APPENDIX O

Best value planning

This appendix provides more detail of WRW's approach to best value planning and the underpinning analysis. It focuses on public water supplies and should be read alongside sections 5.5, 7.5 and 7.7 of the draft regional plan main report. The approach to assigning value through the ValueStream decision making tool and metrics is described, as is the estimation of overall plan benefits. The relative impact of plan choices through reconciliation is also shown, and more detail is provided on the sensitivity tests carried out.

Contents

O.1. Overview of best value approach

WRW's approach to decision making, i.e. selecting options to meet the water resources needs, was developed collaboratively by the group through 2020, 2021 and 2022. The methods used are set out in a methodology and a series of supplementary notes. The methodology explains the choice of approach, linking best value planning into the problem formulation. In this appendix, we focus on the best value elements of our planning for public water supplies.

In WRW, decisions as to which public water supply options are needed are ultimately taken by the water company boards, linked to their governance of their WRMPs. The regional role is to support that decision making, so that national, regional and multi-sector considerations are factored into those decisions with consistent evidence. This is supported by common ambitions, which cascade through outcomes, metrics and objectives as set out in Table 6 of the regional plan main report.

Section 5.5.2 of the regional plan main report summarises how we have used ValueStream as part of our core common methodology to determine best value scores for options. The tool – developed by WRW and expert partners – is based on multi-criteria analysis (MCA) and is designed to accommodate a range of metrics and objectives into the decision making. The tool takes different value metrics and weights them according to relative preferences to form an optimisation which maximises value according to the values and weights. This was used as part of the decision making to inform, and evidence to support, the selection of best value plans.

A key feature of MCA is its emphasis on the "decision making team" in establishing objectives, criteria (metrics) and weights. Deciding on the "best value" plan for water resources management is a complex task covering a range of economic, environmental and well-being aspects. Different stakeholders have different views of these aspects, what they mean, and their importance. In selecting the "best value" plan we need to consider views of customers and stakeholders, building consensus, and doing so in a transparent way. We also need to recognise that water resources planning is a technical area and use expertise appropriately.

Our agreed methodology was therefore to use the senior management group of Water Resources West as the "decision making team" to establish the objectives, criteria and how they should be measured. This group comprises experienced water managers, environmental regulators and represents a range of water users. However, it was important that this group took into account the views of a wider range of stakeholders in selecting the metrics. The Resource Position consultation (March 2020) provided the opportunity to gather stakeholder views on the ambitions and strategic choices. The senior management group therefore took this into account in its selection of metrics in May 2020. Subsequent consultations, including the Emerging Plan consultation (January 2022) provided opportunities to review this and inform the weightings and options selection.

The following sections explain more about how this was done and provide more detailed evidence than in the main report.

O.2. ValueStream, metrics and weightings

ValueStream

ValueStream is a tool that takes supply demand balance data and a list of options, and identifies which of those options could be selected to resolve any supply demand deficit. To do this it uses a set of data about the option, which includes the Ml/d contribution and its performance in other areas, formulated as a number of metrics. Each metric has a "value weight" assigned so that the tool can add them together to form a "value score" as per multi-criteria decision analysis (MCDA). A set of options, each selected on dates that resolve the deficits, with a best "value score" would be a candidate "best value plan" (Figure 1).

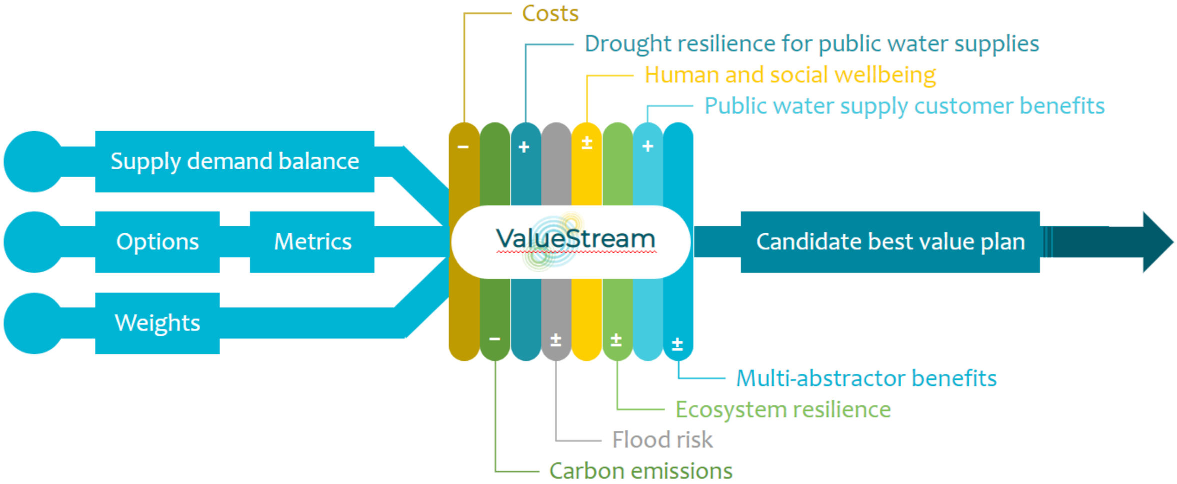
The ValueStream tool was developed by HR Wallingford for WRW. It can be used in two ways. In its "optimisation mode" it can select the options and dates to find a combination which gives the best "value score". In its "simulation mode" the user can enter a selection of options, with dates, and the tool will report the "value score" and whether the supply demand balance is met.

ValueStream, being a spreadsheet based tool, has the advantage of being easy to deploy across multiple company systems and easy for water resource planners to use. It also benefits from transparency and auditability since all its calculations are visible to the user. However, it also has some disadvantages: with a large number of options the optimisation can take several hours, and only one water resource zone can be optimised at a time. To overcome these disadvantages, linked to their problem characterisation[1], Severn Trent and United Utilities embedded the ValueStream approach in their own optimisation tools. Outputs from those other optimisation

[1] Problem characterisation is a way for us to understand the nature of water resources in the region. It highlights the complexity of the planning problem to inform selection of appropriate planning methods. WRW's problem characterisation is available here: waterresourceswest.co.uk/s/WRW-Problem-Characterisation-Report-v30-July-2021.pdf

tools could then be fed into ValueStream's simulation mode to calculate consistent best value scores.

