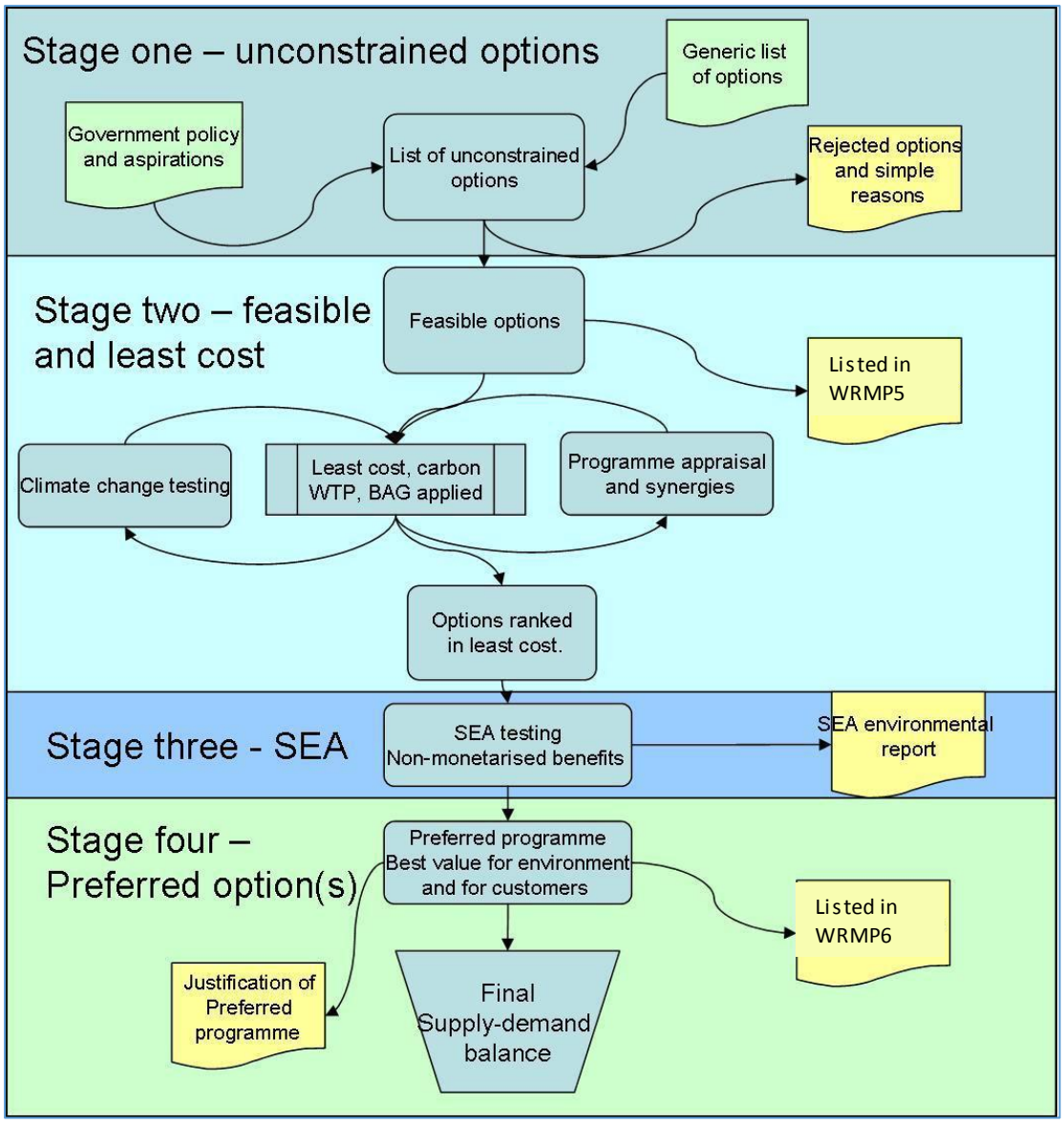
Appendix D – Our Options

D1 Our options screening process

An important stage in the water resources planning process is the identification and evaluation of the range of options we have available to us for managing the supply / demand balance over time. Figure D1.1 illustrates the stages we go through to narrow down our list of possible investment options.

Figure D1.1: The stages of an option appraisal process



This appendix explains how we produced our unconstrained list of options and the screening process that we have followed. Chapter 6 of this draft Water Resources Management Plan (dWRMP18) summarises the preferred options that we believe will provide a sustainable and best value solution to the long term water supply / demand challenges that we face. Descriptions of the social and environmental impacts of the full range of feasible options considered in our plan are given in the accompanying Strategic Environmental Assessment report.

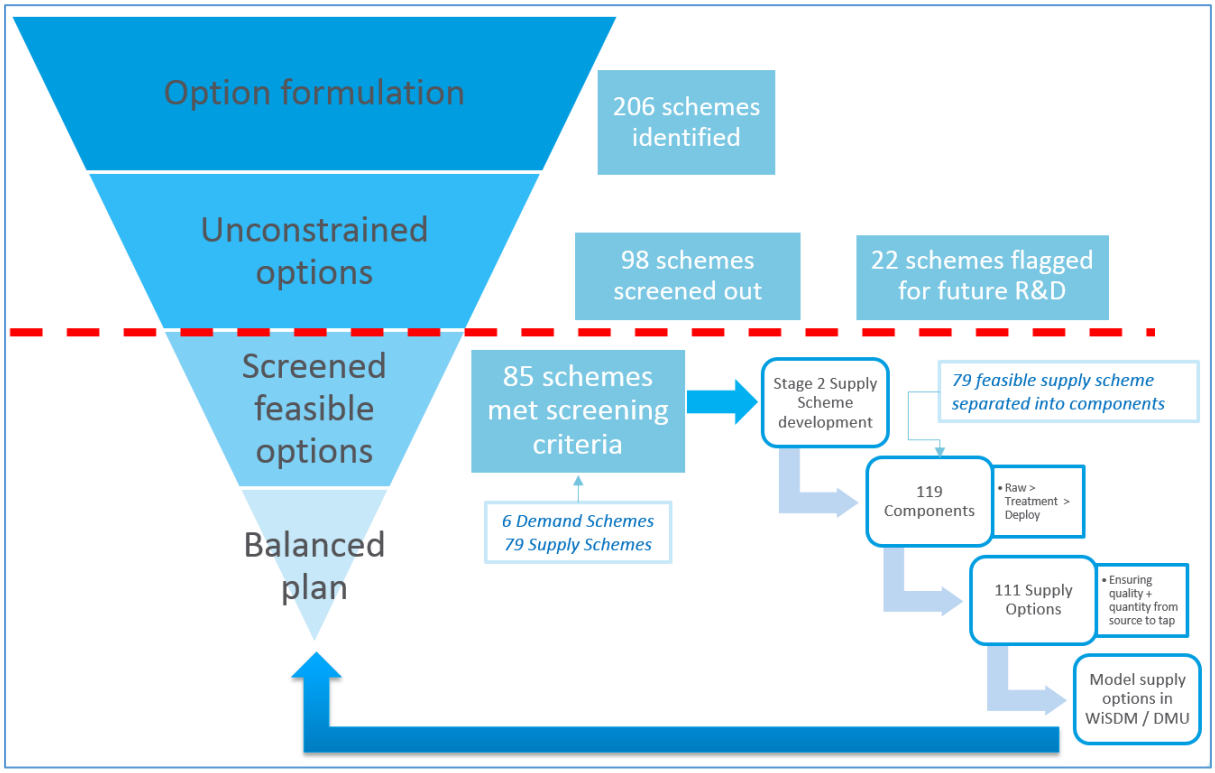
The first step of our options appraisal process was an initial assessment of a wide range of potential future supply and demand management options and a review of their viability. We used a screening process to exclude the least feasible options and to allow us to focus on those with the best potential for future development. The most feasible options were then taken forward for a more detailed engineering and environmental assessment.

The options appraisal process is at a strategic level and does not preclude the need for further analysis as we implement our plan. This strategic process is not a substitute for the detailed, option appraisal that would be needed to support site specific planning or abstraction consents.

The stages of this process have taken an initial list of 206 potential options to enhance water supply capability, and screened the potential options against a set criteria. This reduced the number of options to 85, 79 of which were supply related. During the next phase of scheme option development, we broke these feasible options down into their raw water, treatment and deployment components. These 119 components were then engineered into 111 feasible supply options, which represent the different ways that they could be configured to deliver holistic source to tap supply solutions.

The stages of our screening process and how they have gradually reduced the number of options being considered in our dWRMP18 are illustrated in figure D1.2 below.

Figure D1.2: The stages in our options appraisal process



The remainder of this chapter describes the types of options that were considered and explains the process we have followed to screen out the least feasible options.

D2 Developing a list of unconstrained supply / demand options

For the first stage of this process, we identified a wide range of potential investment options that could be implemented to fill projected deficits in the supply demand balance over the 25 year planning period and beyond.

At the time that the initial unconstrained list was being developed, our detailed understanding of the future supply / demand needs of each of our Water Resource Zones (WRZs) had not been completed. Therefore, we developed a range of unconstrained options by considering those supply areas that we considered could be vulnerable to potential future changes in supply and demand for water. For example:

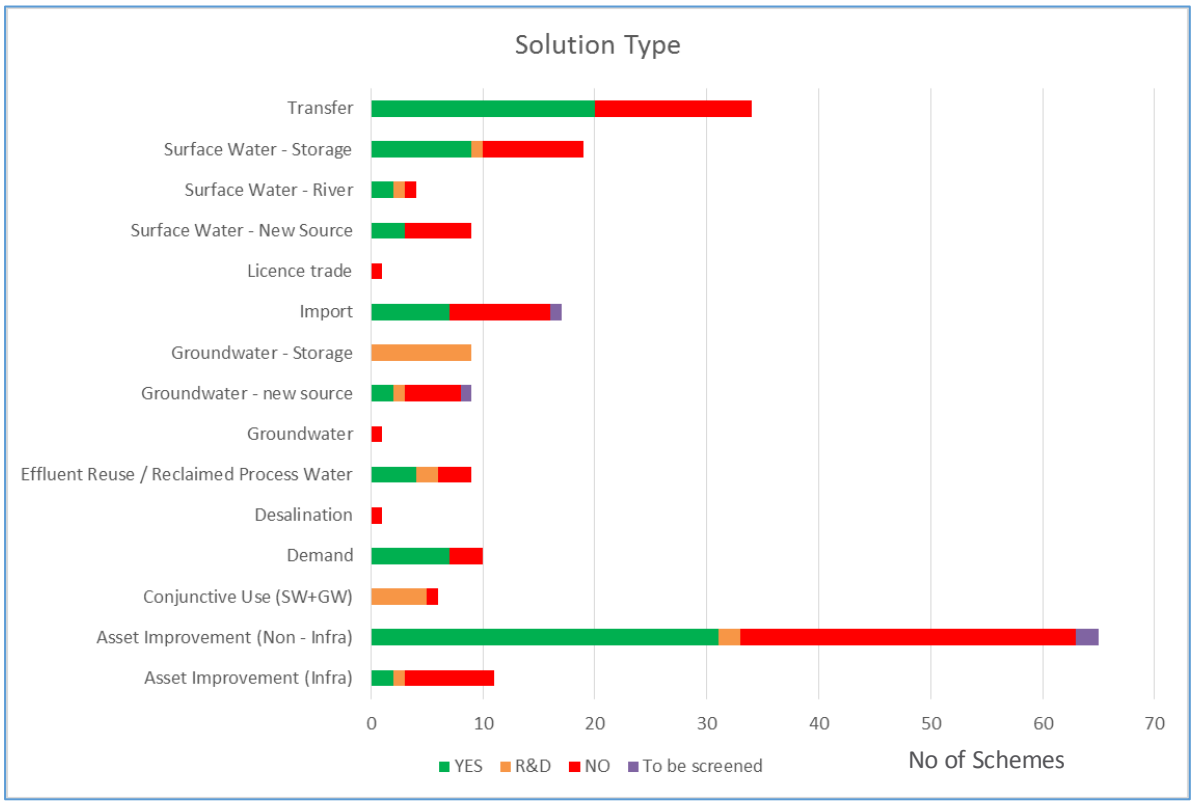
- those WRZs where our extensive AMP6 Restoring Sustainable Abstraction low-flow investigations were indicating that we may need to reduce abstraction on environmental grounds;
- areas supplied from sources which were identified in the Environment Agency's 2016 Sustainable Catchments data release as being likely to cause a future environmental deterioration and impact on Water Framework Directive status;
- areas supplied from sources with current or projected water quality performance problems and where treatment or catchment investment is likely to be needed;
- areas supplied from sources with current or projected supply performance or resilience concerns;
- supply areas expected to see significant population and housing growth;
- areas fed by sources thought likely vulnerable to drought and climate change, principally surface water sources where deployable output is linked to river flow or groundwater spring sources.

When we carried out our initial assessment we tried to identify potential opportunities to maximise the sustainable use of our existing strategic assets and abstractions. In particular, we looked for options around:

- existing assets with underused capacity/flexibility due to constraints posed by abstraction licences, treatment capacity, pipework constraints etc.;
- existing assets where additional deployable output can be gained with relatively limited capital works;
- pipeline or river transfers from zones/assets likely to have surplus to those with deficit;
- transfer of abstraction from environmentally-unsustainable locations to locations where they would be sustainable, e.g. by moving abstraction down-catchment;
- water quality improvements that have or are likely to happen at Severn Trent's waste water treatment works river discharges that could augment river flows;
- links from neighbouring water company assets.

The range and type of unconstrained supply options that we identified through this process are illustrated in figure D2.1 below.

