpose of cost estimation and operational functionality. The total cost estimate for each option is the sum of the relevant Components and thus includes all associated Elements. Our approach has given a detailed build-up of costs with each estimate making best use of standard cost data and our own delivery costs.

Our estimated option costs include allowances for the contractor design fees meaning that we have design-and-build estimates for our options. We have also included our internal costs to procure, assure and manage the project, ensuring that customers are protected by appropriate supervision of the scoping, procurement and implementation process. An allowance for optimism bias has been included based our experience of the tender-to-outturn ratio of similar activities and guidance provided by the HM Treasury.

To estimate the operational costs of our options, we have collected actual cost data from our existing assets or other industry available records. These costs have been challenged based on the expected benefits from our ongoing or future improvement programmes. Future market trends for material expenditure are also considered to provide a robust, futureproof assessment of costs.

Appraisal of our cost estimation approach has not been limited to internal assessments and comparison. We have commissioned a further external benchmarking exercise by a third party to validate that our option costs remain competitive both inside and outside our sector.

The competitiveness and efficiency of our technical solutions is supported by the work carried by our consultants Atkins-ARUP and documented in a separate PR19 submission to Ofwat covering supply / demand and resilience workstreams. This approach has been through three levels of assurance, as described in Appendix B3, to provide us with an appropriate level of confidence in our submission.

A6.4 Programme delivery

A number of stakeholders asked for more information on our ability to deliver the proposed engineering programme of new sources of supply. We acknowledge that our preferred programme of options in our draft WRMP was challenging in terms of the number of options needing to be progressed in AMP7. The changes made to the phasing of the programme of new supply-side options since our draft WRMP (described in Appendix A6.1) mean that the delivery programme being included in our final WRMP is more staggered across AMP7 and AMP8 and is less 'front-end loaded'. In combination with our robust delivery management process, this will reduce the risks around the overall delivery programme.

Our robust, established delivery management process and standards facilitate the development and delivery of a large programme of capital investment projects. This delivery process is overseen by our Programme Management Office (PMO) whose centralised position ensures that standard procedures are implemented and that all information including project deliverables, risks and issues are considered throughout the entire investment period.

The delivery strategy for our overall AMP7 capital programme has already begun, and our Asset Creation (delivery) teams are translating the wider PR19 Business Plan into an AMP7 delivery programme to understand our high level prioritisation criteria. Our delivery programme will mature as we progress towards the commencement of the AMP7 period and gain better understanding of individual project constraints and interdependencies through collaboration with key stakeholders. Liaison with our water resources, operational, network control and delivery teams will ensure that network interventions are co-ordinated to minimise impact and risk to our day to day operations and customer supplies.

We will build on the learning from AMP6, which has been a relatively busy period in terms of interventions required on existing assets that had potential to impact service to customers if not managed appropriately. We recognised this early in AMP6 and improved our intervention risk assessment process administered by our Network Control team. They now have a minimum 12 month look ahead plan to allow efficient and risk based approach to phase activity impacting on our ability to maintain service to our customers.

In developing the preferred programme of options we have been able to determine an outline delivery programme, however we have not yet undertaken a detailed phasing study for the potential construction interaction between options and we acknowledge that maintaining security of supply is of paramount importance. At this stage, our outline delivery programme gives us sufficient information for us to be confident that our existing resilience capability will allow us to undertake the required interventions without impacting service to customers.

Referring to the preferred programme of options described in Appendix B6.1, we will be commencing delivery of 11 supply side options in AMP7, 10 in AMP8 and a further one in AMP9. Of the options to be delivered in AMP7, five require interventions on existing surface water treatment work located across our Strategic Grid WRZ. These are:

- Option OGS01: Site J WTW
- Option DOR08: Site B WTW
- Option DOR02: Site I WTW
- Option WIL05: Site E WTW
- Option MEL29: Site Q WTW

All of the above treatment works involved within the options are already 'second source resilient'. This means we can make up any production shortfall using alternative treatment plants whilst short duration connection / diversion activities are undertaken. Although Site E WTW and Site J WTW require significant construction activity, this work will be separate and offline from the existing treatment processes as we plan to develop separate process streams to improve overall resilience capability of the expanded works.

The remainder of the option in our preferred programme being commenced in AMP7 (without direct WTW interaction) involve making connections to the existing network. We are confident that we have identified a viable approach to making these connections without impacting on customer supplies. For example:

- Option NOT04: Heathy Lea is a pipeline transfer option which will require short duration shutdowns to allow connections to the existing network and cause no impact to production capacity. The Derwent Valley Aqueduct is a twin pipeline at the point of connection so there will no reduction in distribution capability.
- Option BAM03: Site R to Grindleford capacity improvements will involve short duration shutdowns to allow the pipeline capacity improvement to be carried out. However, this is on part of the grid that is already duplicated and there will be no reduction in distribution capability.
- Option CRO05 and CRO06: Making additional provision of raw water available to Site B WTW from the River Soar and Thornton Reservoir will require localised connection to the raw water inlet to Site B WTW. These can be managed appropriately by utilising our operational flexibility at that site to prevent impact to customer supply.
- Option GRD18: Peckforton Boreholes in the North Staffs WRZ are individually second source resilient using other boreholes or increased output from Site L WTW. This will allow short duration shutdowns whilst new water treatment works are constructed and commissioned. Conversely, Site L WTW production can be reduced by increasing borehole production during connection / diversion activity, though the work required is relatively minor in nature.
- Option WTW05: The implementation of the East Midlands raw water storage (Site CQ) option including a new water treatment works will be carried out largely offline from our current water production and distribution capability. Similarly, the Draycote reservoir expansion and distribution enhancements will require only minimal work to the water production site, which is second source resilient.

Overall, we are confident that our preferred programme of supply side options is achievable, will provide the stated benefits and meet the challenge of providing a cost effective and sustainable water supply into the future. If, during subsequent option development, an option is identified to be no longer deliverable then we will identify an equivalent alternative from our feasible options list. Our consistent approach to deriving and preparing the feasible and preferred options means that we are confident that we have alternatives available in all of our WRZs. We are also confident that these alternatives have been developed sufficiently to prevent significant impact to the deliverability of the plan outcomes.