Figure 1. Decision-making process using ValueStream, showing the input information (including the eight selected metric) that the process relies upon to select a candidate best value plan



Metrics

The metrics, used to support decision making consistently across the region, were selected by our multi-sector senior management group. Eight metrics were selected by the group, although it was subsequently decided to split some of the metrics into positive effects (i.e. benefits) and negative effects (i.e. disbenefits). This was to ensure that the weighting, optimisation and decision making was not blind to potential netting-off of benefits and disbenefits. Summary definitions of the metrics are provided in Table 1.

Table 1. Summary definitions of the Water Resources West metrics

	Metric name	Description
1	**Cost**	Total NPV based on capex (initial and replacement) and opex (fixed and variable). Aligned to water resources planning guideline requirements.
2	**PWS drought resilience**	Supply-demand balance change at 1 in 500 level (Ml/d)
3	**Carbon costs**	Total NPV of monetised carbon cost. Calculated using BEIS carbon values.
4	**Flood risk**	Flood risk assessment from SEA converted to a numeric scale.
5	**Human and social wellbeing**	Air quality, climate resilience, economy, tourism and recreation, human health and well-being, cultural heritage and landscape assessments from SEA converted to a numeric scale.
6	**Ecosystem resilience**	Biodiversity, ecosystem resilience, INNS, soils, geodiversity and land use, waste and resource use assessments from SEA converted to a numeric scale.
7	**PWS customer supply resilience**	Customer valuations ("willingness to pay") NPV for supply interruptions and water quality (aesthetics and hardness)
8	**Multi-abstractor benefits**	Water quality and quantity, and water resources from SEA converted to a numeric scale.

A number of the metrics are derived from the SEA assessments, and these are the ones that are split into positive and negative effects. Including the SEA assessments in the optimisation to select options further integrates the SEA in the decision making. It complements but does not replace other uses of the SEA, to screen options and to provide an assessment of the overall plan, including cumulative effects. This helps integrate the SEA into the plan preparation process from its early stages.

The method of formulating metrics as a numeric scale was developed at facilitated workshops. The multi-sector WRW senior management group were supported in this by appropriate experts. HR Wallingford and PJM Economics led the workshops. The participants included water resources planners and decision makers from water companies, environmental regulators from the EA, NRW and RAPID, representatives from industries such as the Canal and River Trust and the National Farmers Union, and specialists in environmental assessment from Wood and Ricardo.

SEA option-level assessment outputs for each supply-demand option range from significant positive effect (+++) to significant negative effect (−−−). This needed to be converted to a numerical value to be used within the MCDA process. A score was assigned to each level of each SEA metric such that 0 represents the lowest (worst) value and 100 represents the highest (best) value, and intermediate numbers are chosen such that numerical differences are proportional to differences in value. In the workshop, a consensus was sought from the group as to how each of the SEA levels should be mapped to a number between 0 and 100 and aggregated into a metric.

Table 2. Score attached to the option-level SEA assessments in the metric derivation.

SEA assessment		Score used to derive the WRW metric	
		Positive	Negative
Significant positive effect	+++	100	
	+++/?	95	
Moderate positive effect	++	50	
	++/?	45	
Minor positive effect	+	25	
	+/?	20	
Neutral / uncertain	0	0	100
	?	0	100
Minor negative effect	−/?		80
	−		75
Moderate negative effect	−−/?		55
	−−		50
Significant negative effect	−−−/?		5
	−−−		0

The SEA considers both construction and operational impacts, which are assessed separately. In the workshops, the group took the view that benefits would be more significant in the operation of the schemes, whereas negative impacts would be more significant at the construction stage. The agreed weighting was 100:75 in both cases, which equates to the weights shown in Table 3 below.

Table 3. Weighting between construction and operational effects in the SEA derived metrics.

	Positive	Negative
Constuction	42.86%	57.14%
Operation	57.14%	42.86%

The final choice in the formulation of the SEA metrics was how to combine assessments for several SEA objectives into a single metric value. After discussion amongst the group, it was concluded that the SEA objectives would be weighted equally within a metric. For example the ecosystem resilience metric was formed from five SEA objectives, each weighted 20% of the total metric value. Metrics which covered a broader area, by combining more objectives, would then be considered for a higher weighting (see below).

In this way, the option level SEA assessments were used to derive metric values between 0 and 100 by combining several objectives, operational and construction effects. Negative and positive effects from the SEA were kept separate and reported as separate metrics.

Other metrics are directly monetised: the direct financial costs, carbon costs[2] and water company customer valuations of service levels. These were all expressed as 80 year £m net present values (NPVs) discounted according to the Water Resources Planning Guideline and Green Book.

The customer valuation of service levels was carried out by FASTTRACK[2] in March 2021. FASTTRACK[2] carried out a triangulation of water companies' PR19 and WRMP customer research. This included Hafren Dyfrdwy, Severn Trent, South Staffs, United Utilities and Welsh Water. Triangulated company and regional average values were produced for interruptions, hardness and aesthetics (which included taste, odour and appearance) as shown in Table 4. FASTTRACK[2] produced a calculation tool for the water companies to use. Companies entered the change in service level for these categories for each option and the tool produced an 80 year NPV representing the benefit (or disbenefit). The sign of the NPV value could be positive or negative depending on whether the likelihood of service impacts would increase or reduce as a result of implementing the option.