Figure D2.1 – Range of Identified supply-side unconstrained options



We also formulated a list of potential water efficiency options that could be used to help customers reduce consumption, as summarised in table D2.1. One important difference for this draft WRMP has been the change in legislation around supplying non-household customers and the role of licensed retailers. Changes to the water market came in to effect on 1 April 2017, and mean that most businesses and non-household customers in England can now choose which company they want to supply their retail water services. The wholesale supplier of water no longer deals directly with these household customers, and instead it is the retailer who will offer services such as water efficiency to these customers. As a result, our previous water efficiency options to target non-household customers are no longer available to us, and instead we will engage with retailers to understand their water efficiency programmes.

Table D2.1 – Range of identified demand-side unconstrained options

Type of scheme	Comment
New buildings Higher specification water efficient fitting as standard	Offer house builders advice on higher specification and more water efficient fittings in homes (A selection of taps, showers, WC, bath, water butts). Alternatively, we could offer a financial incentive/subsidy if there is an extra cost for installing fitting of a higher water efficiency specification.
Distribution of free water saving products	This is a continuation of our current policy to promote and provide water saving devices to all customers. This part of our current offer to meet our statutory water efficiency duty and regulatory water efficiency targets
Domestic audit and retrofit with 3rd parties	In addition to our own home audit and retrofit programme we will build partnerships with other organisations (e.g. social housing and energy efficiency providers) where partners install water efficient devices in customer homes on our behalf
Education	Offering education to children and adults about the need for and benefits of using water wisely is a continuation of our current policy to promote water efficiency information to customers. This is part of our current offer to meet our statutory water efficiency duty and regulatory water efficiency targets
Rainwater harvesting / grey water reuse - retrofit domestic	Install rainwater harvesting / grey water reuse systems in existing domestic properties.
Rainwater harvesting / greywater reuse – new build domestic	Install rainwater harvesting / grey water reuse systems in new build domestic properties.

In addition to these water efficiency options, we have considered options to increase the uptake of domestic water metering.

Type of scheme	Comment
Compulsory household metering	Our supply area is not designated an area of serious water stress by the Environment Agency, and so we do not have legal powers to compulsorily meter household customers. However, we have tested whether such a policy could be cost beneficial.
Targeted accelerated metering programme with 'persuaded optants'	We would proactively install meters at property boundaries on a geographical basis and use the metered data to inform our network management and leakage targeting. We will engage with household customers and inform them whether they could have saved money

Type of scheme	Comment
	had they been paying on a metered basis. Water consumption insight would also be used to target water efficiency activity.

D3 Scheme rejection log and the list of feasible options

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.

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Ref	Screening criteria	Y / N
1	**Does the option address the problem?**	**Y**
	a) Is the scale of the option proportionate to the needs of the Water Resources Zone or area where there is a potential future shortfall?	Y
	b) Will the option have a high likelihood of being able to mitigate against future deployable output loss due to climate change impacts or licence changes to existing sources?	Y
2	**Does the option avoid breaching any statutory &/or regulatory constraints?**	**Y**
	a) Is the option likely to be acceptable in terms of planning and statutory environmental constraints local to the scheme (e.g. internationally or nationally designated sites), subject to any reasonable mitigation measures?	Y
	b) Does it cause serious damage or deterioration to the WFD water body? (Category 1 and 2 Environment Agency's Achieving Sustainable Abstraction)	Y
3	**Is the option promotable / does it meet customer and stakeholder expectations?**	**Y**
	a) Could this scheme have a negative impact on the customer experience at the tap? e.g. supply, pressure, water quality (taste, odour, discolouration), compulsory metering (customer complaints PR09)	Y
	b) Does the scheme compliment other parts of STWL's business plan strategy and deliver wider benefits, e.g. supply resilience, quality and capital maintenance?	Y
	c) Is the scheme likely to be acceptable to local (non-statutory) stakeholder groups, subject to reasonable mitigation?	Y
	d) Does the option avoid customer discrimination or social equity issues?	Y
	e) Does the option clearly represent one of the more favourable development options for this specific source of water?	Y
4	**Do we have confidence that the option will succeed?**	**Y**

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Ref	Screening criteria	Y / N
	a) Is the option scalable and operationally flexible to meet changing STWL supply/demand needs?	Y
	b) Is there a high level of confidence that the scheme will be technically feasible?	Y
	c) Is the option resilient under-a range of external future scenarios? (licence reform, water quality, climate change, political & legislative changes)	Y
	d) Could the scheme deliver the benefits without the need for extensive trials, research and development?	Y
	e) Is likely that a Public Water Supply Abstraction licence be secured?	Y
5	**Is the proposed scheme subject to Welsh legislation?**	**Y**
	a) Does it satisfy Welsh Government's expectations for new water exports from Wales? (e.g. Future Generations & Wellbeing Act?)	Y
	b) Would the people of Wales be disadvantaged by this option?	Y
6	**Should the option be taken through to the Constrained List?**	**Y**

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. Through this unconstrained options screening stage we produced a list of 111 possible new water supply options. 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.

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Table D3.1: Scheme Rejection Log

WRMP19 Ref	Scheme Name	Question 1: Does the option address the problem?	Question 2: Does the option avoid breaching any statutory &/or regulatory constraints?	Question 3: Is the option promotable / does it meet customer and stakeholder expectations?	Question 4: Do we have confidence that the option will succeed?	Question 5: Is the proposed scheme subject to Welsh legislation?	Question 6: Should the option be taken through to the Constrained List?	Key Reason for Rejection
1	Acton Trussell Borehole	Y	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
5	Derwent Valley Transfer Main	N	N	N	N	n/a	N	Option unfavourable. Alternative solutions to utilise Carsington raw water source and Site R treatment and deployment are preferred. Option may potentially cause a detrimental impact to an environmentally protected site.
6	Derwent Valley Storage Increase	Y	N	N	N	n/a	N	Option may potentially cause a detrimental impact to an environmentally protected site.
10	Beckbury Group increase	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
11	Belper Meadows BH Recommissioning	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
13	Buckshaft BH Conjunctive Use	N	N	N	N	n/a	N	Option no longer valid. Distribution upgrades completed in AMP5.
15	Cotswold Springs Recommissioning	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.

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18	Elan Reservoir to Llandinam Pipe	N	n/a	n/a	n/a	n/a	N	There is no supply/demand deficit in Llandinam and Llanwrin WRZ.
19	Elan Reservoir Expansion (Small Dam to Wye)	Y	N	N	N	N	N	Option may potentially cause a detrimental impact to an environmentally protected site.
20	Elan Reservoir Expansion (Medium new dam)	Y	N	N	N	N	N	Option may potentially cause a detrimental impact to an environmentally protected site.
21	Elan Reservoir Expansion (High dam)	Y	N	N	N	N	N	Option may potentially cause a detrimental impact to an environmentally protected site.
23	Site S Hydraulic Enhancement & Increase flow	N	n/a	n/a	n/a	n/a	N	Option not valid as there is no Deployable Output benefit.
24	New Pipeline from Elan to Site U	N	n/a	n/a	n/a	n/a	N	Option no longer valid - superseded by Birmingham Resilience Project.
26	Shared South Staffordshire Asset to Site G	N	n/a	n/a	n/a	n/a	N	Option not valid as there is no Deployable Output benefit. This is being considered for PR19 Resilience.
28	Hencott Borehole	N	n/a	n/a	n/a	n/a	N	Option may potentially cause a detrimental impact to an environmentally protected site.

WRMP19 Ref	Scheme Name	Question 1: Does the option address the problem?	Question 2: Does the option avoid breaching any statutory &/or regulatory constraints?	Question 3: Is the option promotable / does it meet customer and stakeholder expectations?	Question 4: Do we have confidence that the option will succeed?	Question 5: Is the proposed scheme subject to Welsh legislation?	Question 6: Should the option be taken through to the Constrained List?	Key Reason for Rejection
35	Kenilworth BH Scheme	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
36	Warley Tower (South Staffs) Link	N	n/a	n/a	n/a	n/a	N	Option not valid as water not available for Deployable Output under Business As Usual. Drought Scheme only.
37	Purton WTW (Bristol Water) Link	N	n/a	n/a	n/a	n/a	N	No Water Available.
40	Monksdale BH Recommissioning	Y	N	N	N	n/a	N	Option unfavourable. Low confidence in Deployable Output benefit after treatment processes.
41	Nanpantan WTW Redevelopment	N	n/a	n/a	n/a	n/a	N	Option no longer available. The land has been sold off.
42	New WTW at Carsington	N	n/a	n/a	n/a	n/a	N	Option not valid - superseded by scheme 125.
43	New river WTW at Hayden (Gloucs)	Y	Y	N	N	n/a	N	Other more favourable options to utilise River Severn water are available. Unsuitable location and water quality risks due to proximity of STWks.
46	New river WTW on River Idle	Y	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
49	Nottingham Groundwater	Y	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.

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51	Pinnock Springs Recommissioning	N	n/a	n/a	n/a	n/a	N	Option no longer valid. Abstraction Licence revoked as part of AMP6 Restoring Sustainable Abstraction Programme.
56	River Tame Resource Development	N	n/a	n/a	n/a	n/a	N	Option unfavourable for final effluent reuse. Minworth STW is prioritised for further development due to greater Deployable Output benefit.
57	Buxton Resource Development	N	n/a	n/a	n/a	n/a	N	Option no longer available WTW closed down.
59	Lower Severn to Site C	Y	Y	N	N	n/a	N	Other more favourable options are available for achieving same outcome.
60	New Birmingham Trent Support BH	N	n/a	n/a	n/a	n/a	N	Option not valid - superseded by scheme 144.
62	Convert Short Heath BH to Potable Supply	N	n/a	n/a	n/a	n/a	N	Option no longer valid. Duplication - this is a sub option to scheme 12.
63	Stableford BH Recommissioning	Y	N	n/a	n/a	n/a	N	Option may potentially cause deterioration under WFD.
65	Stanton by the bridge/Milton Combined Trent Augmentation	N	n/a	n/a	n/a	n/a	N	Option not valid - superseded by scheme 64.

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67	Severn Rail Tunnel to Gloucester	N	n/a	n/a	n/a	n/a	N	Option no longer available.
69	River Dane to Site L	Y	N	n/a	n/a	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
72	Rudyard Reservoir to Site L	Y	N	n/a	n/a	n/a	N	Option may potentially cause deterioration under WFD.
73	Naturalise Site L Compensation	N	n/a	n/a	n/a	n/a	N	Option not valid as there is no Deployable Output benefit.
74	Site G River Severn Winter Licence	N	n/a	n/a	n/a	n/a	N	Option no longer valid - superseded by Birmingham Resilience Project.
75	Rivelin Raw Export Reduction	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 169.
76	Expand Uckington BH Output	N	n/a	n/a	n/a	n/a	N	Option no longer valid. Scheme being delivered in AMP6.
85	Middle Severn Support Reservoir	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 143.
86	Site S to Site G Transfer Link	N	n/a	n/a	n/a	n/a	N	Option no longer valid - superseded by AMP6 scheme.

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87	Bourne Augmentation (Coleshill)	Y	Y	N	N	n/a	N	Option unfavourable for final effluent reuse. Minworth STW is prioritised for further development due to greater Deployable Output benefit.
91	Wing to Hallgates new link main	N	n/a	n/a	n/a	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
92	Whitacre to Birmingham Trunk Main	N	n/a	n/a	n/a	n/a	N	Option no longer valid - superseded by Birmingham Resilience Project.
93	Strategic Grid Enhancement (Whitacre to Leicester)	Y	N	n/a	n/a	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
97	Blackbrook Reservoir Transfer	Y	Y	N	N	n/a	N	Option no longer valid. More favourable development for source of water.
98	D.O. Recovery at Existing GW sites	N	n/a	n/a	n/a	n/a	N	Option is not valid. Recovery of Deployable Output is a maintenance driver for PR19 investment.
100	Clungunford Resource	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
102	Llandinam Raw Resource	N	n/a	n/a	n/a	n/a	N	There is no supply/demand deficit in Llandinam and Llanwrin WRZ.

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106	Whitchurch Zone Resource	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
107	Rutland Link	N	n/a	n/a	n/a	n/a	N	No Water Available.
113	New Borehole nr. Chalford	N	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
115	Barr Beacon Bulk Import	N	n/a	n/a	n/a	n/a	N	Option no longer valid - superseded by Birmingham Resilience Project.
116	South Staffs Borehole Raw Import into Site S	N	n/a	n/a	n/a	n/a	N	Option not valid. Low confidence in continuous supply.
118	Elan-Wye Additional Augmentation	Y	N	n/a	n/a	n/a	N	Option may potentially cause a detrimental impact to an environmentally protected site.
119	Process water recovery	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 99.
124	Dove Augmentation (Clay Mills)	N	n/a	n/a	n/a	n/a	N	Option unfavourable for final effluent reuse. Minworth STW is prioritised for further development due to greater Deployable Output benefit.
126	Wellesbourne Conjunctive Use	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
127	Ombersley to Site U transfer	N	n/a	n/a	n/a	n/a	N	Option no longer valid - superseded by Birmingham Resilience Project.

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129	Bromsgrove GW Licence Transfer	N	n/a	n/a	n/a	n/a	N	Option no longer valid. Scheme being delivered in AMP6.
130	Lower Worfe BH Augmentation	Y	N	n/a	n/a	n/a	N	Option may potentially cause deterioration under WFD.
133	Weston Jones Pump Replacement	N	n/a	n/a	n/a	n/a	N	Option no longer valid. Scheme being delivered in AMP6.
136	Purchase Eyebrook reservoir and associated abstraction licence.	N	n/a	n/a	n/a	n/a	N	Option unfavourable. Alternative option (scheme 190) for better use of source water.
137	Purchase borehole and licence from RWE for borehole site near Rugeley	Y	N	N	N	n/a	N	Option may potentially cause a detrimental impact to an environmentally protected site.
139	Transfer water from Campion Terrace and/ or Lillington boreholes to Site C for treatment	N	n/a	n/a	n/a	n/a	N	Option not valid as there is no Deployable Output benefit.