A6.5 Resilience

As described in Appendix B7, where we have identified that new supply capacity is needed to maintain the supply / demand balance, we have prioritised selection of options that make the best use of our sustainable sources of supply. We have focussed on options that:

- Increase the flexibility and resilience of our supply system, such as the new strategic supply links from our Strategic Grid WRZ into the groundwater supplied Nottinghamshire WRZ;
- Increase or optimise deployable output from existing, sustainable sources where possible, such as increasing the treatment capacity of our existing Site E, Site F and Site J water treatment works;
- Make use of potential trades in and out of our region to optimise national use of resources. We have met all neighbouring companies and other sector organisations to identify potential transfer option. These discussions are ongoing and the final WRMP will include an updated narrative to make this position clearer.

In addition, the preferred programme of options and the appraisal of different investment choices has been developed in parallel with our wider water distribution and supply resilience strategy. We have ensured that we understand the holistic total expenditure (Totex) implications of our investment choices, and we can derive a fully integrated, optimised supply/demand, infrastructure and leakage investment plan.

Our supply / demand decisions are underpinned by our broader capital maintenance and water quality investment programme. At the same time, the options and activities included in our WRMP not only contribute to addressing future supply/demand challenges, but also deliver broader benefits to our customers by creating more resilient supplies.

A6.6 SEA and environmental considerations

Our draft WRMP was accompanied by a separate Strategic Environmental Assessment (SEA) Environmental Report, a Habitats Regulations Assessment (HRA) and a Water Framework Directive (WFD) assessment to ensure an integrated approach to environmental assessment of our draft WRMP. The consultation response to our draft WRMP included a number of requests for further explanation of some aspects of our approach to environmental appraisal.

We made a considered approach to integrating environmental factors into the development and selection of options. The first stage of screening, described in Appendix D of our WRMP, included environmental criteria to ensure options with a high potential for negative environmental impact were removed between the unconstrained list and constrained list stages. Options on the constrained list were further developed and prepared to a level of detailed commensurate with the strategic nature of the planning process. Environmental constraints were again considered and suitable provision made to the option arrangement in order to avoid or mitigate potential environmental impact. This included, for example, alternative routing of new pipelines or adjustments to the location of new assets.

Integrating environmental considerations into the option development and selection process has meant that our appraisal process takes into account a range of factors including technical feasibility, delivery risks and environmental considerations in an equal manner. The SEA process facilitated review of critical environmental constraints in an agreed and consistent manner, ensuring that we considered the full range of potential environmental impacts of the options.

We included environmental mitigation when refining the selected least cost options to formulate our preferred programme of options. This ensured that the option costs were robust and representative. We

prepared social and environmental costs for all options to monetise any remaining impacts and enable an appropriate comparisons between options to be made and assist the decision making process. The environmental and social values were included in our Water Infrastructure and Supply Demand (WiSDM) investment optimisation modelling (described in Appendix B3 of this document and Appendix E of our WRMP) alongside the capital and operational costs of the options.

We recognise the need to carry out an 'in-combination' assessment of our preferred programme of options with the WRMP of our neighbouring water companies. We will complete this in-combination assessment once information about the final preferred programme of all neighbouring companies is available.

In response to some specific consultation queries, we will be updating Section 7 of our SEA Environmental Report to more clearly demonstrate how the SEA has influenced the selection of the preferred programme of options. This will include the discussion of options in the feasible list that were not taken forward into the preferred programme. For example, the SEA identified certain reservoir options, transfer options and a river augmentation option in our constrained list which had a wide range of major adverse effects. These options were not selected due to their poor performance against the SEA objectives, which informed their removal from our WRMP. Further discussion regarding the screening and selection process is provided in Appendix A6 of this document and Appendix D of our WRMP.

Further explanation of the different aspects of our environmental appraisal is provided in the following sections.

Habitats Regulation Assessment (HRA)

No likely significant effects have been identified options in the preferred programme of our final WRMP. In light of the recent People vs Wind European Court of Justice (ECOJ) ruling, we will review all our HRA screening conclusions to identify those that relied on mitigation to conclude no Likely Significant Effects (LSE) both individually and 'in combination'. Any options in our preferred programme where this is applicable will be subject to a HRA Stage 2 (Appropriate Assessment). Should there be a need for an HRA Stage 2 (Appropriate Assessment), then the Natural England criteria are more applicable. This then will entail:

- Identifying which preferred options that have a LSE were recommended for 'down the line' assessment.
- Reviewing our reasoning to see if it meets the Natural England criteria.
- If Natural England criteria is not met, then we will need to consider undertaking a more conclusive assessment; but
- If uncertainty remains then the Option may need to be subject to Stage 4 imperative reasons of overriding public interest (IROPI).

We will also review the potentially-relevant in-combination Development Plans. As indicated in the HRA: *'the certainty of developments, the precise spatial location and their timing make it difficult to identify any potential cumulative effects with the [Plan]'*. The final shortlist of Local Development Plans will be shared with Natural England for agreement on which projects to include.

The HRA for our draft WRMP was finalised in November 2017. A review has highlighted that the Site Improvement Plans (SIPs) available for the relevant Special Areas of Conservation (SACs) pre-date the November 2017 date. Recent updates to the SIPs based on an update of the Environment Agency's Review of Consents will be reviewed and the HRA Screening updated as appropriate.

Landscape

The SEA Objective concerning landscape and visual amenity focusses on potential adverse effects on landscape designations. It is acknowledged that Ancient Woodland is important due to its contribution towards landscape quality. Therefore, the presence of Ancient Woodland influences the sensitivity of the designated landscapes (Refer to Table 4.4 in our SEA Environmental Report). Nevertheless, potential adverse effects on Ancient Woodland are already considered within the Biodiversity objective topic and addressing these effects within the landscape and visual amenity objective topic may be considered as double counting.