Table 4. Customer valuations (WRW average) used in the PWS customer supply resilience metric

Service impact	Units	Customer valuation		
		Central estimate	Upper	Lower
Interruptions	£ per day per year	£1,348	£1,760	£1,176
Aesthetics	£ per contact	£1,614	£2,186	£1,495
Hardness	£ per customer affected	£20	£40	£10

Accordingly, companies produced a full set of metric values (Cost, PWS drought resilience, carbon costs, flood risk, human and social wellbeing, ecosystem resilience, PWS customer supply resilience, and multi-abstractor benefits) for each of their feasible options as an input to ValueStream.

[2] Calculated using carbon values from the Department of Business, Energy and Industrial Strategy

Value Weights

With the metrics defined, a set of weights were required. The weights assign relative value between the decision metrics. This is a feature of all MCA assessments. WRW derived weights initially taking a stakeholder view in a facilitated workshop. This was then followed by customer research to inform updates to the weights.

WRW chose to express the value weights in monetised terms. This is not a common approach in MCA and not the same as a CBA, however it adds clarity to the value judgements being made. MCA generally results in paying more for more benefits. By monetising the weights, and therefore the scores we are making this more explicit, i.e. easier to see how much monetary value is being placed on different benefits in the MCA results.

Initial stakeholder weights were derived in a workshop of the multi-sector WRW senior management group. This followed on from the formulation of the metrics and again the group was supported by technical experts. The group considered how to weight the different SEA derived metrics, including the separate positive and negative effects relative to each other. The group then considered the inherently monetised metrics (cost, carbon, PWS customer resilience) to see if there was any reason to give additional weight, based on stakeholder and customer views, above the default 1:1 weighting. The final step was to weight SEA metrics and monetised metrics relative to each other. Carbon was chosen as the linking metric as this is an environmental value, and hence qualitatively more similar to the SEA-based metrics than any of the other monetary metrics. The core question asked was: how important to customers and stakeholders is the maximum impact of (monetised) carbon relative to negative ecosystem resilience SEA metric? The maximum carbon impact from the draft feasible options data could then be pegged to a point on the 0-100 scale for the ecosystem resilience negative effects metric.

Workshop deliberations by the group resulted in the SEA-derived metrics being weighted in proportion to the number of underlying objectives. An additional weighting, in the ratio 100:75 was applied to give more weight to the ecosystem resilience metric. This was because ecosystem resilience / sustainable natural resources was thought to be the most impactful, based on customer and stakeholder views. The same relative weighting was judged to apply to positive as well as negative impacts, and both positive and negative impacts were considered to have equal importance in decision making. The inherently monetised metrics were all weighted in the default way, and the maximum carbon impact of £140m was pegged to a score of 75 on the ecosystem resilience negative effects metric. This resulted in the stakeholder weights shown in Table 5.

The companies then carried out additional customer research designed to elicit value weights. A joint exercise was carried out, with common analysis for the three English WRW companies. They were supported by PJM Economics, who also supported with the metric formulation and stakeholder weighting workshops. Welsh Water carried out separate customer research targeted at Welsh customer views. This kind of customer research was not required for Hafren Dyfrdwy which has no deficits to resolve.

The purpose of this quantitative customer research was to obtain measures of customers' decision weights with respect to the metrics entering the MCDA tool. It took the form of a pairwise choice exercise, being most appropriate for evaluating preferences between supply-demand solutions. The surveys benefited from including visually engaging material to communicate the solution option and its relative impacts on each of the key decision metrics. Participants were shown a sequence of option pairs and asked in each case which of the two they would prefer to see implemented in their region. The order in which they appear, and the permutations of options within pairs, would be varied across the sample according to the experimental design. Results were then analysed to establish value weights using an econometric model.

The advantage to measuring value weights rather than, or as well as, preferences over solution options, is that customer preferences can be considered directly in terms of how much weight to put on the various decision metrics. There may be good reason why decision makers choose to adopt different weights to the weights derived directly from customers, for example due to their greater knowledge and understanding of the policy and operational context than customers. However, understanding how customers trade off these metrics against one another is a good way to ensure that their views are being appropriately reflected in the weights that are chosen.

Table 5. Stakeholder and customer derived weights for ValueStream analysis. Customer weights are shown as an average for the three WRW companies in England, and the confidence range is also shown.

	Metric		Stakeholder weight	Customer weight		
				Central	Lower	Upper
1	**Cost**		1.00	1.00		
2	**PWS drought resilience**		N/A[3]	N/A		
3	**Carbon costs**		1.00	1.81	1.56	2.05
4	**Flood risk**	positive effects	0.28	0.77	0.69	0.85
		negative effects	0.28	0.77	0.69	0.85
5	**Human and social wellbeing**	positive effects	1.96	0.72	0.63	0.80
		negative effects	1.96	0.72	0.63	0.80
6	**Ecosystem resilience**	positive effects	1.87	1.01	0.91	1.12
		negative effects	1.87	1.01	0.91	1.12
7	**PWS customer supply resilience**		1.00	1.00		
8	**Multi-abstractor benefits**	positive effects	0.84	0.64	0.56	0.73
		negative effects	0.84	0.64	0.56	0.73

Customer weights, as a WRW average for the English companies, are shown alongside the stakeholder weights in Table 5. While the general scale and pattern of weighting is similar across the customer generated weights and those generated in the workshops, there are four main observations:

- The weights of the performance metrics from the customer research are generally slightly higher than those from the workshops. This implies that customers place slightly more value on performance generally, which could favour more expensive plans which

[3] The PWS drought resilience measure was used as a constraint in the decision making to ensure sufficient Ml/d were selected to resolve the deficits. It was therefore not weighted. Subsequent analysis by the water companies considered levels of service change.

generate more value. The implications of the cost-performance trade-off should be explored in the stage 2 best value trade-off analysis.

- Customers place significantly more value on the avoidance of carbon emissions than the workshop weights would imply. The workshop assumed that government carbon value were the appropriate ones (hence the weighting of 1.00). This is compatible with stakeholder responses from our emerging plan consultation. Carbon reduction featured in a number of responses. See Figure 2 below.
- Customers also place more value on the avoidance of flooding impacts than the workshop weights would imply. Again this is compatible with stakeholder responses from our emerging plan consultation. Flood risk reduction featured in a number of responses. See Figure 2 below.
- Of the metrics derived from the SEA assessments, ecosystem resilience has the highest weight in both the customer and workshop outputs.