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140	NO LONGER AVAILABLE - licence revoked. Purchase abstraction licence from EON/ Uniper for High Marnham site near Newark	N	n/a	n/a	n/a	n/a	N	Option no longer available.
141	Provide sufficient supply to Site K during low flows so that we do not need the controversial Wyelands drought order	Y	N	N	N	n/a	N	No Water Available.
143	W.Midlands Raw Water Storage	Y	Y	N	N	n/a	N	Option not available in timescales required.
145	Desalination in Severn Estuary	Y	N	n/a	n/a	n/a	N	Option may potentially cause a detrimental impact to an environmentally protected site.
146	Vyrnwy back pumping scheme	Y	Y	n/a	N	n/a	N	Option no longer valid - superseded by newly developed solution VYR02.

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147	Importing icebergs/ tankers of water from Northern European countries	N	n/a	n/a	n/a	n/a	N	Option not valid as water not available for Deployable Output under Business As Usual. Perceived as an extreme Drought option.
148	R. Severn Free flow scheme - increasing storage in Severn during low flows by replacing fixed weirs with sluice (gates) and actively managing levels	Y	N	n/a	N	n/a	N	Option unfavourable. Low confidence in asset ownership buy in, may potentially cause a detrimental impact to an environmentally protected site and deterioration under WFD. Alternative options available for better use of source water.
149	To purchase abstraction licence from GDF Suez for Rugeley power station near R. Trent - scheduled to close summer 2016	N	n/a	n/a	n/a	n/a	N	Option no longer available.

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153	Develop next phase of (EA) Shropshire groundwater scheme (SGS)	Y	N	N	N	n/a	N	Option may potentially cause deterioration under WFD.
154	Consider use of currently disused reservoir at Witcombe	N	n/a	n/a	n/a	n/a	N	Option no longer available.
155	Consider use of currently disused reservoir at Esgaireira	N	n/a	n/a	n/a	n/a	N	Option not valid as water not available for Deployable Output under Business As Usual. Drought Scheme only.
156	Purchase abstraction licence from EON/ Uniper for Drakelow on River Trent site near Burton on Trent	N	n/a	n/a	n/a	n/a	N	Option no longer available.
157	Re use effluent/ waste water from other waste water treatment works e.g. from Huthwaite, Trescott, Rugby	N	n/a	n/a	n/a	n/a	N	Option unfavourable for final effluent reuse. Minworth STW is prioritised for further development due to greater Deployable Output benefit.

WRMP19 Ref	Scheme Name	Question 1: Does the option address the problem?	Question 2: Does the option avoid breaching any statutory &/or regulatory constraints?	Question 3: Is the option promotable / does it meet customer and stakeholder expectations?	Question 4: Do we have confidence that the option will succeed?	Question 5: Is the proposed scheme subject to Welsh legislation?	Question 6: Should the option be taken through to the Constrained List?	Key Reason for Rejection
160	Bestwood BHs	Y	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
161	Much Wenlock BHs	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 193.
164	Rowington BH	Y	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
165	Shrewley BH	Y	N	N	N	n/a	N	No Water Available for Public Water Supply Abstraction Licensing.
167	Thelsford BH	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 126.
168	Birmingham Road BH	Y	N	n/a	n/a	n/a	N	Option may potentially cause deterioration under WFD.
170	Obtain water network rail are currently pumping out from their tunnels as part of their dewatering options	N	n/a	n/a	n/a	n/a	N	Option unfavourable. Location is unsuitable for deployment into the Strategic Grid.
171	Bromsgrove/ Site G Conjunctive use- Henley to Redditch link main	N	Y	N	N	n/a	N	Option not valid as there is no Deployable Output benefit.

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WRMP19 Ref	Scheme Name	Question 1: Does the option address the problem?	Question 2: Does the option avoid breaching any statutory &/or regulatory constraints?	Question 3: Is the option promotable / does it meet customer and stakeholder expectations?	Question 4: Do we have confidence that the option will succeed?	Question 5: Is the proposed scheme subject to Welsh legislation?	Question 6: Should the option be taken through to the Constrained List?	Key Reason for Rejection
172	Tettenhall BH	Y	N	n/a	n/a	n/a	N	Option may potentially cause deterioration under WFD.
177	WE005 - Infrastructure charges	N	N	n/a	N	n/a	N	Option unfavourable. Proposed OfWAT policy would remove opportunity to deliver these schemes.
180	*WE008 - Compulsory metering programme	Y	N	N	Y	Y	N	Option is not valid. We are not in a water stressed area as defined by the EA so cannot compulsory meter our household customers. We are proposing a proactive metering strategy (enhanced metering).
181	WE009 - Non Household	Y	N	N	Y	Y	N	Option is not valid. This is a retail activity and need to better understand their plans for this activity as the market develops.
182	WE010 - BOPPS	Y	Y	N	Y	N	N	Option is not valid. Keep our BOPPS policy under review, especially if metering is increased.
185	Expand Lake Vyrnwy	Y	N	n/a	n/a	Y	N	Option may potentially cause a detrimental impact to an environmentally protected site.

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WRMP19 Ref	Scheme Name	Question 1: Does the option address the problem?	Question 2: Does the option avoid breaching any statutory &/or regulatory constraints?	Question 3: Is the option promotable / does it meet customer and stakeholder expectations?	Question 4: Do we have confidence that the option will succeed?	Question 5: Is the proposed scheme subject to Welsh legislation?	Question 6: Should the option be taken through to the Constrained List?	Key Reason for Rejection
188	Recover WRMP 14 Strategic Grid DO losses	N	n/a	n/a	n/a	n/a	N	Option no longer valid. This regional option for the Strategic Grid is superseded by multiple specific supply options.
189	Consider use of currently disused BHs at Stanley Moor	Y	N	n/a	n/a	n/a	N	Option may potentially cause deterioration under WFD.
196	Birmingham Boreholes (Hockley sites)	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 12.
197	Overton Scar Repeated Peak Demand licence over abstraction	N	n/a	n/a	n/a	n/a	N	Option not valid. Duplication of scheme 106.
199	Increase Rodmore output	Y	Y	n/a	N	n/a	N	Option unfavourable. Low confidence in Deployable Output benefit after treatment processes.
201	Thoresby Licence trade	N	N	n/a	n/a	n/a	N	Option not available as being utilised for the Restoring Sustainable Abstraction Programme.

WRMP19 Ref	Scheme Name	Question 1: Does the option address the problem?	Question 2: Does the option avoid breaching any statutory &/or regulatory constraints?	Question 3: Is the option promotable / does it meet customer and stakeholder expectations?	Question 4: Do we have confidence that the option will succeed?	Question 5: Is the proposed scheme subject to Welsh legislation?	Question 6: Should the option be taken through to the Constrained List?	Key Reason for Rejection
206	WE011 - Water Reuse	Y	Y	N	N	N	N	Option is not valid. There are no viable options available and have discussed with the EA who agree. We sponsored an EngD at Exeter University investigating RWH and undertook a greywater reuse trial in social housing properties. We will continue to review any new/innovative schemes and would adopt these at the earliest opportunity.

Table D3.2: Feasible options (111 solutions)

Solution Ref.	dWRMP Table Type	Solution Name	Solution WRZ Location	Estimated Resource Zone Benefits (Ml/d)	Delivery Period (yrs)	dWRMP 19 Supply Option
GRD16	GW enhancement	Clungunford / Oakley Farm BH enhancements	Bishops Castle	2	5	
GRD17	Bulk supply	Strategic Grid to Bishops Castle WRZ transfer solution	Bishops Castle	1.3	5	
MIT01	Bulk supply	Site O WTW to Site K WTW raw water transfer main	Forest & Stroud	15	5	
GRD15	Bulk supply	Whaddon (Strategic Grid WRZ) to Forest & Stroud WRZ transfer solution	Forest & Stroud	5	5	Y
RAW07	Bulk supply	Potable water import to Kinsall WRZ at Whittington	Kinsall	1	5	
BHS17	Bulk supply	Shelton WRZ to Mardy WRZ transfer solution adapting existing assets (Solution 1)	Mardy	3	5	
BHS18	Bulk supply	Shelton WRZ to Mardy WRZ transfer solution using new assets	Mardy	3	5	
GRD07	Bulk supply	Shelton WRZ to Mardy WRZ transfer solution adapting existing assets (Solution 2)	Mardy	1	5	
GRD08	Bulk supply	Nottingham WRZ to Newark WRZ transfer solution	Newark	5	5	
WTW01	Effluent reuse	New WTW on the River Trent near Little Haywood supported by raw water augmentation of the River Trent	North Staffs	13	10	
BHS04	GW enhancement	Swynnerton BHs asset and water treatment enhancements	North Staffs	7	5	
BHS09	GW enhancement	Elmhurst BH asset and water treatment enhancements	North Staffs	2	5	
BHS10	GW enhancement	Elmhurst BH asset enhancements and transfer to Site L WTW	North Staffs	2	5	
BHS13	GW enhancement	Croxton BH output increase and transfer to Hob Hill DSR	North Staffs	2.5	5	
BHS14	GW enhancement	Croxton BH output increase and transfer to Hanchurch DSR	North Staffs	2.5	5	
RAW01	SW new	Raw water import from Canals and Rivers Trust to Milford WTW	North Staffs	15	10	
RAW17	Bulk supply	Carsington reservoir to Site L transfer solution	North Staffs	10	5	
GRD11	Bulk supply	Site U WTW to North Staffs WRZ transfer solution	North Staffs	15	5	
GRD13	Bulk supply	Potable water import to Peckforton and North Staffs WRZ	North Staffs	5	5	
GRD18	GW enhancement	Peckforton Group BHs asset and water treatment enhancements	North Staffs	6.5	5	Y

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Solution Ref.	dWRMP Table Type	Solution Name	Solution WRZ Location	Estimated Resource Zone Benefits (Ml/d)	Delivery Period (yrs)	dWRMP 19 Supply Option
UNK01	SW new	New WTW on the River Weaver near Nantwich	North Staffs	20	10	
UNK03	SW enhancement	Support Site L WTW from the River Weaver	North Staffs	20	10	
UNK07	SW enhancement	Improve Site L WTW outputs during low raw water periods	North Staffs	7	5	Y
DAM05	Reservoir enlargement	Tittesworth Reservoir capacity increase	North Staffs	5	5	
DAM06	Reservoir enlargement	Tittesworth Reservoir capacity increase	North Staffs	14	10	
WTW29	SW new	New WTW on the River Trent near Stafford, Staffordshire	North Staffs	22.5	10	
GRD20	SW new	New WTW on River Dove near Uttoxeter supported by Carsington reservoir and deploying to Stoke	North Staffs	18	15	
GRD21	SW new	New WTW on River Dove near Uttoxeter supported by Carsington reservoir and deploying to Stoke	North Staffs	27	15	
GRD19	Bulk supply	DVA to Nottingham transfer pipeline capacity increase	Nottinghamshire	15	5	Y
WTW28	SW new	New WTW on the River Trent near Stoke Bardolph, Nottinghamshire	Nottinghamshire	30	10	
NOT01	Bulk supply	Ambergate to Mid Nottinghamshire transfer solution	Nottinghamshire	30	5	Y
NOT04	Bulk supply	Heathy Lea to North Nottinghamshire transfer solution	Nottinghamshire	25	5	Y
NOT05	Bulk supply	Site E to South Nottinghamshire transfer solution	Nottinghamshire	30	5	
GRD09	Bulk supply	Shelton WRZ to Ruyton WRZ transfer solution	Ruyton	1	5	
GRD22	Bulk supply	Cross Wolverhampton strategic transfer solution	Shelton	10	5	
SHE05	SW enhancement	Site M WTW expansion	Shelton	10	5	
SHE06	Bulk supply	Shared South Staffordshire Asset to Shelton WRZ transfer solution (Low flow)	Shelton	10	5	
WTW16	SW new	New WTW on the River Severn near Buildwas, Shropshire	Shelton	15	10	
BHS16	GW enhancement	Much Wenlock BH treatment enhancements	Shelton	0.7	5	
SHE01	SW enhancement	Site M WTW Expansion	Shelton	18	5	
SHE02	Bulk supply	Potable water import to Shelton WRZ (localised)	Shelton	12	5	
SHE03	Bulk supply	Potable water import to Shelton WRZ (WRZ wide)	Shelton	18	5	

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Solution Ref.	dWRMP Table Type	Solution Name	Solution WRZ Location	Estimated Resource Zone Benefits (Ml/d)	Delivery Period (yrs)	dWRMP 19 Supply Option
SHE04	Bulk supply	Shared South Staffordshire Asset to Nurton Transfer (High Flow)	Shelton	18	5	
GRD01	Bulk supply	Site U WTW transfer to Wolverhampton and Telford WRZ	Shelton	21.5	5	
GRD06	Bulk supply	Cross Wolverhampton strategic transfer solution	Shelton	15	5	
BHS12	GW new	New GW source in the Hopton GWMU	Stafford	3.5	5	
MIL01	GW enhancement	Milford BH output enhancements	Stafford	2	5	
GRD05	Bulk supply	Leek to Stoke trunk main enhancements	Stafford	5	5	
GRD10	Bulk supply	North Staffs WRZ to Stafford WRZ transfer solution	Stafford	7	5	
GRD12	Bulk supply	Site Q WTW to North Staffs WRZ transfer solution	Stafford	7	5	
BAM01	Bulk supply	Site R WTW to Ambergate pipeline capacity increase	Strategic Grid	7.5	5	
BAM02	Bulk supply	Potable water import to Site R WTW with Site R to Ambergate pipeline capacity increase	Strategic Grid	60	5	
BAM03	Bulk supply	Site R WTW to Grindleford pipeline capacity increase	Strategic Grid	7.5	5	
BAM04	Bulk supply	Site R WTW to Baslow pipeline capacity increase	Strategic Grid	20	5	Y
BAM05	Bulk supply	Site R WTW to Ambergate transfer solution	Strategic Grid	50	10	
CARSC01	Reservoir enlargement	Carsington to Site L, Site J and Site F WTWs	Strategic Grid	100	15	
CARSC02	Reservoir enlargement	Carsington to Site L, Site F and Site E WTWs	Strategic Grid	100	15	
CARSC03	Reservoir enlargement	Carsington to Site L, Site J, Site F and Site E WTWs	Strategic Grid	100	15	
CLYWB01	Reservoir enlargement	Site U and Site P WTW upgrades supported by River Severn raw water storage capacity increase	Strategic Grid	90	15	
VYR01	Bulk supply	River Severn raw water import to Site U and Site P WTWs	Strategic Grid	60	5	
VYR02	Bulk supply	River Severn raw water import to Site U WTW	Strategic Grid	60	5	
RIV01	Bulk supply	Potable water import to Chesterfield	Strategic Grid	20	5	
LIN01	SW new	New source and treatment at Linacre reservoir	Strategic Grid	5	10	
OGS01	SW enhancement	Site J WTW expansion	Strategic Grid	15	5	