Referring to specific queries regarding our landscape assessment:

Options BAM04 and NOT01: Impact on the National Park

The framework assessment tables in Appendix E of our SEA Environmental Report identify the potential landscape and visual amenity effects of the options to increase output from the Derwent Valley reservoirs. It should be noted that option BAM04 is no longer within the preferred programme and is replaced with smaller scale option BAM03 as described in Appendix A6.1. The smaller scale nature of option BAM03 means that we have reduced the construction activities required. We will still require construction works and access to our existing assets within the Peak District National Park and we will develop suitable approaches to eliminate or minimise impact during further development of the option.

The notional route of the pipeline within option NOT01 passes through part of the Peak District National Park, the Teversal Pastures Area of Outstanding Natural Beauty (AONB) with potential for moderate adverse effects. These effects would be temporary and can mitigated through best practice construction techniques, for example, pipeline routing optimisation, appropriate selection of construction method and the screening and control of site runoff.

Reservoir expansion options: Impact on biodiversity & landscape

The reservoir expansion options in our preferred programme (DAM07, DAM01, DAM03 and DAM02) will be reviewed and the potential adverse effects on marginal bankside habitat will be considered further. With regard to landscape and visual amenity, it was determined that the increased water levels would have negligible adverse effects.

Updates to our assessment reconsidering the impact of the reservoir expansion options to marginal bankside habitat may identify potential adverse effects. However, these effects are unlikely to be greater than 'minor adverse', as such we do not expect any material changes to our WRMP.

Options that could impact on landscape designations

We acknowledge that four options in our preferred programme have the potential to have adverse impact on landscape designations. These are associated with the current notional routing of new pipelines:

- Option NOT04 includes construction of a section of pipeline within the Peak District National Park.
- Option NOT01 includes construction of a pipeline within the Teversal Pastures AONB.
- Option CRO05 includes construction of a section of pipeline within two areas of Ancient Woodland.
- Option LIT01 includes construction of a pipeline in proximity to number of areas of Ancient Woodland.

As described previously, we will seek to first eliminate or otherwise mitigate the impact of these options on landscape designations through best practice construction techniques, for example, pipeline routing optimisation, appropriate selection of construction method and the screening and control of site runoff.

Prior to the implementation of these options we will engage with appropriate stakeholders to gain greater understanding of the specific sites that may be affected. Where appropriate we will also consult with other water companies to identify any potential cumulative effects on designated landscapes and develop Protected Landscape Mitigation Strategies as required.

Local Nature Reserves

Local designated sites such as Local Nature Reserves (LNRs) are not included within the scope of SEA methodology as set out in Section 5.2.1 of our Scoping Report. We have identified a total of five LNRs which influence the severity of the adverse residual effects towards the SEA objective of biodiversity, flora and fauna to four options in our preferred programme (NOT01, GRD19, WIL05, LIT01). These LNRs are:

- Teversal/Peasley Network LNR
- Bulwell Hall Park Meadows LNR
- Sutton Bonnington Spinney & Meadows LNR
- Bulwell Hall Park Meadows LNR)

These LNRs sites will also be considered in the project level environmental assessment during the implementation phase of options, including thorough consultation with the relevant authorities. It should be noted that as described in Appendix A6.1, option GRD19 is no longer being progressed in the preferred programme but is replaced with similar option NOT05 with similar interaction with the LNR.

Sites of Special Scientific Interest (SSSIs)

Our assessment of the implementation phase of several options in our preferred WRMP (NOT01, NOT04, LIT01, WIL05, DAM03, CRO05) has identified potential adverse effects on a total of 11 SSSIs, as described in Section 7.2 of our SEA Environment Report. Consequently, project level environmental assessment will inform the detailed design and selection of mitigation measures, for example optimisation of the pipeline routes to ameliorate adverse effects. We will make this clearer in our final WRMP. The number of SSSIs identified as potentially being subject to adverse effects will be counted, however, it is not feasible or representative to calculate the total area as the consultee has suggested.

The mitigation measures that we applied to options in our WRMP are high level commensurate with the early and strategic development stage of the option. As the option development phase progresses through to detail design stage then discussions will be held with Natural England and other stakeholders to agree appropriate mitigation measures following the detailed environmental assessment. Specifically regarding option WTW05, prior to implementation we will consult Natural England to discuss and agree appropriate mitigation measures to be incorporated in detailed design. This may include funding a study on the geological features of interest prior to the development of the reservoir and providing habitat to provide a link between the new reservoir and the existing SSSIs adjacent to the site.

Biodiversity

Discussion regarding our approach to biodiversity is provided in Appendix B1. We acknowledge our ability to influence, protect and enhance the biodiversity of our regions as a result of the scale and scope of our operation. Promoting biodiversity, particularly in the aquatic ecosystem, is one of the cornerstones of our business objectives. In terms of the SEA, we will review the assessment to identify opportunities for achieving biodiversity gain. These opportunities will likely revolve around the creation of new habitat associated with the reservoir options but we will also seek other opportunities to support biodiversity gain where appropriate. Option WTW05 in particular will be reviewed to account for opportunities of bankside habitat creation.

We recognise the importance of preserving the fauna and flora which depend on our reservoirs. Some of the assessments we have undertaken in connection to these storage options have already identified potential

adverse impacts on ecology as well as loss of habitat. However, we will seek to expand our existing WFD assessments (Appendices A and B of our WFD assessment report) and SEA assessment (Environmental report and SEA matrices) of the construction and operation phases of option implementation to include further consideration of habitat loss, changes in water quality within the reservoirs and impacts on ecology. Where potentially adverse impacts are identified, we will endeavour to undertake further investigations and develop mitigation measures in consultation with Natural England, local Wildlife Trusts and other relevant stakeholders.

Section 7 of the SEA Environmental Report will be updated to present strategic opportunities for Net Gain of biodiversity in our final WRMP.