WRW commissioned an independent peer review of the weightings research. This review was carried out by Dr Silvia Ferrini, a member of the Centre for Social and Economic Research on the Global Environment at the University of East Anglia. The main objective of the review was to assess whether decision metric weights fed into the ValueStream tool are valid and informative for WRW water companies. Dr Ferrini concluded that "given the aim of the study, the weights derived from the customers' survey are valid measures to inform the multi-criteria tool".

After reviewing their customer research, Welsh Water decided to retain the stakeholder derived weights. This puts more weight onto the human and social wellbeing than the customer derived weights for England.

Figure 2. Sample of feedback gathered from our emerging plan consultation, of relevance to metric weightings. Three particular metrics are highlighted. Other aspects, e.g. wellbeing did not feature so prominently in the feedback.

Carbon

"It's got to be the multi-benefit... One of the key priorities of planning is protecting the environment. We need to find that balance between the environment and economic growth. It's similar to planning, in that everything is always a priority!" Local authority

"It would also be helpful to underpin all of this with cost / benefit analysis, featuring different weightings." Local authority

"We would encourage plans to be aiming for carbon neutrality" Environmental group

"Too many carbon emissions and too much power used." Academic institution

"I find it extraordinary that WRW plan to invest so heavily in hard infrastructure with all the embedded carbon that entails." Environmental group

Flood risk

"Flood risk has very low weighting (0.28), yet it has major impact" Flood Action Group

"Investing in new technologies, flood management and carbon sequestration are key." Local authority

"In terms of climate change, we could be using our surplus water to support marshlands to absorb more carbon." Business customer

"I like the approach where there are things that are going to benefit the natural environment." Environmental group

"We need to achieve environmental net gain if these water transfers are to occur." Charity

"The creation of habitats and wetland can help with things like water treatment, but these doesn't seem to be covered that much as options. I'd call for more of this." Charity

"If we use natural flood management then we won't need to worry as much about flooding and moving water around because it will be stored naturally. It's the same situation where we're treating nature as being there for us and it's not just there for us. Water systems are also diverse ecological systems" Charity

"The most environmentally friendly ones are the ones I'd most support." Local authority

Ecosystem resilience

"Flooding does need to be more prominent within this framework." Environmental group

"It's as if the company only sees the benefit when the water can be sold, but not when it's going to towards increased flood resilience" Environmental group

"I like how the plan is shaping up and will allow benefits to stack up, such as … flood management, access to nature and carbon sequestration through habitat creation." Domestic customer

"The environment underpins our society, and it is a complex system. That means we need to take a complex approach to tackling this issue, so I would not necessarily prioritise any particular area and would focus as widely as possible." Government body

O.3. Estimation of plan benefits

Water companies, and ultimately their boards, were responsible for deciding the best value plan to put forward for consultation in this plan. The approach described above, alongside our wider work to align supply and demand forecasts and explore water transfers, gave the water companies a consistent set of evidence to inform those decisions. This was complemented by company-specific considerations described in each of the companies WRMPs.

The exploration of water transfers, through reconciliation of plans was an important consideration and this is explain further in Section O.4 below. First we explain how overall plan benefits were estimated, building on the customer valuations expressed Table 5.

Section 7 of the main plan document provides an estimate of the overall plan benefits from public water supplies, and the relative impact that water transfers make to the plan. These are order-of-magnitude indicative estimates of the value created by the plan. They were calculated using a variety of methods looking at the benefits and disbenefits of what is proposed in the regional plan. In making these estimates we sought to use a conservative approach to benefit valuation wherever possible, to avoid over-stating the benefits.

Drought resilience benefits

The largest benefit of the plan arises from providing public water supplies that are resilient to drought. We estimate the benefits of this using the estimates and methodology from the 2018 National Infrastructure Commission (NIC) report "Preparing for a Drier Future". In the NIC's analysis for this report the benefits of drought resilience were measured in terms of avoided costs. The avoided costs were the costs of emergency measures to provide household water supply during a drought for the period 2020-2050. The costs were reported on a present value basis weighted by the occurrence probability for 1 in 200 and 1 in 500 droughts. We took those values and scaled them to the population of WRW, and calculated an 80 year NPV reflecting the shift from 1 in 200 to 1 in 500 resilience across the planning period. This is a conservative approach because it doesn't seek to capture the much greater value created by simply having water available for day-to-day life and business.

Environmental destination benefits

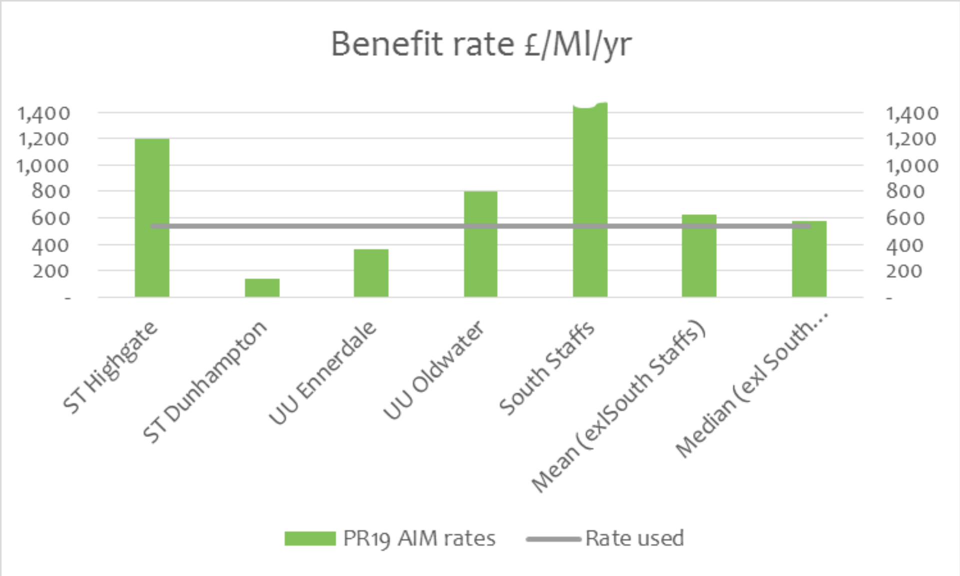
Another large benefit of the plan arises from the abstraction reductions linked to environmental destination. We estimated this using evidence from the Environment Agency's National Water Environment Benefits Survey[4]. We took the value to improve waterbody status from poor to moderate, using the low estimate of the England and Wales average. Again, this is a conservative approach as abstraction reductions are actually prioritised towards catchments with greater benefits. We used this estimate to derive a volumetric rate that could be applied to the abstraction reductions in the regional plan. We followed an approach analogous to that used by some water companies for the abstraction incentive mechanism (AIM) rates at the 2019 periodic review.