Solution Ref.	dWRMP Table Type	Solution Name	Solution WRZ Location	Estimated Resource Zone Benefits (Ml/d)	Delivery Period (yrs)	dWRMP 19 Supply Option
LIT01	SW enhancement	Site F WTW expansion	Strategic Grid	10	5	Y
WIL02	SW enhancement	Site E WTW expansion and transfer main	Strategic Grid	21	5	
WIL05	Effluent reuse	Site E WTW expansion and transfer main supported by raw water augmentation of the River Trent	Strategic Grid	35	5	Y
MEL23	SW enhancement	River Trent to Site Q WTW transfer with Site Q WTW enhancements	Strategic Grid	15	5	
MEL29	SW enhancement	Carsington Reservoir support to Site Q WTW with Site Q WTW enhancements	Strategic Grid	30	5	Y
MEL37	Effluent reuse	Raw water augmentation of Staunton Harold Reservoir with Site Q WTW enhancements	Strategic Grid	5	5	
MEL39	GW enhancement	BH raw water transfer to Site Q WTW with Site Q WTW enhancements	Strategic Grid	5	5	
MEL41	SW enhancement	Site Q WTW enhancements with new supported abstractions from the River Derwent	Strategic Grid	15	5	
MEL47	Effluent reuse	Site Q WTW enhancements supported by raw water augmentation of the River Trent	Strategic Grid	20	5	
CRO04	SW enhancement	Blackbrook Reservoir to support Site B WTW	Strategic Grid	12	5	
CRO05	SW enhancement	Thornton Reservoir to support Site B WTW	Strategic Grid	12	5	Y
CRO06	SW enhancement	River Soar to support Site B WTW	Strategic Grid	17	10	Y
CRO07	SW enhancement	Blackbrook Reservoir and Thornton Reservoir to support Site B WTW	Strategic Grid	17	5	
WTW05	New reservoir	East Midlands third party raw water storage asset including new WTW	Strategic Grid	45	10	Y
WTW06	New reservoir	East Midlands third party raw water storage asset including new WTW	Strategic Grid	45	10	
WTW07	New reservoir	East Midlands existing third party raw water storage asset including new WTW and infrastructure	Strategic Grid	18	10	
WTW08	SW new	New WTW on the River Severn near Ombersley, Shropshire	Strategic Grid	15	10	
BHS01	GW enhancement	Watery Lane BHs asset and water treatment enhancements	Strategic Grid	3	5	
BHS02	GW enhancement	Waverly Road BHs asset and water treatment enhancements	Strategic Grid	2	5	
BHS05	GW enhancement	Broomleys BHs asset and water treatment enhancements	Strategic Grid	1.1	5	
BHS06	GW enhancement	Maximise deployment from Diddlebury WTW and Munslow BH	Strategic Grid	0.9	5	Y

Solution Ref.	dWRMP Table Type	Solution Name	Solution WRZ Location	Estimated Resource Zone Benefits (Ml/d)	Delivery Period (yrs)	dWRMP 19 Supply Option
BHS07	GW enhancement	Ladyflatte BHs asset and water treatment enhancements	Strategic Grid	2.7	5	Y
BHS11	GW enhancement	Haseley Spring source asset and WTW enhancement	Strategic Grid	2	5	
BHS15	GW enhancement	Birmingham BHs conversion to potable supply	Strategic Grid	15	5	Y
RAW02	SW new	Raw water import from Canals and Rivers Trust to Site C WTW	Strategic Grid	15	10	
RAW08	Effluent reuse	Site C WTW output increase using additional and supported abstractions from the River Avon	Strategic Grid	10	10	
RAW09	Effluent reuse	Site C and Site U WTW output increase using additional and supported abstractions from the River Avon	Strategic Grid	20	10	
RAW11	Bulk supply	River Severn to Site C mutual support solution with supported River Avon abstractions - (Upper)	Strategic Grid	84.5	15	
RAW12	Bulk supply	River Severn to Site C mutual support solution - (Upper)	Strategic Grid	78.5	15	
RAW13	Bulk supply	River Severn to Site C mutual support solution with supported River Avon abstractions - (Mid)	Strategic Grid	79	15	
RAW14	Bulk supply	River Severn to Site C mutual support solution with supported River Avon abstractions - (Lower)	Strategic Grid	64.5	10	
RAW15	Bulk supply	River Severn to Site C mutual support solution - (Mid)	Strategic Grid	59	15	
RAW16	Bulk supply	River Severn to Site C mutual support solution - (Lower)	Strategic Grid	44.5	10	
DAM01	Reservoir enlargement	Stanford Reservoir capacity increase	Strategic Grid	2.5	5	Y
DAM02	Reservoir enlargement	Lower Shustoke capacity increase	Strategic Grid	2.5	5	Y
DAM03	Reservoir enlargement	Whitacre Reservoir capacity increase	Strategic Grid	2.5	5	Y
DAM07	Reservoir enlargement	Draycote Reservoir capacity increase with transfer main from Site C WTW to Coventry	Strategic Grid	9	5	Y
DOR02	SW enhancement	Site I WTW enhancements	Strategic Grid	2	5	Y
DOR05	SW enhancement	Site C WTW enhancements	Strategic Grid	9	5	Y
DOR07	SW enhancement	Site Q WTW enhancements	Strategic Grid	2	5	

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Solution Ref.	dWRMP Table Type	Solution Name	Solution WRZ Location	Estimated Resource Zone Benefits (Ml/d)	Delivery Period (yrs)	dWRMP 19 Supply Option
DAM11	New reservoir	West area new raw water storage with Site U WTW and deployment infrasturcture upgrades	Strategic Grid	180	15	
DAM12	SW new	New WTW on the River Severn near Ombersley with raw water imports into the River Severn	Strategic Grid	30	10	
DOR08	SW enhancement	Site B WTW enhancements	Strategic Grid	3.6	5	Y
WTW30	SW enhancement	Site P WTW expansion	Strategic Grid	15	5	
BHS03	GW enhancement	Preston Brockhurst BH asset and water treatment enhancements	Whitchurch & Wem	1.5	5	
BHS08	GW new	New GW source in the Coven GWMU	Wolverhampton	3.5	10	
UNK06	Bulk supply	Maximise outputs from Shared South Staffordshire Asset WTW	Wolverhampton	30	5	

D4 Water trading options - Redacted

D5 Water efficiency and metering options

D5.1 Overview – Base Programme

In line with customer expectations, our statutory water efficiency duty and regulatory guidance we are committed to delivering a high quality innovative and effective water efficiency programme and we propose a base water efficiency programme as shown in Table D5.1

Table D5.1 – Base Water Efficiency Programme

	Total Ml/d Water Saving
AMP 7	16.59
AMP 8	16.18
AMP 9	15.03

This programme compares to our AMP6 household programme of 18Ml/d. In AMP6 we also had an enhanced 7Ml/d non-household demand reduction programme targeted in to WRZ's (Strategic Grid and Nottinghamshire). As a result of the opening of the non-household retail market in England we stopped our non-household programme and increased household activity to make up the shortfall.

Changes to the water market came in to effect on 1 April 2017, and mean that most businesses and non-household customers in England can now choose which company they want to supply their retail water services. The wholesale supplier of water no longer deals directly with these non-household customers, and instead it is the retailer who will offer services such as water efficiency to these customers. Delivery of water efficiency with non-household customers is highlighted as a key opportunity and differentiator in the retail market, and as a result, our previous water efficiency options to target non-household customers are no longer available to us.

Despite requesting information to inform our draft WRMP, we have received no information on the proposed water efficiency activities of retailers operating in our supply area, though we will continue to monitor what is happening in that market and continue to engage with Retailers. As part of the options for our AMP7 plan and beyond we are reviewing opportunities to incentivise non-household water efficiency in a compliant way both in England and for our Welsh WRMP. (Note: only customers using >50Ml per year are contestable in the Wales). If non-household opportunities are developed these will be tested in AMP6.

In developing our proposals, we have made reference to:

- Environment Agency (EA) / Natural Resources Wales (NRW) Final Water Resource Planning Guidance.
- Defra Guiding Principles for water resource planning
- Water Strategy for Wales
- Waterwise Evidence Base Reports
- Market Transformation Programme
- Waterwise Water Efficiency Strategy for the UK
- Our own water efficiency programme and, consumption modelling forecasting analysis
- Water Strategy for Wales

We have also engaged with Environment Agency and Natural Resources Wales.

To inform our draft WRMP, we have assessed the viability of a range of potential water efficiency options:

- providing free products to our household customers on request;
- subsidising higher value water saving products for our household customers;
- carrying out water efficiency audits and install water saving products in the homes of our household customers (Home Water Efficiency Check HWEC programme currently delivered by 3rd parties, testing insourcing options);
- incentives for housebuilders to build new properties to 110 litres per person per or less;
- to work with social housing to carry out water efficiency audits and install water saving products in the homes of social housing tenants;
- to continue to provide education and advice to our household customers on how to use water more wisely;
- rainwater harvesting / water reuse options.

Our base programme maintains the approach we have successfully followed in previous years:

- free products on request for our customers,
- subsidised higher value products on request for our customers,
- advice to our customers on how they can use water more wisely,
- carrying out water efficiency audits and install water saving products in the homes of our household customers.

Our draft WRMP includes additional household water efficiency activities that go beyond these baseline activities. Our plan includes proposals to carry out the following water efficiency enhancements:

Home Water Efficiency Audits

We will carry out proactive water efficiency audits and install water efficient products in our customers' homes (HWEC) in targeted, geographical areas.

In addition to our baseline water efficiency programme our plan is to carry out a further 10,000 audits annually over a 15 year period. The size of the programme is finite and limited by the number of household customers and assumed uptake rates. We have trialled this approach during AMP6 and we currently see an uptake rate of approximately 20% which we expect to be maintained.

An additional 10,000 audits per year will deliver a further 1.34 Ml/d of savings per AMP.

Social Housing Water Efficiency Checks

We will deliver a HWEC programme working directly with social housing providers to help their tenants save water which will help more vulnerable customers by making their water and potentially their energy bills more affordable as they reduce their water consumption.

We are currently trialling working directly with social housing providers on a HWEC type programme and will complete a trial in early 2018. Early feedback on the trial indicates high recruitment rates and opportunities for demand reduction.

An additional 7,000 audits per year will deliver a further 0.94 Ml/d of savings per AMP.

This home audit approach is higher cost compared to simply providing products to customers on request, but it provides greater certainty that products are installed and that savings are being achieved as well as additional opportunities to engage customers to promote behaviour change for water efficiency and sewer blockage prevention. Our trial of this approach in 2015-17 has also shown that this approach is also popular with our customers. To keep costs down, we intend to roll this programme out area by area but we will also focus on areas with potential supply demand deficits first. In addition, trials to deliver home audits during metering activity are being undertaken to explore opportunities to support more vulnerable customers all across the Severn Trent region by targeting those with high consumption or customers who are struggling to pay.

Metering Options

Our previous Water Resource Management Plans have set out an ongoing approach to household metering that has been led by customer demand for the free meter option. As a result, only around 41% of households in our region currently pay by meter. Our last WRMP projected that this would grow to around 70% by 2040 based on our current metering policy.

We have explored a range of metering growth strategies that could accelerate the rate of meter coverage through AMP7 with options to get to full metering by the end of AMP8 or AMP9. Based on the benefits reported by other companies, we believe that achieving full meter coverage could deliver up to an 80Ml/d demand benefit. 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 have previously expressed support for supply pipe adoption, and we would be pleased to see this happen at some point in the future for the benefit of our customers, as it would simplify addressing the problem of supply pipe leakage. We also want to explore what smarter metering technologies could be deployed in future.

We do not currently have the power to implement a compulsory metering programme as we are not classified by the Environment Agency as a seriously water stressed area. However, the scale of the emerging supply / demand challenge means there are grounds for exploring with Environment Agency and Defra whether such an application would be appropriate, whether for the whole region or specific water resource zones, and on what timescale. In the absence of these legal powers, we are recommending a 'persuaded optant' strategy in AMP7. This means installing meters proactively and offering customers the opportunity to switch based on information on what their measured bill would be.

We believe this metering approach complements our 'no-regret' package of AMP6 leakage, metering and demand management measures. We would follow an area by area approach, targeting the water resource zones with the greatest supply/demand deficit (Notts, North Staffs and Strategic Grid). This will complement our longer term plans for new water source development, as we want to (and will need to demonstrate to planners and regulators that we have) fully explored options to manage water demand before we seek to develop new sources of water.

As a result of this metering policy change, we expect the rate of meter coverage to accelerate in AMP7 and we aim to have achieved full coverage by the end of AMP9. We have considered the cost / benefit implications of a range of metering delivery profiles, and we have tested different options for increasing the pace of delivery and for prioritising which zones to focus on. The expected meter coverage that our recommendation will deliver is set out in the Table 3 below.