'In combination' effects

We understand the need to consider the potential environmental effects of our options as a collective and not just individually. An initial in-combination assessment was undertaken using the information available at the time of our draft WRMP submission. This considered potential interactions between options WIL05, LIT01 and MEL29, as these solutions targeted abstractions and hence posed a potential risk of deterioration to the waterbodies in question. Option NOT04 was, and remains, assessed as a transfer solution only which does not need to be enabled by a new or an increased existing abstraction. The NOT04 solution will be enabled by surplus water within the Strategic Grid WRZ as a result of implementing other options within our WRMP. This surplus water resource is delivered from a combination of sources, all of which have been individually assessed against a WFD compliance. As a consequence, option NOT04 does not form part of the in-combination impact assessment for WFD due to our understanding that it does not pose a risk of deterioration to any WFD waterbodies.

A number of consultation responses requested clarification on our approach to the in combination assessment of the River Derwent and Derwent Valley raw water resources. Following the consultation period, the preferred programme of options has been modified as described in Appendix A6.1. This includes variations of the options BAM04 and GRD19 that were referenced in some consultation responses:

- The BAM04 transfer option has been replaced by a similar but smaller scale transfer option BAM03: Site R to Grindleford pipeline capacity increase (7.5Ml/d)
- The GRD19 transfer option has been replaced by a larger scale transfer option NOT05: Site E to South Nottinghamshire transfer solution (30Ml/d).

The intent of these options is to transfer potable water from our Strategic Grid WRZ to the Nottinghamshire WRZ. We recognise that the intent of some consultation responses regarding BAM04 and GRD19 will apply to the alternative options BAM03 and GRD19 and we have addressed these requests accordingly.

Two of the options noted by the consultee (NOT01 & GRD19) will transfer water between our Strategic Grid WRZ and our Nottinghamshire WRZ. The water being transferred will be produced within the Strategic Grid WRZ which covers a large part of our region and is not limited to River Derwent raw water sources. Options that enable us to produce additional water in the Strategic Grid WRZ have been individually assessed against a WFD compliance. The deployable output benefit achieved from the options has been assessed using our Aquator water resources model. The approach to modelling included ensuring that under predicted scenarios our existing licenses were not exceeded and that existing HOFs were unaffected. As a result we have proposed a programme of options that provide benefit whilst ensuring we operate within our current permissible bounds in terms of abstraction from raw water sources across the Strategic Grid WRZ area.

Options NOT01 and NOT04 do not form part of our in-combination impact assessment for WFD as they do not pose a risk of deterioration to any WFD waterbodies. Option NOT05 will be enabled through a small increase in abstraction at Ambergate, the details of which are still to be refined. However, it is anticipated that the

increase will be small and subject to the existing HOF conditions. Therefore, option NOT05 will be considered as part of the in-combination impact assessment for WFD within the main WFD report and the associated Appendix B. We believe the preferred programme of options in our final WRMP is achievable and will not deteriorate the WFD status of catchments.

As noted previously, we recognise the need to carry out an 'in-combination' assessment of our preferred programme of options with the WRMPs of our neighbouring water companies. We will complete this in-combination assessment once information about the final preferred programme of all neighbouring companies is available.

Monitoring plan

Section 8 of the SEA Environmental Report currently provides high-level monitoring indicators as appropriate to the strategic level of the assessment (refer to Section 8.3 of the SEA Environment Report). We will expand Section 8, so that it sets out strategic targets. These will be used to help develop specific targets when we undertake detailed environmental assessment as the options are developed in the future. The targets will also inform future monitoring plans, which will be used during the implementation phase of the plan.

The strategic targets will cover several potential impacts to the natural environment, built environment and human receptors and will include data sources where appropriate, as highlighted in Section 8 of the SEA. These will include water resources, water quality, biodiversity, climatic factors, transport, nuisance (community), amenity effects, landscape and visual amenity and cultural heritage.

The proposed monitoring indicators for the impacted receptors (described in Section 8.3 of the SEA Environmental Report) include data sources where possible, for instance, complaints logged with us and Local Authority Environmental Health Officers or equivalent and specific species and habitats surveys. The responsibility for the monitoring plan and the process we follow when taking remedial action will also be presented in this section.

Prior to the implementation of options, detailed monitoring plans will be put in place with specific targets and with responsibility clearly assigned. This will mean that the effects of options can be measured and actions tracked. Section 8 will be updated to make the ownership of the monitoring plan clearer alongside the strategic targets.

A6.7 SEA and environmental considerations - Update on specific options

A projected future supply / demand balance deficit has been identified in our Nottinghamshire WRZ. We have taken a considered approach to deriving suitable means of providing security of water supply into the future within the Nottinghamshire area. The option development and selection process included carrying out SEA, HRA and WFD assessments commensurate with the current stage of the options. Using a multi-criteria analysis selection tool, this option (NOT04) was determined to be one of the most favourable options to include in our future programme.

We received a number of queries relating to specific options that requested additional information regarding the environmental appraisal and potential delivery risks. This additional information is provided in the following section itemised by each specific option.

Option NOT04: Heathy Lea to North Nottinghamshire transfer solution

During the consultation we were asked whether this option would be subject to an Environmental Impact Assessment (EIA).

We are committed to acting responsibly and sensitively toward the environment and we place key importance on environmental considerations. Protecting and improving the environment for the future is a core part of our business operations to deliver a sustainable water industry.

We will ensure that environmental considerations of the construction and operation of the option are understood and the mechanism to do this is embedded within our project delivery procedures and standard methodologies for these types of infrastructure projects. We understand and are committed to compliance with the Town and Country Planning Act 1990 (and other relevant legislation) and the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended). Our standard operating procedure to permitted development rights, planning permission and EIAs highlighted it is not necessarily a statutory requirement for all such projects to be accompanied by a full Environmental Impact Assessment. As the option details are developed further, we will seek to address any likely environmental impacts in a pro-active manner by completing the necessary surveys and incorporating any mitigation requirements into the design of the option. Where appropriate or necessary, we will include a full Environmental Impact Assessment of the option in this process.