Figure 3 shows how the rate used in our approach benchmarks against the AIM rates set in Ofwat's 2019 Final Determination. If we calculate an average (excluding South Staffs for having an unusually high rate) then the rate we used is slightly below the average. This affirms the conservative approach to benefits estimation. The figure also illustrates why these benefit estimate are to be thought of as order of magnitude estimate, as the real benefit will vary considerably by site.

In making the estimate we applied this rate to all elements of abstraction reduction to meet the environmental destination, including WINEP, WFD and the longer term BAU+ scenario.

[4] Updating the National Water Environment Benefit Survey values, Environment Agency, June 2013.

Figure 3. Benchmarking of per Ml abstraction reduction benefit with PR19 Final Determination AIM rates. Note that South Staffs (which includes Cambridge Water in a single rate) is an outlier, off the scale at £49,100/Ml/yr.



While throughout this analysis we have sought to use conservative approaches to avoid overestimating benefits, the abstraction reduction is one area where there is a potential for the benefits to be overestimated. This is despite the conservative assumptions in the choice of benefit value from the national survey. The method that we have used assumes that all the abstraction reduction translates into an environmental benefit in the same way that AIM works. We assume that the full environmental benefit associated with an improvement in WFD status is achieved by the reduction in public water supply abstraction. In practice there may be co-dependencies with other environmental improvements before the improve status is realised. It is a necessary assumption at this stage as we don't have detailed evidence available. The water companies will be carrying out investigations to improve the understanding in the catchments to inform the actual licence changes that are needed.

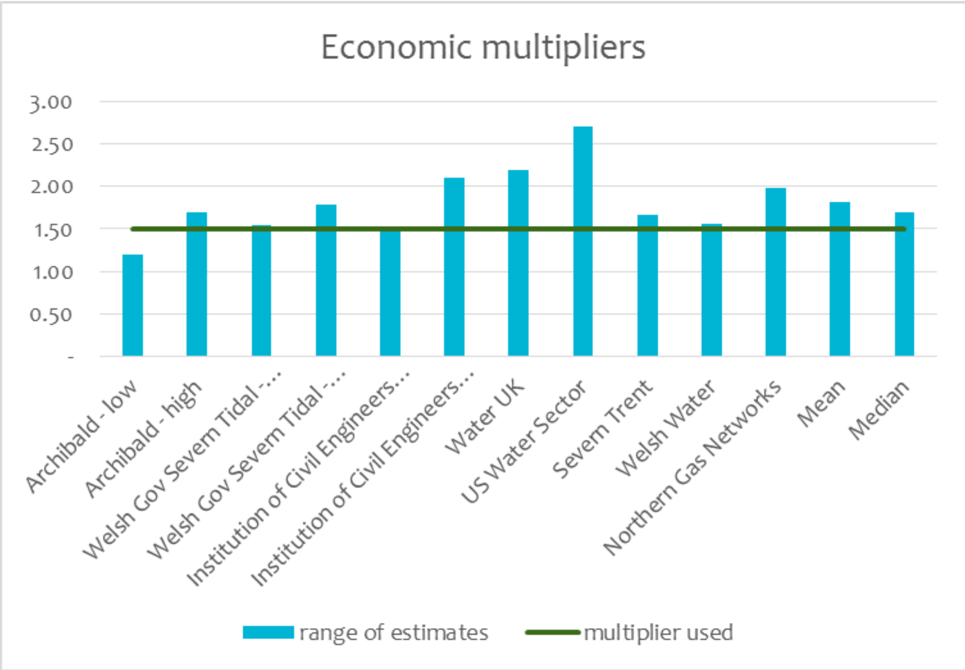
In-region economic gain

A third large benefit is the in-region economic gain from water transfers. This is as a result of the infrastructure investment in the WRW region paid for by consumers outside the region. It can be thought of as a benefit to "levelling-up", by bringing investment to areas of lower GDP per capita from the more affluent South East. However, this should not be thought of as a "zero-sum-game" as the South East also benefits from better water resource options than local alternatives.

We estimated this benefit using an economic multiplier approach. This recognises that investment is a direct spend which creates revenue for businesses in our region and jobs within the region, and also that the recipients of this money also spend a proportion of it within the region. The money ripples through the economy creating additional economic effects.

We carried out benchmarking analysis, ranging from classic economics papers on the subject, to similar infrastructure and evidence from water companies. This is shown in Figure 4. In line with our conservative approach we opted to use a multiplier of 1.5 to calculate our high-level estimate. This is below the average from the range of estimates shown in benchmarking.

Figure 4. Benchmarking of economic multipliers.



A multiplier of 1.5, means that once the ripple through is accounted for, and the fact the not all of the investment will be spent again in the region, the economic benefit is 1.5 times the original investment.