Table D5.2 – Household meter installations and coverage per AMP

		AMP7	AMP8	AMP9	AMP10
Current metering policy	Number of meter installations	147,878	134,619	122,549	111,560
	%age of households metered by end of AMP	55%	60%	65%	69%
Recommended new metering policy	Number of meter installations	497,878	779,332	420,220	0
	%age of households metered by end of AMP	65%	88%	100%	100%

We expect the increase in meter coverage to deliver an average demand saving of around 10Ml/d by the end of AMP7. This is based on an assumed consumption saving of around 10% and includes benefits from finding and fixing leaking supply pipes.

However, we believe that there are wider demand management benefits that will result from increasing metering coverage, especially if we target the delivery on a geographical basis. In particular, we view the need for increased meter coverage to be a crucial enabler to delivering our very ambitious leakage reduction strategy. Currently around 60% of our household customers are not metered, and that means we have to estimate their consumption when we monitor leakage performance on our network. That makes it very difficult to distinguish changing consumption patterns from any leakage breakout on our network.

By increasing the number of metered properties on our network, we will have greater visibility of changing water demand patterns and better control of our network performance. This will make leaks easier to detect, and will mean we are able to deploy leakage repair more effectively and efficiently. This improvement in leakage detection and repair performance will be crucial to us achieving our challenging 15% leakage reduction target.

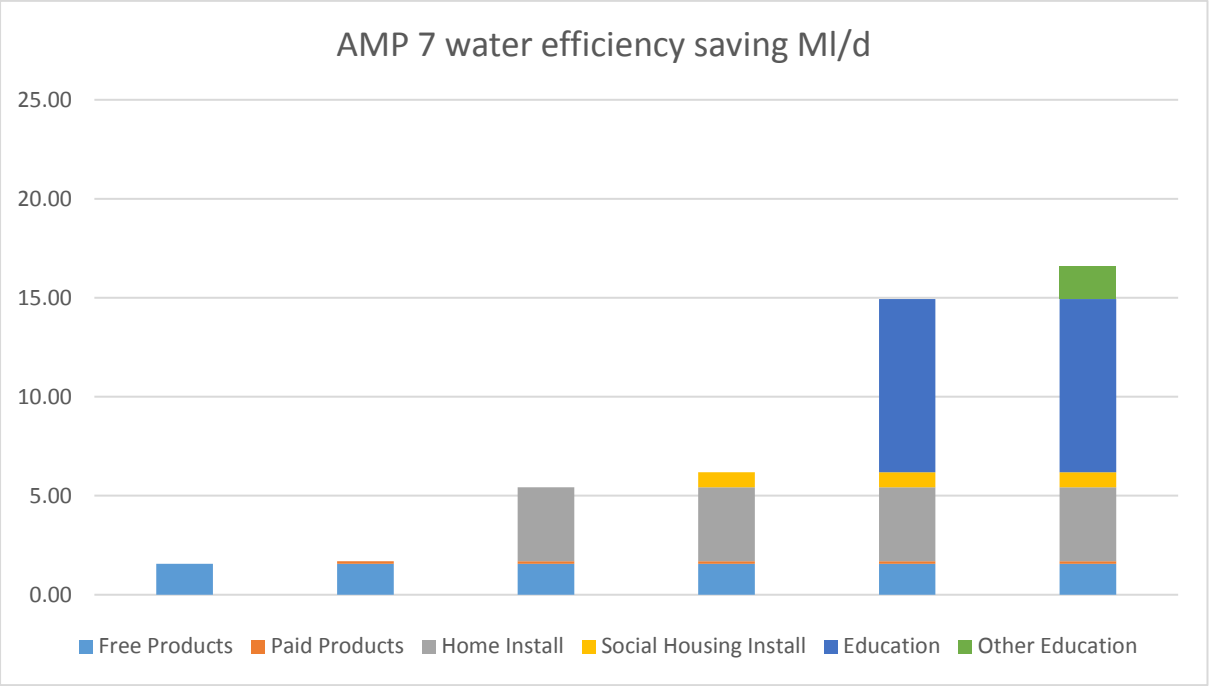
D5.2 Revisions to demand saving assumptions

Through more accurate measurement of the water savings from our activities we are now more confident in the levels of savings we can forecast for our AMP7 water efficiency programme. We have used our AMP6 water efficiency programme to re-assess the savings we previously assumed from our water efficiency activity. This has included using measured savings and information from our current home water efficiency audit and install programme (HWEC) and surveys by our free product supplier. This has resulted in a small reduction in the savings we forecast compared to our old assumed water savings. The impact of these changes is shown below in Table D5.3 and figure 5.1:

Table D5.3 – Water saving assumptions

	Total Ml/d (old water saving assumptions)	Total Ml/d (revised water saving assumptions)
AMP 7	19.93	16.59
AMP 8	19.27	16.18
AMP 9	16.20	15.03

Figure D5.1 – AMP7 water efficiency saving Ml/d



D5.3 Decay of savings

Our improved understanding of the amount of water saved through our different water efficiency activities has also helped us to understand how the potential for future savings will likely decay over time. This is because:

- Over time, customers will replace their existing water fittings with more modern and efficient fittings. For example, the Market Transformation Reports conclude that existing toilets and taps will be replaced with more efficient models. The lifespan (replacement rate) of products ranges from 15 – 25 years, e.g. toilets have been assessed as 15 years, taps 25 years, which will limit our opportunities for installing cistern displacement devices (CDDs) and retrofitting WCs to dual flush or flow regulators. In our baseline demand forecasts we assume reductions in consumption from technology and behaviour change, therefore decaying savings from retrofit products ensures we do not double counting savings.
- The product life of retrofit products.
- Customers removing retrofit items.

We use different decay rates for different approaches (Table D5.3). We have based these decay rates with reference to:

- Waterwise evidence base reports
- Revisiting the long term benefits of our previous water efficiency install programme

Table D5.3: Percentage decay of previous year's savings

Approach	% decay of previous year's saving
Free products	5.5%
Paid/Subsidised products	1.25%
HWEC/ Metering Teams	5.5%
Infrastructure charges	0%
Education	5%

D5.4 Water efficiency options not taken forward

The following options were included on our unconstrained list, but have not been taken forward in our draft WRMP.

Infrastructure Charges

During AMP6 we have investigated options to incentivise developers to build new houses to more water efficient standards to 110 litres person day or less through a discounted infrastructure charges scheme. As an option this is high cost for low benefit, and is dependent on the outcome of an OFWAT consultation on proposed changes to new connections charges. It is anticipated this option will no longer be viable in future.

Water Reuse

Although we are still committed to testing and trialling domestic water reuse options (grey water and rain water) there are currently no commercially viable household retrofit options and new build solutions could only be undertaken by developers. Alternative water sources and reuse could feature as options in future if new technologies are developed however at this stage there is no certainty around the required technology. Instead, we propose to investigate this option on an R&D basis in the short to medium term.

In AMP 5 and 6 we have undertaken rainwater harvesting and grey water reuse trials in an attempt to open up this opportunity. In partnership with a Social Housing provide we trialled a novel greywater reuse system in ten new build properties. For rainwater harvesting and reuse we sponsored and Engineering Doctorate at Exeter University to investigate conventional and novel low cost rainwater harvesting systems. Although there are no viable retrofit systems available currently, we will be using the outcome of the research to continue R&D studies to investigate these opportunities, focusing on the potential dual benefits of active attenuation and water reuse offered by these systems.

D6 Our recommended supply options

Our dWRMP18 proposes a number of water supply schemes to enhance our supply capability, and to replace sources of unsustainable abstraction. These schemes form part of our long term package of supply and demand measures to balance supply and demand.

A summary of the preferred schemes is given below. More information about the environmental and social impacts of these options is included in the Strategic Environmental Assessment that accompanies this dWRMP18.

Heathy Lea to North Nottinghamshire transfer solution

This solution aims to provide new strategic transfer capacity from the Strategic Grid water resource zone (WRZ) into the Nottinghamshire WRZ, via a new pipeline with a total distance of 34.6km. A new pumping station is also proposed as part of this solution.
Supply Benefit: 25Ml/d

Birmingham boreholes conversion to potable supply

We operate five river augmentation boreholes in Birmingham, which were designed to supply additional water into tributaries of the Trent, to support one of our downstream abstraction points. These Birmingham Groundwater Scheme assets are rarely used at present and could deliver much greater benefits if used for direct supply in Birmingham. The boreholes will pump to a new centralised water treatment works, and will introduce a groundwater element into the Birmingham supply system, improving supply capacity and resilience.
Supply Benefit: 15Ml/d

Site C water treatment works enhancements

The current maximum output of Site C treatment works is limited to 27 Ml/d, this scheme will enable the site to produce 36 Ml/d deployable output. This scheme will install additional treatment capacity which will increase output and improve resilience by providing some redundancy in our treatment process to allow maintenance and protect against failure. *Supply Benefit: 9Ml/d*

Site I water treatment works enhancements

A minor improvement to the treatment process at Site I WTW will allow us to increase treatment capacity. The additional output will be used in the Strategic Grid.
Supply Benefit: 2Ml/d

Site E water treatment works expansion and transfer main supported by raw water augmentation of the River Trent

Using spare raw water from Carsington reservoir, and diverting final effluent from Barnhurst STW into the River Penk, we will use our existing abstraction at Witches Oak intake to support a 50 Ml/d expansion of Site E WTW. A new pipeline will transfer the additional potable water for use in the Strategic Grid.
Supply Benefit: 35Ml/d

Site F water treatment works expansion

Using spare raw water from Carsington reservoir, we will use our existing abstraction at Site F to support a 30 Ml/d expansion of Site F WTW. Existing pipelines will be used to transfer the additional potable water for use in the Strategic Grid.

Supply Benefit: 10Ml/d

Site B water treatment works enhancements

By improving the treatment processes, we will increase the sustainable output of Site B WTW using the existing raw and potable water transfer capability.

Supply Benefit: 3.6Ml/d

Whaddon (Strategic Grid WRZ) to Forest & Stroud WRZ transfer solution

Using the existing Strategic Grid assets, we will use newly created Deployable Output to support the Forest & Stroud WRZ (Figure D6.2).

Supply Benefit: 5Ml/d average

Improve Site L water treatment works outputs during low raw water periods

The maximum design capacity of Site L treatment works is 48 Ml/d but its normal output is closer to 44 Ml/d. Site L operates in conjunction with the wider groundwater sources in the North Staffordshire water resource zone, and the zonal deployable output is maximised by optimising the balance between the reservoir and the groundwater sources. During winter and spring, we maximise use of the reservoir while storage is at or above target levels, and during summer months we reduce output from the reservoir and increase use of the groundwater sources.

The minimum output from Site L treatment works is around 16Ml/d due to the configuration of the water treatment process. This minimum output is a key constraint on the zonal deployable output. When reservoir storage is very low we cannot reduce Site L treatment output below 16Ml/d, and so to preserve storage we have to shut down the treatment works and transfer all demand onto the groundwater sources.

This solution will reconfigure Site L treatment works to allow output to go below the current 16Ml/d minimum. This will giving greater operational flexibility during dry weather and will improve the conjunctive use with the North Staffordshire groundwater system.

Supply Benefit: 7Ml/d

Peckforton Group boreholes asset and water treatment enhancements

The Peckforton borehole group will require enhanced water treatment in AMP7 due to deteriorating raw water quality in the groundwater unit. Installation of treatment offers an opportunity to increase the output from the group and relieve the supply/demand stress within the North Staffordshire water resource zone. The solution will include enhanced water treatment installation, new chlorination treatment, new pumping plant and the potential upgrade of Tixall booster pump to get water into the North Staffordshire zone.

This solution brings wider benefits, as it allows us to preserve the integrity of the wider North Staffordshire water resource zone and prevent the large loss of zonal deployable outputs that would be caused by restoring sustainable abstraction licence changes.

Supply Benefit: 6.5Ml/d increase in source outputs, but has benefit of preventing the wider loss of 29.5Ml/d of zonal deployable output.

River Soar to support Site B water treatment works

This scheme will make use of the River Soar to support Site B water treatment works during critical periods. Site B treatment works receives its water from Cropston and Swithland reservoirs. One of the most viable options to increase raw water availability is to provide a new feed into the system from the River Soar. This scheme would preserve reservoir storage by using the river source when flows are above the hands off flow (HOF), and then using reservoir storage to supply the treatment works when river levels are below HOF.

Based on the 2013 EA Soar CAMS review, the river has 17Ml/d water available for abstraction. This solution would also include: the creation of a primary settlement lagoon to aerate water and trap river sediment prior to transfer to Site B treatment works, new raw water pipelines & pumping stations, and upgrades to treatment processes to enable treatment of river water.
Supply Benefit: 17Ml/d

East Midlands raw water storage including new water treatment works

We have been engaging with a number of third parties who own existing, operational assets that are nearing the end of their useful life and that could be used for future raw water storage. We have not included specific details of the preferred option here due to our ongoing commercial discussions, but we describe the option here as the conversion of third party assets for the strategic storage of water abstracted from rivers during periods of high river flow.

Several assets have been investigated and the SEA has identified the need to carefully develop such solutions to avoid adverse effects on geological SSSIs that are present within some disused assets, as reflected in the precautionary major adverse rating for the SEA geological objective. Further investigations will be required to develop this innovative solution in a sustainable manner so as to minimise adverse environmental effects whilst maximising the potential beneficial effects associated with using such assets for substantial and sustainable water supply benefit, as well as allied recreational and biodiversity enhancement opportunities.