During the course of developing the option for our WRMP, we prepared a notional pipeline route. This pipeline route will be subject to further consideration and is likely to change, although the final route will be in keeping with the principle of the option as presented in our WRMP. The notional route enabled us to carry out a high level environmental risk assessment for the option commensurate with the current stage of the project. This included consideration of the SEA, HRA and WFD aspects of the proposed works and preparation of a risk table as demonstrated in Figure 6.5:

Figure 6.5 Environmental risk summary table: Option NOT04

WRMP Assessment	Findings (pre-mitigation)	Non-standard Mitigation Measures or other investigation highlighted[4]
HRA Findings	No Likely Significant Effect	Risks as expected for similar schemes, no show stoppers
WFD Findings	Negligible	
SEA Findings (Highest Significance Adverse Effect pre-mitigation)	Major Adverse	Pipeline refinement is strongly recommended as design progresses to avoid a SSSI, some areas of ancient woodland and registered parks and gardens. Impacts during construction on the setting of two AONBs and a National Park should also be considered during the design (and planning) process.

No formal assessment of land and planning matters or the likelihood for needing an EIA has been carried out yet. However, we acknowledge our ability to influence, protect and enhance the biodiversity of the region as a result of the scale and scope of our operations. Promoting biodiversity, particularly in the aquatic ecosystem, is one of the cornerstones of our objectives. We would welcome the opportunity to work with the Nottinghamshire Wildlife Trust to establish opportunities for biodiversity improvements as a result of the proposed programme of work.

Option BHS07: Ladyflatte BHs asset and water treatment enhancements

During the consultation of our draft WRMP, the Environment Agency commented on our option to enhance the Ladyflatte borehole source to achieve an abstraction of up to 2.7Ml/d. It was queried that owing to the location of the abstraction, the Ecclesbourne Catchment may experience a reduction in flows due to the potential aquifer drawdown. This potential reduction in flows may adversely impact on the ecological receptors, especially fish and macro-invertebrates which may be sensitive to changes in flow regime. The assessment is highlighted as uncertain, owing to the lack of data on the connectivity between the Ecclesbourne Catchment and the underlying aquifer.

In light of this uncertainty, further investigations will be undertaken to ascertain the likely connectivity between the aquifer and the surface waterbody, the likely magnitude of drawdown and related reduction in flows, as well as the sensitivity of ecological receptors to changes in flow regime. We believe this option is still achievable, subject to appropriate mitigation measures, which could include the following investigations:

- A detailed review of underlying geological strata, in order to establish the connectivity of the aquifer to the Ecclesbourne catchment.
- Modelling of the drawdown level likely to be experienced under the 2.7 Ml/d abstraction scenario and associated impacts on flows within the Ecclesbourne Catchment.
- Determination of likely impacts on ecological receptors (review of available ecological data or expert opinion, in the absence of data) in light of the new evidence provided by the hydrogeological and hydrological investigations.

Further investigations will be undertaken to ascertain the likelihood and severity of impacts upon WFD status for the aquifer and surface water body. These investigations will indicate whether WFD deterioration for either or both of the waterbodies will occur under the 2.7Ml/d abstraction scenario and whether any mitigation measures may be implemented to enable the option to be delivered. In the event that WFD deterioration risks cannot be mitigated, an alternative sustainable option will be provided in order to ensure that the final WRMP remains compliant whilst still meeting the needs of our customers.

Option CRO05: Thornton Reservoir to support Site B WTW

During the consultation of our draft WRMP, the Environment Agency commented on our WFD assessment of this option. In particular our conclusion that the option was compliant. We have now revisited the WFD assessment of this option which uses Thornton Reservoir as a raw water source for Site B WTW. We accept that based on currently available information, the option may potentially pose a risk of deterioration to Rothley Brook.

We believe this option is still viable in conjunction with appropriate mitigation, such as the provision of compensation flow for Rothley Brook and the implementation of specific licence conditions, similar to the previous S158 agreement. However, we have reflected the level of uncertainty posed by this option in our revised WFD assessment and compliance statement. We agree that we have not fully considered the implications of the new 12 Ml/d abstraction for the wider Rothley Brook Catchment and we have now re-assessed the option WFD compliance in Appendix B of the WFD report. Our assessment has drawn on the reservoir's recent use and operational pattern. The previous operational pattern involved the release of 10 Ml/d to the Rothley Brook and re-abstraction at Astley. Historically, there was an S158 agreement about the monitoring that would take place at Thornton Reservoir and the Rothley Brook abstraction. Thornton Reservoir also has compensation release of around 1Ml/d.

We will carry out further investigations to understand the impact of the abstraction on the flow regime within Rothley Brook and determine whether these will have adverse effects on its biology. We understand the Rothley Brook experiences issues with elevated phosphate concentrations and hence, alterations in flows may potentially lead to a further deterioration in status (currently moderate).

To this end, we propose to undertake the following:

- Cross-sectional flow surveys along Rothley Brook – to understand the changes in depth and velocity and whether these are likely to impact on ecological receptors.
- Ecological surveys – to understand the macroinvertebrate and fish species assemblages and understand whether the species present may be sensitive to the likely depth and velocity changes inferred from the cross-sectional flow surveys.

Based on the results of these investigations, we will either propose mitigation measures to ensure no deterioration or we will seek an alternative sustainable option to ensure that the final WRMP remains compliant whilst still meeting the needs of our customers.

The SEA for this option provides a strategic assessment of potential adverse effects on receptors such as Groby Pool Woods SSSI. During the implementation phase of the option, we will undertake project level environmental assessment which will inform the detailed design of options incorporating any mitigation measures required to ameliorate adverse effects. We will engage and consult with Hinckley & Bosworth Borough Council and other relevant consultees at that time to inform the mitigation approach.

Option WTW05: East Midlands Raw Water Storage

During the consultation of our draft WRMP, the Environment Agency commented on our WFD assessment of this option. The concerns were that Appendix B of our WFD assessment noted that abstraction would be subject to have a Hand Off Flow (HOF) of 340 Ml/d at Kegworth to protect the aquatic environment. However, the Environment Agency highlighted our option to gain a 45Ml/d deployable output benefit would require a higher HOF than 340 Ml/d. It was stated this is due to only a further 17 Ml/d can be licensed on the watercourse with the 340 Ml/d HOF.