We have only applied the economic multiplier to inter-regional transfer investment. Investment in-region to meet in-region needs also has economic effects. However, such investment is paid for by consumers in region over the long term by ultimately being paid for through water bills. It may therefore displace some other economic activity at the regional level. In line with our conservative approach we have therefore decided to exclude this from our high-level estimates. It may be appropriate to consider such benefits more locally at the stage of planning applications.

Benefits and disbenefits expressed through ValueStream metrics

The next largest group of benefits and disbenefits arise from those attributes expressed through WRW's ValueStream metrics. These represent the more direct impacts of implementing the water resources options selected in the preferred plans.

We estimated these benefits for the region using the central estimate of customer weights for the English companies and the stakeholder derived weights for Welsh Water. Out of these metrics the greatest value-effect come from carbon, reflecting the relatively high value that customers in WRW's region place on avoiding carbon emissions.

Other benefits

Some other benefits, although smaller, are also recognised in the analysis.

As part of its preferred plan, United Utilities is proposing to improve the level of service for temporary use bans. It will move from 1 in 20 to 1 in 40 in 2031. We have included the value customers place on this service improvement, based on the company's customer research.

Another effect arises from the transfers. Inter-regional transfers involve the receiving company paying bulk supply charges to the water company that is providing the water. Bulk supply charges are set by the company following guidance provided by Ofwat. Such charges are expected to reflect the direct costs of making the water available. They would also include a proportional contribution to the general costs of running the water company. Such costs are shared between all customers of the company. Since the transfer would not increase these general costs, the amount paid towards these costs by customers in the WRW region would reduce. One could think of this resulting in a small bill reduction for customers in the region. However, given the priorities and investment pressures linked to environmental improvement, e.g. water quality, it is better thought of as making those improvements more affordable for customers in region. Affordability is an important consideration for WRW. Analysis by CEPA for Water UK shows that the three water companies with the highest proportion of customers facing water poverty are Hafren Dyfrdwy, Welsh Water and United Utilities.

One further effect is biodiversity net gain (BNG). All supply options are required to have a 10% net gain. The starting point for BNG is to avoid biodiversity and habitat losses where possible. This was reflected into the option scopes, and through our metrics (see Section O.2) we deliberately excluded any net gain. This was to avoid the perverse effect of selecting more damaging options to get a greater net gain. The net gain means ensuring that lost or degraded environmental features are compensated for by restoring or creating environmental features that are of greater value to wildlife and people.

As part of our integrated environmental appraisals the biodiversity metric was used to calculate the number of "biodiversity units" lost for each option, and therefore the number that needed to be created to give the net gain. We then converted this into a monetised benefit using cost and benefit estimates from the recent Defra consultation on BNG[5].

Table of estimated benefits

Figures 17 and 19 of the draft plan main report show stacked bar-charts of the estimated benefits and disbenefits. The same information is reported here in table form, see Table 6.

It's important to note that this is not intended to be a formal cost-benefit analysis, but an indicative, high-level, order-of-magnitude assessment to illustrate the benefits of the plan to regional stakeholders. Water companies will make the more detailed case for investment in their WRMPs and business plan submissions to Ofwat.

Table 6. High-level estimate of plan benefits and disbenefits.

£m 80 year NPV	Total plan		Net impact of transfers	
	benefits	disbenefits	benefits	disbenefits
Supply option impacts estimated by metrics approach				
Cost	-	2,892	-	(a)-
Carbon cost	-	(b)1,026	-	(c)-
Flood risk	94	449	-	39
Human & social wellbeing	419	414	19	29
Ecosystem resilience	167	773	20	56

[5] Consultation on Biodiversity Net Gain Regulations and Implementation, Defra, January 2022

£m 80 year NPV	Total plan		Net impact of transfers	
	benefits	disbenefits	benefits	disbenefits
PWS customer supply resilience	151	-	17	-
Multi abstractor benefits	129	184	6	19
Subtotal	960	5,738	62	143
Demand option impacts estimated by metrics approach				
Cost	-	6,820	-	(d)-
Carbon savings	182	-	-	-
Flood risk	-	-	-	-
Human & social wellbeing	254	130	-	-
Ecosystem resilience	-	202	-	-
PWS customer supply resilience	115	-	-	-
Multi abstractor benefits	987	-	-	-
Subtotal	1,538	7,151	-	-
Additional economic, social and environmental effects				
Drought resilience benefits	8,029	-	-	(e)-
Environmental destination benefits	1,501	-	-	(f)-
In-region economic gain from transfers investment	2,490	-	2,490	-
Biodiversity net gain benefits	155	-	14	-
Making water quality and other improvements more affordable	(g)-	-	105	-
TUBs level of service improvement	326	-	-	-
Subtotal	12,501	-	2,609	-
Grand total	**14,999**	**12,889**	**2,672**	**143**
Net benefit	2,110		2,529	

Table notes:

(a) Cost of transfers recovered in bulk supply charges to south east companies
(b) Carbon disbenefit is relatively large, reflecting the 1.81 weighting from WRW customers in England, beyond the standard BEIS carbon values.
(c) Carbon in a non-local impact that is assessed in WRSE plan. Location change of carbon emission from WRSE to WRW has no effect.
(d) Inclusion or exclusion of transfers results in no change to the demand management plans.
(e) Inclusion or exclusion of transfers results in no change to drought resilience
(f) Inclusion or exclusion of transfers results in no change to environmental destination
(g) This benefit is netted off in the cost line in the total plan analysis

O.4. Relative impact of plan choices

Another way of looking at the impact of choices in developing the plan is to consider the relative impact compared to full range of possible plan performance. This affords a different view for decision makers which avoids weighting the metrics.

This way of looking at things was particularly useful during the process of reconciling plans between different regions. Each region used a slightly different approach to assessing the performance of its plan, reflecting the characteristics and priorities of the region. It was therefore not appropriate to look at weighted scores to explore cross-regional trade-offs. Instead, the agreed inter-regional approach was to consider the relative performance of each regional plan under different transfer scenarios.