The solution will include the conversion of the asset to a raw water storage reservoir which will be filled with water pumped from the River Soar at times of high flow. A new water treatment works located at the asset will treat raw water from either the River Soar or raw water storage reservoir. A new pipeline will transfer potable water to the nearby Avon Soar Link Main which forms part of the Strategic Grid.
Supply Benefit: 45Ml/d

Site Q water treatment works enhancements supported by Carsington reservoir

This scheme will increase the dry weather output from Site Q water treatment works by increasing abstraction from the River Dove, supported by additional releases from Carsington reservoir. Infrastructure will be installed to enable augmentation releases of up to 30Ml/d from Carsington Reservoir to the River Dove catchment. A new contact tank will be installed at Site Q water treatment works to operate in series with the existing contact tank to increase the overall treatment output to 235Ml/d.
Supply Benefit: 30Ml/d

Draycote Reservoir capacity increase with transfer main from Site C water treatment works to Coventry

A small increase in storage capacity at Draycote Reservoir will allow us to increase output at Site C WTW. A new pipeline will transfer potable water to our existing network for use in the Strategic Grid.
Supply Benefit: 9Ml/d

Site R water treatment works to Baslow pipeline capacity increase

By improving the hydraulic performance of the DVA we will be able to use spare treatment capacity at Site R WTW. Additional raw water will derive from a combination of existing spare capacity in the Derwent Valley reservoirs and a reduction in the export to Yorkshire Water which is currently up to 68 Mld.
Supply Benefit: 20Ml/d average

Stanford Reservoir capacity increase

At Stanford Reservoir an expansion of 10% would provide an additional 0.134 Ml of storage. The embankment has been designed to overtop for events between the 150 year and 1,000 year floods. In this option the spillway is to be raised by a small amount without making any alterations to the embankment.
Supply Benefit: 2.5Ml/d

Thornton Reservoir to support Site B water treatment works

This scheme will make use of the Thornton reservoir by constructing a raw water main and installing a booster pump to Site B water treatment works.

Supply Benefit: 12Ml/d

Ambergate to Mid Nottinghamshire transfer solution

This solution involves the construction of a new strategic link main from the Strategic Grid water resource zone into the Mansfield area of the Nottinghamshire zone. The concept is for a new 21km pipeline and pumping station to be installed, which will transfer water from our River Derwent sources via the Strategic Grid into the Nottinghamshire zone to replace unsustainable groundwater abstraction.
Supply Benefit: 30Ml/d

Whitacre Reservoir capacity increase

This scheme will increase Whitacre reservoir capacity by 5% to provide an additional 0.074 Ml of storage, involving raising the top water level by 0.17m.
Supply Benefit: 2.5Ml/d

Ladyflatte Borehole asset and water treatment enhancements

Ladyflatte borehole stopped abstracting in 2013. It is licenced to produce just over 3Ml/d and the treatment was designed to treat that quantity. Upgrading the process units to achieve the licence would be considered as part of the scheme.
Supply Benefit: 2.7Ml/d

Lower Shustoke capacity increase

At Lower Shustoke reservoir an expansion of 10% would provide an additional 0.192M m3 of storage and would involve raising the top water level by 0.52m. Lower Shustoke reservoir operates in conjunction with Upper Shustoke which, together, form an off-line storage facility. At this stage it has been assumed that a non-return arrangement could be fitted to the pipework connecting the two reservoirs. This arrangement would enable the lower reservoir to be held at a higher water level than in the upper reservoir.
Supply Benefit: 2.5Ml/d

DVA to Nottingham transfer pipeline capacity increase

This solution new pipeline will enhance the network connection between the Derwent Valley Aqueduct and the Nottinghamshire water resource zone to enable additional transfer of potable water from the Strategic Grid into this zone.

Supply Benefit: 15Ml/d

Maximise deployment from Diddlebury water treatment works and Munslow borehole

The concept behind this scheme is to upgrade existing assets at Diddlebury water treatment works to provide an additional flow into the local distribution service reservoir in order to meet peak demands within our Ludlow control group .

Supply Benefit: 0.9Ml/d

D7 Greenhouse gas emissions

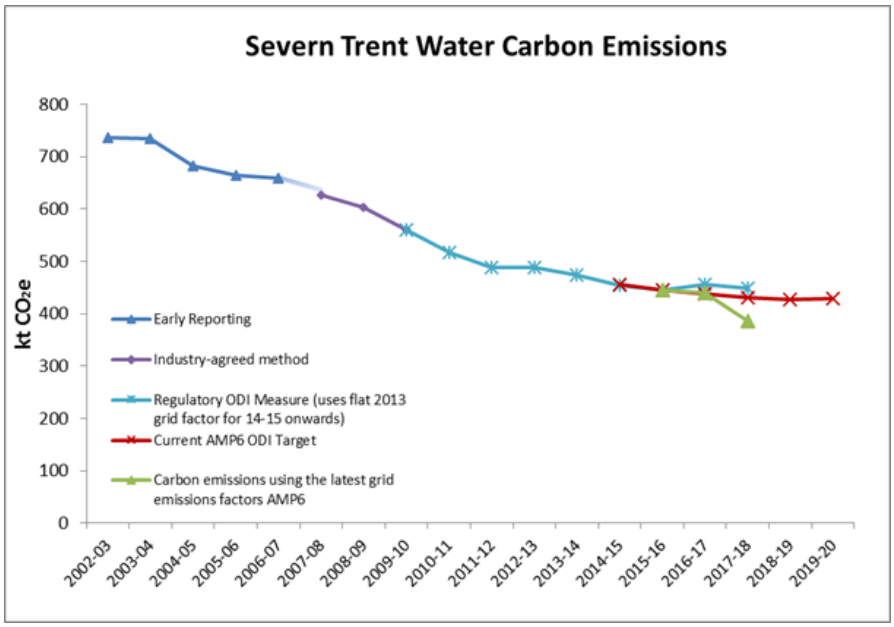
Greenhouse Gas (or 'carbon') emissions contribute to climate change and need to be reduced. Severn Trent Water's total operational emissions are 386 $ktCO_2e$ per year, which is c0.1% of the UK's total emissions. On top of this, there are significant emissions in our supply chain from outsourced maintenance and construction activity.

We recognise that we need to reduce our direct carbon emissions and influence our indirect emissions. Our long term aim is to continually reduce carbon emissions and generate renewable energy, in a way which provides value for our customers. Considering the carbon in our planning processes is a key way to do this.

The price we and others, pay for energy and environmental taxes mean that there is an increasingly close link between cost and our carbon impact. These costs are increasing as the UK moves to a low-carbon economy. So aside from our commitment to play our part in reducing emissions, impact on our customers' bills is a key reason to focus on carbon emissions. Our research shows that customers and stakeholders agree with our overall strategy of prioritising action to reduce carbon where there is a long-term financial benefit to customers.

We consistently track and project our operational emissions in line with Government guidance. Since 2008 we have been using the UKWIR Carbon Accounting Workbook for calculating operational greenhouse gas emissions[1]. We publish this information annually in our annual report and accounts and report our performance to Ofwat and to the Carbon Disclosure Project. We also set ourselves internal and external carbon targets and incorporate these into our business plans for every five year price review period. Despite increasing demand for water, and increasingly stringent quality requirements, we continue to reduce our emissions year on year, when accounting for the most recent grid emissions factor.

Figure D7.1: Severn Trent Water Operational Carbon Emissions 2002 - 2017



[1] *Carbon accounting in the UK Water Industry: methodology for estimating operational emissions, report no 08/CL/01/5*

Between 2009-2017 we have held the Carbon Trust Standard in recognition of our consistent carbon reduction and our carbon management programme.

Every five years we will set out what emissions reductions we think we can achieve. This will take into consideration the upwards pressures we face and the investment plans we have agreed with our customers and stakeholders.

We want to maintain the improvements we have made, and find ways to reduce carbon further whilst still improving service. We know that this should be done only at a cost our customers are willing to pay. The future supply / demand challenges described in our draft WRMP mean that our ambition to continue reducing carbon emissions will become increasingly difficult. Many of our solutions for replacing unsustainable sources of abstraction and preventing future environmental deterioration are carbon intensive.

Our approach to carbon in the water resource management plan

Our approach to considering carbon impacts in the water resource management plan is similar to the approach we used for our last water resource management planning process. We assess the carbon impacts of different activities and include these impacts in the selection of options.

To do this we estimated the carbon impacts of the individual capital scheme options and combined these with a notional price for carbon in our WiSDM investment planning model. We have used a price of £48.76 per tonne of CO_2e, based on the previous 'shadow cost of carbon' published by Government.

The benefits of this approach are:

- We are able to quantify the most significant direct and indirect carbon impacts of our water resource management plan over the 25 year period.
- Carbon is considered as a part of decision making and can influence the cost benefit ratio of different schemes. This helps us to identify and prioritise the lower-carbon solutions which meet our requirements.

Our approach is based on the 2012 UKWIR guidelines[2] which included:

- Guidelines to estimating embodied and operational carbon associated with water company projects.
- Guidelines for carrying out whole-life costing including carbon values.
- Guidelines for what carbon prices and emissions factors to apply in whole life costing.

We believe that our approach strikes the right balance between our intention to minimise our carbon footprint and our other commitments to customers.

For each individual capital scheme, changes to direct operational emissions from fuel, processes and energy use (known as scope 1 and 2) emissions were estimated and used to calculate operational carbon impacts. The predominant driver of operational carbon emissions in all water supply schemes is electricity consumption.

The primary indirect carbon impact of our individual capital schemes (known as scope 3 emissions) is embodied carbon, i.e. the carbon associated with the construction of assets. An embodied carbon impact has been estimated for each scheme in the plan.

[2] UKWIR (2012) *'A framework for accounting for embodied carbon in water industry assets' (*CL01/B207)

D7.1 The carbon impacts of our WRMP

We have estimated both the embodied and operational carbon emissions impact of the supply and demand measures outlined in the draft WRMP using the following approach.

Operational Emissions

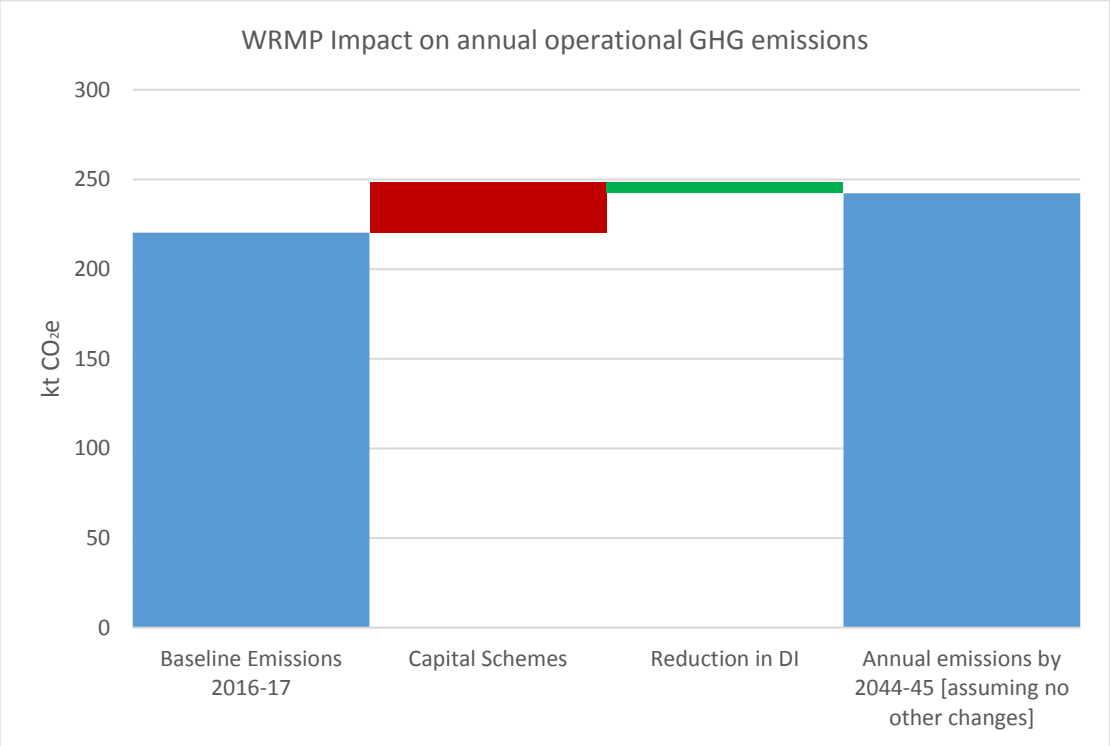
We have used our operational GHG emissions model to generate a projection of the likely carbon impacts that result from our 25 year WRMP strategy.

The methodology used to produce the overall profile for water services consisted of the following steps:

- The baseline operational emissions for water supply activities was calculated using the most recent final version of the UKWIR Carbon Accounting Workbook (version 11, April 2017).
- Increases to the baseline have been calculated where new capital schemes require additional electricity after commissioning as described above. The projected additional net energy consumption per year as a result of the capital schemes included in the plan is 65 GWh – equivalent to around 28 kt CO_2e per year using the current conversion factors for electricity from the national grid. This impact would be phased based on the timing of implementation of the capital schemes.
- Changes to the baseline emissions have been estimated based on the projected changes to the overall distribution input, which represents planned levels of leakage and demand (for example due to growth or water efficiency measures). These factors influence the energy requirement to pump and treat water and hence affect carbon emissions.
- Changes to the energy efficiency of our operations and our renewable energy generation from water services assets have *not* been included. These measures are discussed further below.
- Changes to the emissions intensity of Sgrid electricity has *not* been included.