We have carried out a series of different Aquator water resource modelling exercises to demonstrate the expected benefit of the option. Whilst there is variability in benefit magnitude depending on uncertainty factors such as climate change, we believe that sufficient raw water availability can be established within the East Midlands region to achieve a deployable output benefit in the order of that stated, without causing detriment to the environment. We are keen to work with the Environment Agency to demonstrate and agree that the option is viable.

Regarding the WFD Assessment, we originally undertook this assessment while considering that the HOF condition of 340 Ml/d at Kegworth would protect flows from any impacts that may arise as a consequence of the abstraction. However, we recognise that a different HOF may apply if a licence will be granted for this abstraction. As such, we have altered our assessment to remove the reference to the specific 340 Ml/d HOF currently mentioned in the River Soar Abstraction Licencing Strategy (ALS).

The River Soar ALS states that water is available for licensing throughout the catchment above Q70 flows and that this is reliable more than 95% of the time. Therefore, we are confident that no WFD deterioration risks will arise if appropriate HOF conditions are agreed for the proposed abstraction.

Option BHS15: Birmingham BHs conversion to potable supply

During the consultation of our draft WRMP, the Environment Agency commented on our WFD assessment of this option. The concerns were regarding our assertion that this option is WFD compliant whilst noting 'further assessment is required' and that 'The abstraction is unlikely to affect the water balance on a groundwater body scale'. We acknowledge the Environment Agency's comments that that the option involves conversion of the site from an 'infrequently used' augmentation purpose to continuous public water supply and that WFD deterioration and/or serious damage assessments should be based on Recent Actual abstraction amounts rather than Fully Licensed. The Environment Agency also commented that *"as this scheme will result in a significant increase in recent abstraction further Hydrogeological Risk Assessment will be required to inform a more comprehensive WFD assessment more reflective the current circumstances"*.

Our initial WFD assessment of this option for our draft WRMP was based on fully licensed scenarios and we recognise that this should have been based on recent actual abstraction volumes instead. As a consequence, we acknowledge that a change in operation will require further assessment and that this may pose a risk of deterioration to the groundwater body. As such, we have altered our assessment to clarify this and to fully indicate the degree of uncertainty presented by this option. This also means that we have highlighted risks for associated surface waterbodies such as River Rea and Hockley Brook.

As described in Appendix A6.1, this option is no longer in the preferred programme of options and this will be reflected in our final WRMP.

Option MEL29: Carsington Reservoir support to Site Q WTW with Site Q WTW enhancements

During the consultation of our draft WRMP, the Environment Agency commented on our approach to increase raw water abstractions from the River Dove using our Egginton intake. The Environment Agency noted that we *'recently carried out trials on the Eggington intake and found it was unable to reach its full licensed quantity due to pump capacity limitations caused by the dynamic nature of the river channel'*.

This options involves transfer of raw water from the River Derwent to Carsington Reservoir and subsequently discharged into the River Dove before abstraction and transfer to Site Q WTW. Our Egginton intake is an abstraction site on the River Dove which transfers raw water to two raw water supply reservoirs prior to treatment at Site Q WTW.

Recognising there may be limitations at the existing Egginton intake, this option has been developed on the basis of providing a new river intake further upstream on the Dove (near Rolleston on Dove) to support the existing Egginton intake. From the new abstraction site, a new pipeline will be installed from the new to the existing Egginton intake so that a connection can be made to the existing transfer mains to the raw water supply reservoirs for Site Q WTW. We are also investigating the work required to improve the existing intake to remove or reduce the restrictions to current operations.

Our detailed feasibility will continue to assess resilience of our network as a result of option implementation and make suitable provisions to safeguard customer supply as appropriate.

The combined impacts of options relying on Carsington Water will be reviewed to determine the significance of the potential impact on water levels. The results of this assessment will be presented in an updated Section 7.4 of the SEA Environmental Report.

Option DAM07 and DOR05: Draycote reservoir capacity increase and Site C WTW enhancements

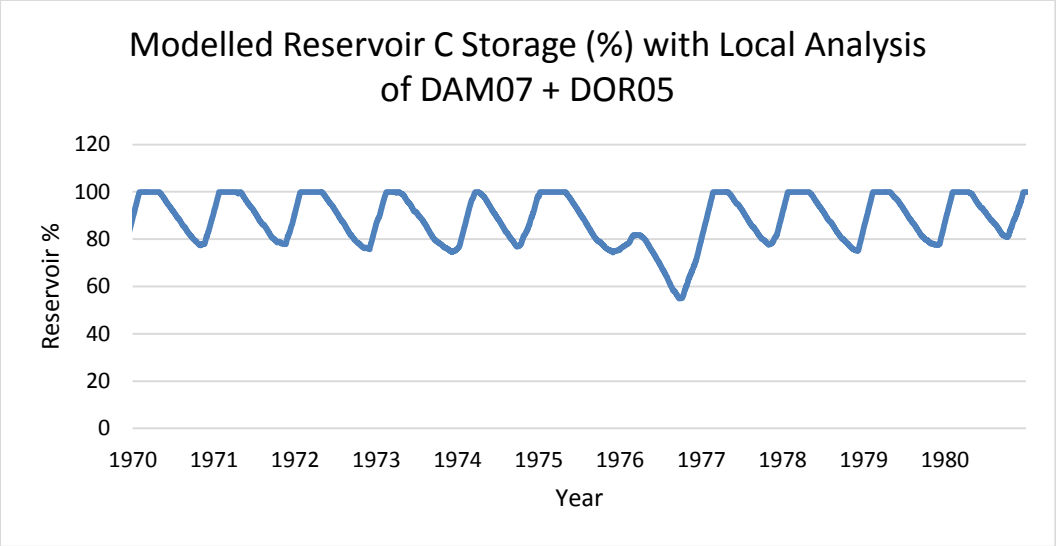
We received queries from the EA regarding the availability of water to refill the raw water supply reservoir subject to expansion in option DAM07. We have carried out further Aquator water resources modelling to demonstrate that these options are viable. A summary of our findings is given below, separated into three sections:

- Part 1: Analysis of option modelling demonstrating predicted reservoir refill patterns
- Part 2: Historic and recent actual reservoir refill data (1998 – 2018)
- Part 3: Effect of changes to the option implementation programme

Part 1 – Analysis of option modelling demonstrating predicted reservoir refills patterns.