In order to consider the relative impacts it was important to normalise the metrics on a common 0 to 100 scale. On such a scale a metric score of 100 represents a theoretical best performing plan, targeted at that metric alone. Conversely a score of 0 represents a theoretical worst performing plan for that metric. Each company therefore calculated theoretical best and worst metric scores for each zone based on the largest deficit to be solved by supply options across all the scenarios, and the options available to solve that deficit. To avoid outliers biasing the result, we used the 90^{th} and 10^{th} percentiles to normalise the scores, rather than the absolute maximum and minimum. It was important to do this at an option and metric level rather than at programme level, otherwise the number of candidate programmes considered by the region would affect the normalisation. It was also important to calculate the percentiles on a per Ml/d basis otherwise option sizes would bias the results. This approach was discussed with the other regions through the RCG working group.

Reconciliation with WReN and WCWR

The first comparison of relative performance was used through reconciliation with Water Resources North (WReN) and West Country Water Resources (WCWR). This considered the following scenarios:

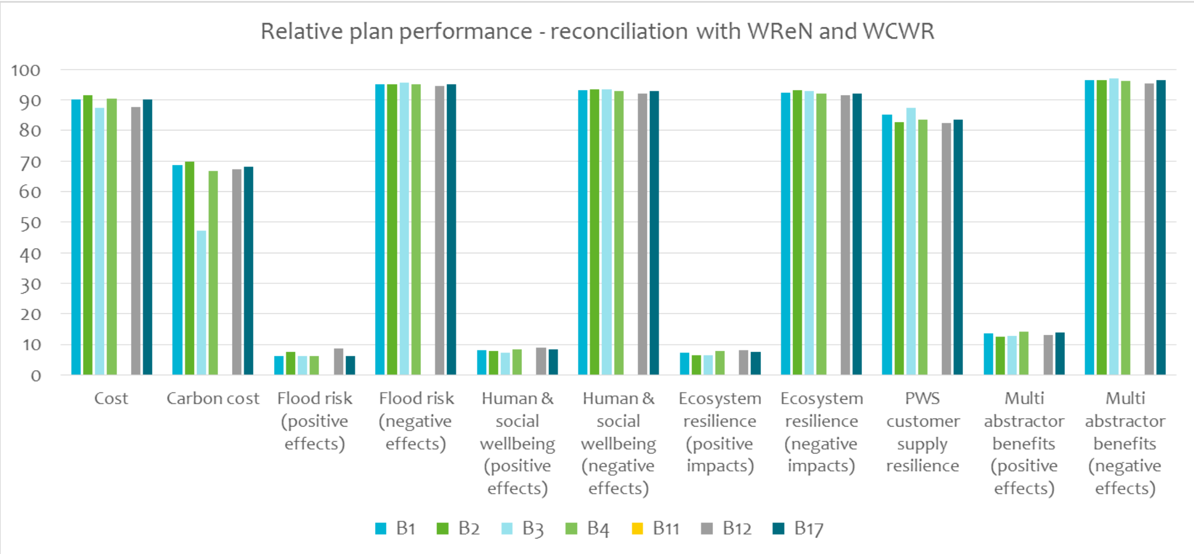
- B1. A baseline scenario using the transfer options selection from the previous reconciliation reported in the emerging plan, but with supply demand balances and other options updated for the draft plan. This assumed that the existing Derwent Valley transfer to WReN continued and that the Kielder option was not selected and that the River Severn Support options did not go to the West Country.
- B2. This scenario considered ceasing the existing 40 Ml/d Derwent Valley transfer to Yorkshire Water in 2035, and retain Derwent reservoir raising option in the plan.
- B3. A scenario which “forced-in” the selection of a 100 Ml/d transfer from Kielder Water (Northumbrian Water) in 2040.
- B4. A potential 35 Ml/d export to the West Country (Bristol and Wessex) in 2030 was explored in this scenario. The West Country export relies on River Severn supporting options (e.g. Vyrnwy) and therefore reduces the maximum available to WRSE.
- B11. In this scenario the existing Derwent Valley transfer was retained and the option to increase reservoir storage in the Derwent Valley was removed. In this scenario it was not possible to solve the supply demand balance and therefore best value scores could not be reported.

- B12. This scenario considered ceasing the existing 40 Ml/d Derwent Valley transfer to Yorkshire Water in 2035, and removing the Derwent reservoir raising option from the plan.
- B17. A scenario which considered use of the River Severn support options to meet 35 Ml/d of needs in the West Country between 2030 and 2040, before becoming available for other uses.

A summary table of inter-regional options selection is provided in the Annex to this appendix.

Results for these scenarios are shown in Figure 5. The general pattern is that the plan shows relatively good performance in avoiding adverse effects (i.e. scores for the negative effect metrics are close to 100). It also shows that there are some beneficial effects, since the scores for most positive effect metrics are not zero, but they are not close to maximising the performance. These general features are common to all the scenarios explored across the plan and was also a feature at the emerging plan stage. The larger benefits explored above, e.g. public water supply resilience to extreme droughts, environmental destination and economic benefits are not included in these metrics. The benefits captured through the ValueStream metrics reported here are secondary benefits to the plan which provides resilient and sustainable water resources. You wouldn't therefore expect very high performance on these ValueStream metrics as the plan is not targeted at reducing flood risk or improving wellbeing as its primary driver. It does however make a measurable benefit to these areas across all scenarios, which is something that would not have been included in the decision making for previous water resources plans.

Figure 5. Relative changes in plan performance metrics under scenarios considered in reconciliation with WReN and WCWR. In this plot a higher score represents better performance on the metric.



The biggest impact across these scenarios is visible for the Kielder option (scenario B3). When this option is included the performance reduces for cost and for carbon costs (i.e. the plan is more expensive and involves more carbon emissions). It does however bring additional benefits to flood risk, PWS customer supply resilience and multi-abstractor benefits. This explains why Kielder is not selected in the preferred plan, but is being explored further to see if the cost-benefit case can be improved.