The operational carbon impact of the plan is shown in figure D7.2 below:

Figure D7.2: Operational carbon impact of the WRMP



The net result of the long term strategy set out in the WRMP is an increase in our carbon emissions – provided we exclude the effect of changes to the emissions intensity of the national electricity grid. This is the net effect of:

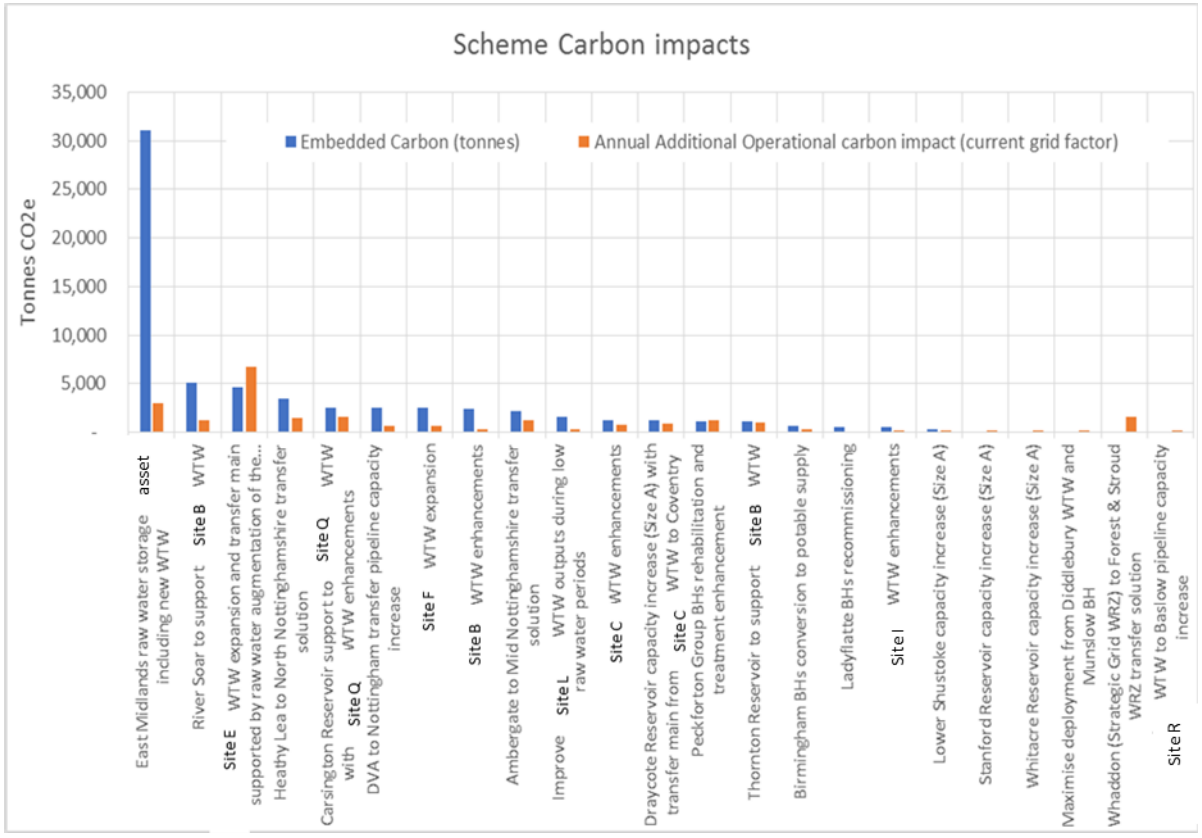
- An increase in energy consumption due to water resource capital schemes.
- An overall projected net decrease in the demand for water across our region over the period and no change in the proportional split of where this demand occurs.

Taking into account the effect of a continuing national move to lower-carbon energy as projected by Government, our total emissions and emissions intensity may decrease significantly over time, as the majority of our emissions result from our consumption of grid electricity.

Embodied Emissions

We have summed the embodied emissions projections from the capital schemes included in the plan to understand the total embodied carbon impact. Note that factors used in the calculation are current and no consideration of future changes to emissions intensity of different products and activities is considered in these numbers.

Figure D7.3: Embodied and annual operational carbon impacts of schemes included in the draft WRMP



The total embodied emissions impact of the schemes in the plan is estimated to be 64,700 t CO_2e, based on the emissions factors in the EA embodied emissions calculator. This is equal to approximately 17% of our current company annual operational emissions.

D7.2 Measures to reduce our carbon impact

The schemes set out in the draft WRMP to ensure we can meet the future demand for water form only part of our overall investment plans. Our wider investment plans, and the estimated carbon impacts of these schemes, will be set out in more detail in our PR19 business plan.

Appendix D: Deriving our investment plan

One of the key outcomes for the PR19 business plan will be that we continue to protect our wider environment. Our activities to achieve this outcome include reducing our contribution to climate change by cutting carbon emissions. As part of our overall PR19 plan we will be continuing measures to reduce our overall carbon emissions. The beneficial effects of these wider initiatives have not been included in the carbon projections included in this draft WRMP. The main actions we will be including in our wider PR19 plan are summarised below. Other measures include improving our transport efficiency and research into better ways to manage our process emissions.

Energy Efficiency

70% of our company emissions come from grid electricity consumption. We continue to improve our energy efficiency through a combination of energy efficiency projects and operational energy management. Our projects include pump replacement and refurbishment, pump monitoring and control optimisation and site heating and lighting improvements. Our strategy also includes an ongoing focus on asset optimisation and process improvement, for example through improving our telemetry systems and optimising the way we control our network. We plan to continue a programme of efficiency measures to continue to reduce emissions.

Renewable Energy

We are leaders in the UK Water sector for renewable energy generation. The more renewable energy we generate, the lower our carbon footprint. Currently, the equivalent of 34% of the energy we use in Severn Trent Water is generated from Severn Trent plc renewable energy sources. In the regulated business, the majority of this energy generation comes from sludge in the wastewater side of the business, but we also generate energy from hydropower in the water side of the business. We will continue to look at remaining renewable opportunities in the regulated business and pursue those where it is economic to do so. We also continue to grow renewable generation in the non-regulated business, which helps reduce UK carbon emissions.

Optimisation in delivery and innovation

There are a number of ways by which we can reduce carbon impacts as we deliver our plan. These include innovating in design, consistently challenging our supply chain to come up with low-carbon solutions and selecting newer, more efficient technologies. For example, we would expect to take advantage of improved technology available on the market as we come to deliver the capital schemes described in the water resources management plan over the next 25 years.

D8 Environmental and social costs

The methodology adopted for the valuation of environmental and social effects uses the EA's Benefits Assessment Guidance (BAG) documentation. This includes the original BAG (EA, 2003), plus the updated User Guide (Eftec, 2012a) and Worked Example (Eftec, 2012b) published in 2012, which link the original BAG with more recent guidance on the use of value transfer in project appraisal. This adapted methodology is consistent with the approach adopted for STWL's previous WRMP (2014).

In accordance with the BAG, environmental and social effects of each feasible list component were qualitatively assessed in the first instance. Once effects had been qualitatively assessed, significant effects were then quantified and, finally, monetary values were calculated according to the approach described by the BAG User Guide where possible. Quantitative parameters considered include the affected population and the scale of effect (e.g. length of pipeline). Relevant data and monetary valuation calculations for each component were recorded in individual assessment proforma. Sensitivity testing of environmental and social costs was also carried out by varying important parameters for each impact category.

The BAG impact categories valued for the feasible list of components for both construction and operational phases are summarised below. In many cases, the identified effects could not be monetised due to the limitations of suitable, relevant studies to enable use of the benefits transfer approach to monetisation recommended by BAG. The SEA, HRA and WFD assessments were therefore used to provide semi-quantitative assessments of these effects.

Construction Environmental and Social Costs

Construction environmental and social costs are assessed over the relevant period during construction based on the outline design details for each component or (in the absence of specific information) generic impacts in relation to construction duration, HGV and traffic movements, and impacts on recreational activities. It was only possible to calculate monetary values for the following construction effects:

- Disruption to recreational activities during construction works. The transfer value used for the valuation of recreation during the construction phase is based on the willingness to pay to undertake different informal recreation activities (Willis & Garrod, 1990). This value is based on the disruption to walkers from construction activities as a cost per person per year.
- Human health impacts from transport. The value transfer used is derived following the Defra Damage Cost Approach (ICGB / Defra, 2015b).
- Marginal cost of traffic delays associated with congestion during construction works. The transfer value selected for the valuation of congestion is based on the marginal cost of congestion associated with HGV and LGV movements (Sansom et al., 2001)

Operation Environmental and Social Costs

Operational environmental and social costs are based on annual average impacts. It was only possible to calculate monetary values for the following operational effects:

- Disruption to recreational activities during operation, using the same transfer value used to assess construction impacts (Willis & Garrod, 1990).
- Human health impacts from transport during operation or from general operational emissions to the air, both derived using the Defra Damage Cost Approach (ICGB / Defra, 2015b).
- Marginal cost of traffic delays associated with congestion during construction works or operation (Sansom et al., 2001).

It should be noted that, in addition, carbon emissions associated with each component for both construction and operation were assessed using water industry guidance and carbon valuation was carried out using national UK government carbon valuation guidance.

Environmental and Social costs of components in the feasible list

Environmental and social costs of the components on the feasible list of options range between £0 - £465,000 (average £35,000) during construction and between £0/year - £48,000/year (average £6,000/year) for operational effects. These are all negative disbenefits and result from temporary or permanent impacts on recreation, air quality and traffic congestion.

Inclusion of Environmental and Social Costs into the Draft WRMP19

The environmental and social values were included in our Water Infrastructure and Supply Demand (WiSDM) investment optimisation modelling alongside capital and operational costs of the options. A fuller description of the WiSDM investment optimisation approach is given in Appendix E.

A total of 23 solutions were selected for the draft WRMP19 programme. Temporary construction impacts of these solutions range between £0 and £196,000 (Average £28,000). A combined total of £555,000 of temporary disbenefits were identified during the construction phase of all solutions in the draft WRMP19 programme across the planning period. Operational disbenefits of the draft WRMP19 programme were valued at between £430/year and £15,000/year (average £3,000).

D9 Resilience options

The WRMP specifically considers our resilience to drought events, and sets out our long term proposals to manage this risk. This draft WRMP has been developed in parallel to our wider PR19 investment plans to prevent loss of supplies to customers. Our PR19 plans – the development of which will be completed in the latter half of 2018 – set out investment we need to make across the whole of our water supply and distribution system to so that our customers benefit from:

- water that is always there when they need it; and
- water that is good to drink.

Our plans to achieve these outcomes include a programme of proposed investments that will improve our ability to maintain supplies to customers during times of loss of water resource (eg due to borehole contamination), loss of treatment capacity (eg due to asset or power failure) or distribution issues (eg burst mains). Our overall strategy for managing system resilience is to:

- operate at the right level of risk;
- optimise the use of our existing assets/system capability
- minimise failure points and implement a more pro-active maintenance approach which allows investment to be prioritised effectively; and
- maximise efficiency and resilience - build a future network which is resilient and effective for customers and the environment and efficient to operate.

Our approach has been to follow the four principal strategic principles of resilience planning (Figure 9.1), as defined in the Cabinet Office's Keeping the Country Running: Natural Hazards and Infrastructure guidance, or a combination of them where appropriate to deliver most cost effective and proportionate risk management response to the hazards and threats.

Figure D9.1: The four strategic principles of resilience planning

For our wider PR19 investment planning, we have applied these strategic principles to the following areas;

- Resilience of our critical assets
- Borehole and ground water resilience
- Power resilience
- Local resilience
- Risk to our assets from flooding

Appendix D: Deriving our investment plan

The supply / demand schemes outlined in this draft WRMP contribute to achieving our PR19 outcomes. Currently, we have not identified any wider resilience investment needs that directly impact on the WRMP. Instead, when we are designing new water supply / demand schemes to meet the needs set out in our draft WRMP, we are including wider resilience benefits within their design and scope. In that way, we are designing supply / demand solutions that not only achieve our long term water resources needs, but also provide multiple benefits and contribute to our ability to manage asset failures.

The supply schemes outlined in this draft WRMP have therefore been designed to provide 'optimum' solutions that deliver holistic benefits and which are co-ordinated with the wider needs of the investment plan. We are seeking supply / demand solutions that could give us additional resilience benefits for no additional cost, or where the marginal cost of improving resilience makes it cost beneficial to include it in the scope of the scheme design. We will continue to refine the detailed scope of these solutions between draft and final WRMP.

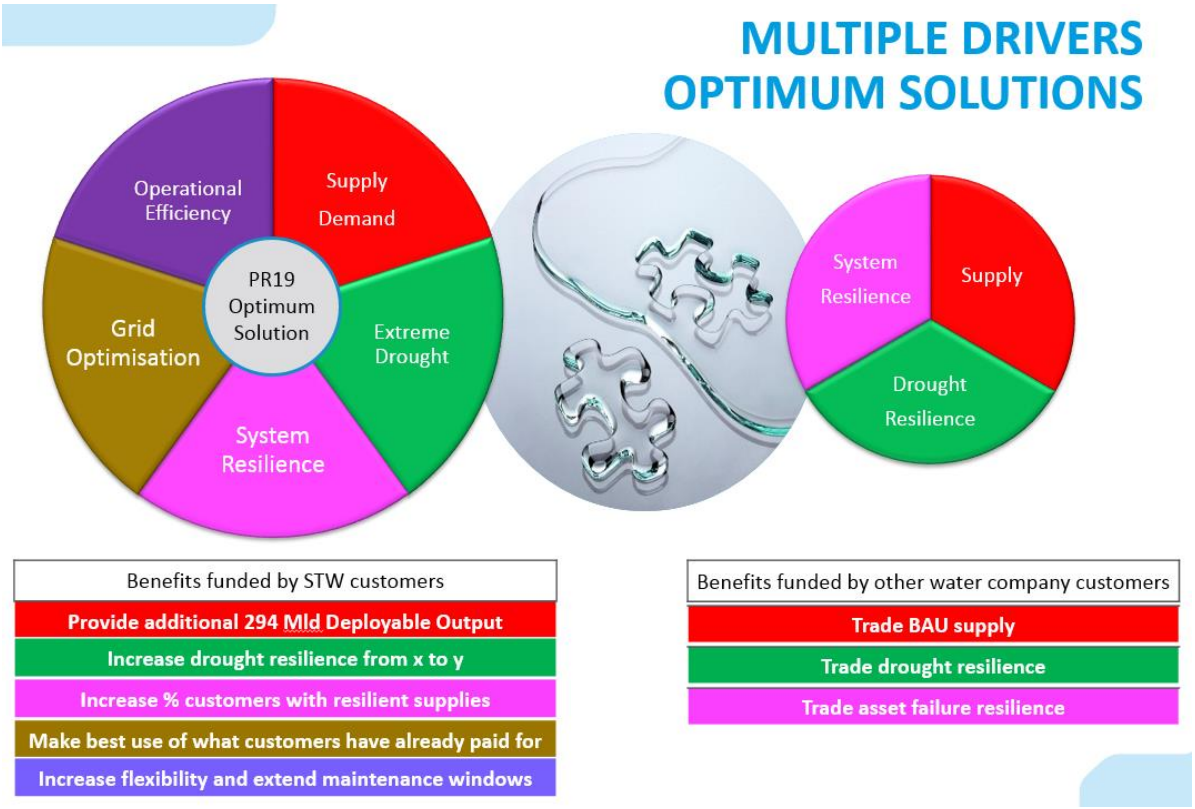
The full range of drivers that have been considered as we have sought to optimise water resources and supply / demand solutions over the long term are summarised in Table D9.1 below:

Table D9.1 – Drivers considered

Driver	Summary of need and opportunity
Reduce operating costs	Reduce water treatment and pumping costs by achieving economies of scale and using lower cost works.
Enable Grid assets to be efficiently maintained	Improve maintenance efficiency through strategic rebuild rather than patching individual processes. Allow more efficient maintenance by extending the period for which a whole process stream can be taken offline. Reduce water quality and customer interruption risks when works are taken out of service. Enable major water treatment works to be taken fully offline. Enable critical Grid aqueducts and pipelines to be taken offline for inspection and extended maintenance.
Drought resilience	Increasing resilience to drought and reducing cost of failure.
Supply demand pressures	Provide increased capacity to address future deficits driven by climate change, water framework directive and population growth. Release 'locked up' deployable output by removing constraints.
Water quality risk	Effectively meet new raw water challenges and drinking water standards.