Our water resource modelling for the combined DAM07 and DOR05 options (reservoir expansion and works capacity increase) shows that had the options been already implemented, we would have expected the reservoir to refill in most previous years with the exception of drought years, where the capacity increase of the reservoir is useful. Predicted reservoir level data from our water resource modelling of the options is shown in Figure A6.6 to demonstrate this matter.

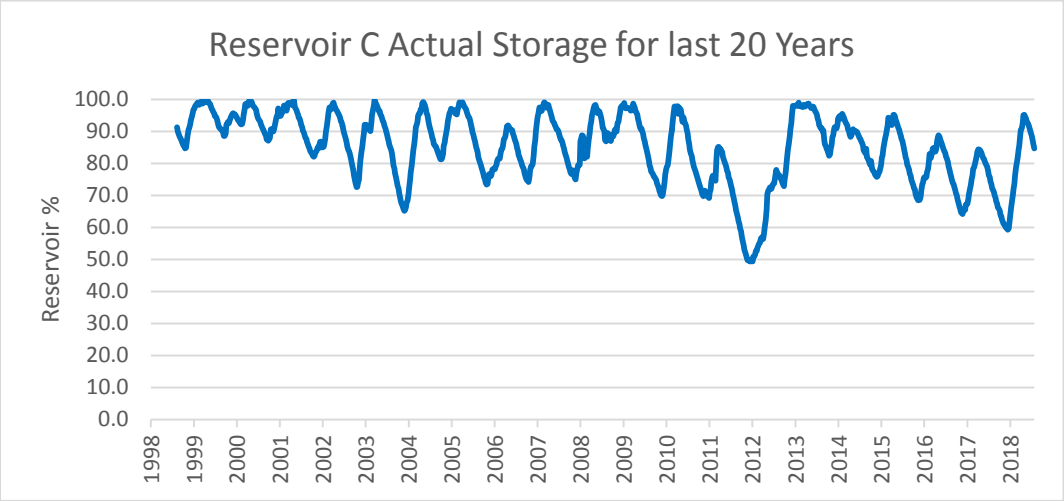
Figure A6.6 Expanded Draycote reservoir: Modelled top water level using historic data (1998 – 2018)



Part 2 – Historic and recent actual reservoir refill data (1998 – 2018)

Figure A6.7 shows actual levels in our existing Draycote raw water reservoir. This shows that the reservoir has refilled to well over 95% full for all but 5 years of the past 20 years. Of these 5 years, 2 years were the 2010-2012 drought period which included dry winter periods.

Figure A6.7 Existing Draycote reservoir: Actual top water level data (1998 – 2018)



The recent years in which we have not fully filled the reservoir have been due partly to the relatively new challenge caused by Metaldehyde and partly due to operational issues with associated plant. However, as demonstrated in Figure A6.7, this year we have again successfully filled the reservoir to the 95% full level. We believe we can continue to achieve good refill in the reservoir during normal years for the following reasons:

- We have supported creation of, and implemented, a metaldehyde model to proactively predict periods when metaldehyde spikes are likely to occur on the rivers from which the reservoir is filled. This means that instead of being unable to abstract during the peak metaldehyde season for many days and thus reducing the amount of refill available across each winter, we are now able to suspend abstraction during the just the actual spike in metaldehyde concentrations in the river. This model has been trialled over the last year and has proven very successful as demonstrated by the increased refill during winter 2017/8.

- During the last refill period we introduced better operational practice around maximising our abstraction, with increased monitoring of when abstraction was available allowing us to make full use of abstraction opportunities as they arose. This increased monitoring has helped us refill to 95% last year.

- We refilled the reservoir during winter 2017/18 despite one of our abstraction pumps being out of service. We are planning to replace this pump during 2018 and with all pumps in service we would expect to see good refill on a more consistent basis in future years.

We believe that having implemented the metaldehyde model, introduce better operational practices and renewed some of our abstraction infrastructure we will be able to fill the reservoir more consistently in the future, with the exception of drought years, where the extra storage offered by option DAM07 will be most beneficial.

Part 3 – Effect of changes to the option implementation programme

Between our draft and final WRMP, we have updated the timings of the options related to Draycote reservoir. This has resulted in the DOR05 WTW enhancement option now being planned to be completed after the DAM07 dam raising option. DOR05 will be completed in 2030 and DAM07 will be complete in 2027. This will further improve the reliability of the benefit of option DOR05 in particular.

Option WIL05 Site E WTW expansion and transfer main supported by raw water augmentation of the River Trent

This option as presented in our draft WRMP involved the augmentation of flows in the River Trent by diverting treated effluent at our Barnhurst site from its current discharge into the Staffordshire and Shropshire Union canal to the River Penk, a tributary of the River Trent. Since publishing our draft WRMP we have liaised with the Canal and River Trust (CRT) and decided to remove the Barnhurst effluent transfer proposal from this option. This is due to the potential adverse impacts of this approach on the Staffordshire and Shropshire Union canal as well as the River Penk. The option requires additional abstractions from the River Trent to be supported and we have several alternative options to the Barnhurst approach, including a revised CRT option to deliver 15Ml/day of surplus water in the Birmingham Canal Navigation to Fradley, near the River Trent. Our analysis of the alternatives and discussions with potential suppliers will be concluded by March 2019. We will update our WFD and SEA assessments to reflect the alternative source of water for this option.

In the event that further opportunities are identified to augment river flows using treated wastewater from our treatment facilities, these would only be progressed if we can demonstrate that there would be no detrimental impact to the watercourse concerned. Any new wastewater effluent discharge would need to be permitted by the EA, and the necessary permit would only be issued if the option was compliant with Water Framework Directive No Deterioration requirements. Effluent discharges are required to be treated to a very high standard prior to discharge to achieve this compliance.

Option UNK07 Improve Site L WTW outputs during low raw water periods

During the consultation of our draft WRMP, the Environment Agency commented on our intention to implement this option to enable Site L WTW to operate at lower throughput and thereby enabling longer periods of operation through the year. The Environment Agency noted concerns about the impact of these options on RSA sustainability reductions in the area and, in particular, the outcomes of the ongoing Lower Churnet desk study.

This option will enable Site L WTW to continue treating water when the abstraction rate is reduced to less than 16Ml/d. The proposal will mean that the minimum throughput of the site to allow it to remain operation will be in the region of 8Ml/d. This provides a deployable output benefit by enabling Site L to operate at a reduced output capacity further into dry seasons than is currently possible.

We have been investigating changes to the compensation flows from Site L as part of the separate RSA scheme. This has considered both decreases and occasional increases to the flowrate of the compensation flow alongside the potential merits of each arrangement. However it is recognised there is a need to consider the impact of any change to compensation on the Mid/lower Churnet. We are continuing to work with the EA to discuss the outputs of these considerations and agree the study outcomes.

The development of the feasible and preferred options in the WRMP has been carried out with reference to the strategic nature of the plan. During development of these options, we used a variety of methods to understand the new and emerging future water supply / demand challenges and explore the available options to provide a sustainable and secure water supply to STW customers into the future. This process included using our in-house expertise in hydrology, hydrogeology, ecology, engineering and economics as well as our specialist suppliers.

A staged approach was carried out to progress options from conception through to development and subsequent appraisal. This has involved studying the individual asset areas that each option involves. We acknowledge that as the options are developed further there will be a need for further detailed environmental feasibility study, particularly of hydrological aspects, to ensure there is no detriment to the downstream

watercourses. This will include assessment of our ability to deliver the agreed compensation rate and any changes to the number of times the reservoir overtops.

We have presented a preferred programme of supply side options that we are confident is achievable; will provide the stated benefits; and meet the challenge of providing a cost effective and sustainable water supply into the future.

Combined effects of options associated with the Derwent Valley system

We understand the need to consider the potential environmental effects of our options as a collective and not just individually. A number of consultation responses requested clarification on our approach to the in combination assessment of the River Derwent and Derwent Valley raw water resources. Our response to this matter is provided in Section 6.6 of this document.

Option GRD16 Clungunford / Oakley Farm BH enhancements

Option GRD16 option provides a deployable output benefit to the Bishops Castle WRZ. This WRZ has no projected future supply / demand balance deficit, therefore the option was not selected in the preferred programme of options in our WRMP.

Nevertheless, we have altered our SEA assessment to reflect the information the Environment Agency has provided about the WFD no deterioration investigation assigned to the Clungunford licence. We recognise the potential risk of deterioration this licence investigation may impose on the River Clun. Based on the information currently available and given the current uncertainty, this option has the potential to deteriorate the WFD status of the River Clun. Therefore the option has been excluded from our final WRMP.

Option BHS03 Preston Brockhurst BH asset and water treatment enhancements

Option BHS03 provides a deployable output benefit to the Whitchurch & Wem WRZ. This WRZ has no projected future supply / demand balance deficit, therefore the option was not selected in the preferred programme of options in our WRMP.

Nevertheless, in light of the new information provided by the EA with regards to the risk of flow failure as a consequence of increased abstraction, we have altered our assessment to reflect the uncertainty regarding the risk of deterioration imposed by this abstraction on the River Roden and the groundwater body itself. Based on the information currently available and given the current uncertainty, this option has the potential to deteriorate the WFD status of the River Roden. Therefore the option has been excluded from out final WRMP.

Pipeline solutions

A number of options in our preferred programme involve the construction of new strategic pipeline transfers. During consultation of our draft WRMP we received queries asking for more information about how we will manage the environmental impacts of the pipeline construction.

We have a company wide Code of Practice which sets out our obligations and duties when we carry out works on private land. This Code of Practice can be found on our website; www.stwater.co.uk/codesofpractice. It also explains what landowners and/or occupiers of land are entitled to expect from our activities.

The Code of Practice has been prepared under section 182 of the Water Industry Act 1991 (the Act) and has the approval of the Secretary of State. The Act allows, and in some cases requires, us to do these works. It also sets out some rules for us to follow when we lay, alter or maintain pipes and their associated accessories. If we are deemed by OFWAT to be in breach of the Code of Practice under Section 181 of the WIA 1991 then an award to the affected party of up to £5,000 can be granted. Breaches of the code can include poor

consultation regarding siting of above ground accessories, excessive disturbance or poor reinstatement of property.

The Code of Practice sets out the procedures that we follow before, during and after we lay pipes in private land. Before we lay a pipe we need to plan a route. We take various factors into consideration including the following:

- Directness of possible routes;
- Disruptive effect of the work;
- Engineering considerations including access for construction work;
- The cost (both of laying and of maintaining the pipe) including the level of reasonable compensation;
- The avoidance of sites of environmental and archaeological importance.

At the route planning stage, we also aim to confirm ownership and occupation of any land that may be affected by any proposed works. We will then consult with landowners and occupiers and seek to minimise the impact on them.
When planning a new pipeline project in a rural location we normally prefer to select a route which passes through open fields, but we will give due consideration to positioning valves and other fittings close to field boundaries to minimise interference with future agricultural operations.

We'll take account of all the matters mentioned above, as well as considering any suggestions that landowners may have about the route of the pipe, the position of valves and fittings, the timing of the work and the reinstatement of land and land drains. By the time we make the final decision about the route we will have taken into account engineering and operational needs, the long and short term costs of the work, and any comments or suggestions that farmers, landowners and land agents have made.

When the work is complete, we will restore the area where we have worked to the same condition that it was in before we started. On the occasions that this is not reasonably possible, we'll pay compensation to reflect the depreciation in the value of the land. If we cause any permanent loss in the value of land as a result of the presence of our pipes, or if farmers suffer from any temporary losses or disturbance caused by the work, then the affected parties may also be entitled to additional compensation. We are committed to trying to reach mutual negotiated agreement over the level of reasonable compensation applicable and if this cannot be agreed we would normally be willing to participate in some other form of Alternative Dispute Resolution (ADR).

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