Water trading	Identify opportunities for trading water with neighbouring water companies, both into and out of our region.
Other resilience	Remove Strategic Grid risks by developing a flexible network that can continue to maintain supplies during a unplanned outage of a water treatment works or strategic link. Provide more headroom to meet future peak demand.

As part of our wider PR19 investment planning, we are exploring the high level costs and benefits of consolidation options and hence the viability of proceeding to more detailed feasibility work. Solutions being considered are wide ranging and include a number of schemes that could either be carried out independently or in conjunction with each other. This includes an assessment of schemes to either maintain, expand or abandon our water treatment works. Options are also being developed that will provide increased treatment capacity on the Strategic Grid through either expanding existing sites or by construction a new works at a different location. This has involved an assessment of potential raw water support options to either supply an expanded/new treatment works or to replace lost deployable output as identified in the WRMP.



D9.1 Resilience of our critical assets

Following the events at Site O in July 2007 we have been on a journey to reduce the risk associated with the temporary loss of supply from our critical assets including aqueducts and our surface water treatment works.

Capital investment projects carried out in AMP5 and also those ongoing in AMP6 will improve our resilience in the event of a temporary loss of a number of our major water treatment works.

We have extended and improved on our methodologies and learning from previous studies and extended it to cover the whole of our critical assets so that we can understand and quantify their risk in a systemic and consistent way. This work has identified that we still have a risk where large numbers of customers could lose supply if we were to suffer from a catastrophic failure at one of a number of our surface water treatment works or section of Strategic Grid aqueduct or pipeline. Our investigation work to date has identified those assets that pose greatest risk to security of supply if they were to fail. Our surface water treatment works, their performance and resilience are also key in ensuring that we provide sufficient day to day operational headroom on our Strategic Grid.

The interconnectivity and resilience already built into the Strategic Grid and beyond is designed to enable us to move water in a flexible and sustainable way in response to an unplanned event. However, this resilience has been provided over a number of Asset Management Periods and in some cases only meets the requirements of "Water there when you need it" and not the requirement of "Water that is good to drink". Our investigation has identified interventions that could be made to the existing assets that will improve how we can operate in a resilience scenario that will allow us to meet both requirements. The improved performance of the resilience assets will allow for enhanced and more flexible operation of the Strategic Grid and water supply network which will maintain levels of service standards when the system needs to be operated in a resilience scenario.

Over 2016-17 we completed a study to help us understand the consequences of not being able to supply customers if we suffer a significant outage from one of our surface water treatment works. This assessment was carried out using our mass flow balance modelling tool 'Miser'. An entire loss of output would be following a catastrophic failure as a result of a severe fire, flood, pollution or terrorist event.

The next phase of work has focussed on improving our understanding of likelihood and duration of possible critical asset failure. We are carrying out a detailed 'Failure Mode Effect Analysis' on each of our major water treatment works sites. The aim of this work is to:

- Confirm all failure modes (events) that could result in a works outage.
- Confirm the operational mitigation that is available to limit the impact of an event.
- Confirm the duration of an outage for each event.
- Confirm the likelihood (probability) of each event.

The events considered will be wide ranging and include asset failure, fire, flood, terrorism, power loss etc. The analysis will also consider the entire end to end treatment process from river intake/raw water reservoir storage through to treatment and final WTW's output.

This will provide us with an improved view of the overall system risk rather than for individual assets. The outputs of the study will help us to prioritise investment and inform the type and scale of resilience solutions to be recommended for a given level of risk.We are developing a range of solutions that will provide resilience, and hence reduce the risk of a loss of supply, in the event of a major asset failure.

D9.2 Borehole and Ground Water Resilience

For groundwater resilience we have focused on identifying investment options to ensure that no customer reliant on a single or significant groundwater source goes without supply for more than 24 hours should there be a significant failure event.

Greater understanding of our groundwater assets and their vulnerability has been gained through AMP5 and AMP6; determined through a combination of our Borehole Capital Maintenance programmes, enhanced groundwater monitoring and surveys and better recording and understanding of actual and near miss pollution events. This data has indicated some vulnerability across our groundwater asset base.

Analysis has shown that whilst groundwater source failure events are of a low probability, they do and have occurred, and in particular supply areas, are potentially high consequence events. The impact on customers can be high (loss of supply) as well as the impact on STW operations when required to respond to events. Our investigation has focused on supply areas where the consequence of these risks occurring is amplified due to the vulnerability of the groundwater source where there is little or no medium or long term asset resilience in place to maintain customer supplies.

A loss of supply to customers for durations of weeks or months would cause significant resource and manpower burden but also with the potential for profound reputational, financial, regulatory and social problems. We are therefore committed to carrying out investment to protect our customers.

The type of solutions that we are investigating to improve the resilience of our groundwater asset base range from catchment management, treatment, new distribution connections. These are being investigated in conjunction with maintenance investment plans and our supply demand balance/drought strategic options.

D9.3 Power Resilience

Power dips or power outages have the potential to cause unplanned supply outages to strategic grid water treatment works and other water sites. In order to improve the power resilience there are two elements of work:

- immediate solutions to eliminate power dips across assets and critical processes
- long-term solutions to ensure power is always on, e.g. by ensuring capacity with standby generators and connection points on site or with UPS where sufficient, etc.

A number of initiatives were delivered in AMP5 for improving resilience, such as schemes for purchasing generators and using them as stand-by for emergency situations, purchase and installation of fixed generators, installation of generation connection points, etc.

In AMP6 a programme of work is currently being delivered at five sites too critical to fail. The main scope of this programme is to identify and implement quick fixes and immediate solutions to eliminate power dips across assets and critical processes that could cause unplanned works outages, and interim control measures if needed.

In AMP7 we are considering power resilience of both water treatment processes and also in terms of overall site resilience.

D9.4 Flooding resilience

In early 2016 following a series of significant flood events around the country (Carlisle 2016 being a precipitative event) the UK Govt. initiated the National Flood Resilience Review (NFRR) to look at the UKs ability to maintain essential services during extreme flooding and extreme weather events. This review included contributions from Utilities and specifically an assessment of infrastructure owned by water companies with respect to their vulnerability (i.e. ability to maintain service) to newly developed flood models developed by NFRR Scientific Advisory Group. These models were used to predict the effects of extreme rainfall events and extreme river flooding events. The models were then compared to the Environment Agency (EA) Extreme Flood Outline Maps to assess the areas at risk.

In Severn Trent we have previously experienced flood events with high return periods (although not as high as 1 in 1000). In 2007 our water treatment works at Site O was flooded and the community of Gloucester and Tewksbury experienced significant disruption, over a prolonged period of time (circa 3 weeks), to their water supply and waste water services. We understand the impact events such as these can have on the local communities. As a result we improved the resilience of our services in many areas;

- Flood barriers have been established at some key, at risk, works
- Single points of failure within works have been identified and addressed
- Second sources are available to our larger populations
- Power resilience has been improved

As part of the NFRR work we have re-assessed our vulnerability to extreme flooding for all our assets using up-to-date flood risk and asset data.

This business case sets out to highlight the impact loss of service (from flooding) can have, the risk across our asset base and considers potential solutions and an overall cost estimate range for a programme of resilience work across AMP7 and beyond for flood protection so that we can continue treating and pumping drinking water and wastewater. The focus is on the impact of river flooding (fluvial), surface water run-off (pluvial) and groundwater levels rising on our assets and their ability to serve our customers.

Loss of our service can have a devastating impact on local communities when it occurs. If water supply is lost customers are forced to severely restrict their usage of water (which may not extend to basic sanitation), collect supplies from bottled water stations, accommodate large scale emergency services in their community, financial losses, insurance claims and reputational damage for businesses being unable to fulfil service and the opportunity cost of diverting time, effort and money to manage and recover events. If waste water services are lost there is a risk of pollution during recovery of the service and impacts on businesses unable to discharge waste to affected sites. Taken together these impacts can prove devastating for communities (e.g. Gloucester 2007, York 2015, Cumbria 2016)

In response to last year's floods, the Cabinet Office initiated the National Flood Resilience Review (NFRR) to look at the UKs ability to maintain essential services during flooding and extreme weather events. Specifically the NFRR looked at the ability to maintain services during extreme rainfall and extreme river flood events. Extreme is defined as an event that on average would occur, on average once in 1000 years. The Scientific Advisory Group appointed to stress test the models created under the auspices of the NFRR concluded the modelling approach was reasonable and use of the EAs Extreme Flood Outline Maps was a reliable way to assess areas at risk. They also concluded that whilst events such as these may appear remote for a particular location such events anywhere in the country are not unusual.

A number of other pieces of research suggest flooding is likely to become more frequent and extreme. The National Infrastructure Commission have just published their National Infrastructure Assessment. This recognises the risk to the services we provide and ranks the industry response as 'More Action Required' (i.e. the highest level of urgency [More action/Sustain/Watching Brief/Research required]) to manage risk against flooding. Defra's "Strategic Priorities for Ofwat" requires Ofwat to challenge companies to assess resilience against floods described in the NFRR and include for provision where required, prioritising upgrades on the basis of high-risk sites first. The National Risk Register of Civil Emergencies identifies key risks that have the potential to cause significant disruption to the UK. It ranks the likelihood of flooding occurring in the next 5yrs such that significant disruption is caused as medium with the impact as medium or medium/high. Planning to mitigate the impacts of this on local communities is critical. Ofwat's 'Resilience in the Round' publication suggests that organisations need to take an 'interdependent' systems view to both 'shocks' (e.g. super storms) and stresses (e.g. ageing infrastructure) in order to manage resilience more effectively. Resilience against the impacts of extreme weather falls into this category.

As part of the NFRR the water sector was asked to look at infrastructure (i.e. key water treatment sites) located in the EAs Extreme Flood Outline Maps and ensure that we had temporary defences available by the end of 2016. Key water treatment sites was defined, in this analysis as, water treatment works serving over 25,000 people. We identified 13 sites at risk. Our assessment concluded that it was not feasible to provide temporary defences at any of these sites for various practical reasons (e.g. some sites already protected, some sites the EA confirmed there was insufficient response time available to deploy temporary defences, some sites have local features that provide protection). An Evidence Summary report was produced clarifying the process we went through for identifying sites at risk and the rationale and justification behind this assessment. Notwithstanding this we have ensured that our operational Flood Contingency plans for these sites are up to date and ready for deployment.

Following this work we received a request by Defra to identify all assets (water and waste water) which serve more than 10,000 people and fall within the EAs Extreme Flood Outline Maps. We have done this and have

concluded that we have 151 sites (Boreholes through to Sludge Treatment facilities) at risk of being unable to maintain service should the extreme flooding events occur.

Having identified these sites and responding to these challenges we believe it is prudent to make them resilient so that they are capable of maintaining service should such extreme events crystalise. This business case sets out a cost effective way of responding to these challenges.

We have sought the views of our customers through various quantitative and qualitative channels so that we have a holistic picture of their needs. We undertook deliberative research to test appetite to protect assets so that service could be maintained in these circumstances. The feedback we have suggests that for the marginal cost of our proposals customers are willing to pay for the benefits.

Having identified the sites/assets at risk of flooding we have appraised each site specifically to understand the unique flood protection requirements. From this we are able to identify specific flood protection solutions.

A range of solutions to improve the resilience of the sites against flooding has been considered which includes the four principal strategic components of resilience (*Keeping the Country Running: Natural Hazards and Infrastructure, 2011)*. Solutions have been appraised using the four principal options of Resistance, Reliability, Redundancy, and Response & Recovery outlined in this document. We have adopted a number of solutions using these strategic components (or combination therefore) to minimise investment whilst maximising resilience benefit. Typically they include;

- 'do nothing' (where impact is considered acceptable for a short period of time)
- increasing interconnectivity so that service provision is no longer dependent on a single asset,
- relocation of critical equipment/asset
- mobile back-up equipment
- permanent defences at key asset level
- permanent defences at site level

D10 Description of our recommended supply options- Redacted