The scenarios that involve transfers to the West Country (B4 and B17) show little difference compared to the baseline. This merely represents a reallocation of water resource between different regions (WRSE and the West Country) and the impact on WRW is the same apart from minor differences due to timing.

The baseline for these scenarios included the Derwent Valley reservoir raising SRO and continuation of the transfer, as per the emerging plan. Scenario B2, which explored stopping the transfer to Yorkshire Water shows improved cost, carbon cost and flood risk performance. It also showed reduced customer supply resilience and multi-abstractor benefits as well as some smaller changes. Scenario B12, which explored stopping the transfer and not raising the Derwent Valley reservoir showed reduced performance for cost, carbon, customer supply resilience and multi-abstractor benefits. There were some other smaller changes, both positive and negative as shown in Table 7.

Table 7. Change in normalised performance score compared to B1 baseline, for the Derwent Valley scenarios

Metric	Scenario	
	B2	B12
Cost	1.2	-2.7
Carbon cost	1.0	-1.4
Flood risk (positive effects)	1.2	2.3
Flood risk (negative effects)	-0.1	-0.6
Human & social wellbeing (positive effects)	-0.3	1.0
Human & social wellbeing (negative effects)	0.2	-1.0
Ecosystem resilience (positive impacts)	-0.7	0.9
Ecosystem resilience (negative impacts)	0.7	-0.8
PWS customer supply resilience	-2.3	-2.7
Multi abstractor benefits (positive effects)	-1.2	-0.5
Multi abstractor benefits (negative effects)	-0.1	-1.1

One thing that drives these scores is that apart from ceasing the existing transfer or raising a reservoir, there are limited other feasible option in this area of the Severn Trent system. The most feasible alternative WRMP option is to increase the capacity of the Derwent Valley reservoirs and this has informed the scope of the SRO scheme.

Reviews involving Severn Trent and Yorkshire Water during the spring 2022 reconciliation determined that the Derwent Valley SRO project was still at a very early stage of development and should not be included in the preferred pathway for the draft plans, on balance of:

- Feasibility and uncertainties on the scale of benefit
- Requirement for further detailed cost and other information to compare against Yorkshire Water backfill options in a best value planning context (WReN)

Uncertainties around the SRO scheme mean the updated baseline planning assumption is termination of the existing transfer from 2035. However, an alternative pathway has been included in the draft plans to reflect the potential that the SRO will be successful for retaining the existing transfer.

This adaptive plan recognises ongoing work by both Severn Trent and Yorkshire Water that will in time allow greater understanding of aspects such as option lead times to develop the timeline. Depending on the outcome of both option investigations and ongoing work on environmentally driven licence changes, there remains the potential to defer licence changes and/or contract termination dates to ensure identification and delivery of the long-term BVP. At this time, 2025 marks the key decision point following further detailed work. Best value considerations to inform the selection also need reflect the impact on Yorkshire Water and WReN. Although option B2 reports better performance in some areas for WRW, loss of the transfer causes deficits in Yorkshire and a worse performing plan for them. This will be considered when more information is available at the adaptive plan trigger points.

Reconciliation with WRSE

The next comparison that was explored through reconciliation was to look at different potential transfers with Water Resources South East (WRSE). For this comparison we initially compare a scenario with the selection of transfer schemes proposed by WRSE and Severn Trent (B18) with the B1 baseline described above. The B18 formed a second baseline and therefore also included the conclusions of the WReN and WCWR reconciliations. Subsequent scenarios are then developed relative to B18:

- B1. A baseline scenario using the transfer options selection from the previous reconciliation reported in the emerging plan, but with supply demand balances and other options updated for the draft plan. This assumed that 75 Ml/d of Vyrnwy raw water was provided to Severn Trent from 2040 onwards and that all other STT support was provided to WRSE, except Mythe. The full GUC transfer to WRSE was also included.
- B18. An updated baseline scenario reflecting the selection of schemes provided by WRSE through reconciliation on 25 May 2022. In this scenario the maximum provided as raw water from Vyrnwy is lower than B1 at 135 Ml/d and Minworth is not used as STT support. Severn Trent takes 75 Ml/d from 2031 to 2060 and this does not restrict the selection of Vyrnwy raw water by WRSE. The full GUC transfer to WRSE was also included, but at an earlier date than scenario B1.
- B22. This was an extreme scenario which considered the situation if no transfers from WRW to WRSE were included in the plan.
- B23. This was the opposite extreme which included all the transfers from WRW to WRSE in the plan.
- B5a. A scenario which added Minworth as an STT support option into the B18 scenario.
- B7a. A scenario which added Mythe as an STT support option into the B18 scenario. This means that the Mythe option was not available to meet Severn Trent's needs in the Midlands in this scenario.
- B8a. This scenario explored the situation if the North West transfer (Vyrnwy and United Utilities Sources) were not available to either WRSE or Severn Trent.
- B9a. This scenario explored the situation if the Severn Thames transfer pipeline was not available for WRSE, but the supporting options could be used within WRW.
- B10a. This scenario explored the situation if the Grand Union Canal transfer was not available for WRSE.

- B13a. This scenario explored the situation if the North West transfer (Vyrnwy and United Utilities Sources) was not available to Severn Trent, but was still available to others.
- B14a. A scenario which added the North West transfer (Vyrnwy and United Utilities Sources) into the plan to meet South Staffs needs. South Staffs reported that it would require 165 Ml/d in this scenario.

Across these scenarios the same general pattern is observed as noted above. This can be seen in the scores shown in Figure 6. It is notable that in these relative terms, there is little variation observed across most of the metrics. The changes in normalised scores relative to B18 are shown in Table 8, which highlights the differences more. As noted above, the larger economic benefits of the transfers are not included in this presentation which shows only the ValueStream metrics.

Figure 6. Relative changes in plan performance metrics under scenarios considered in reconciliation with WRSE. In this plot a higher score represents better performance on the metric

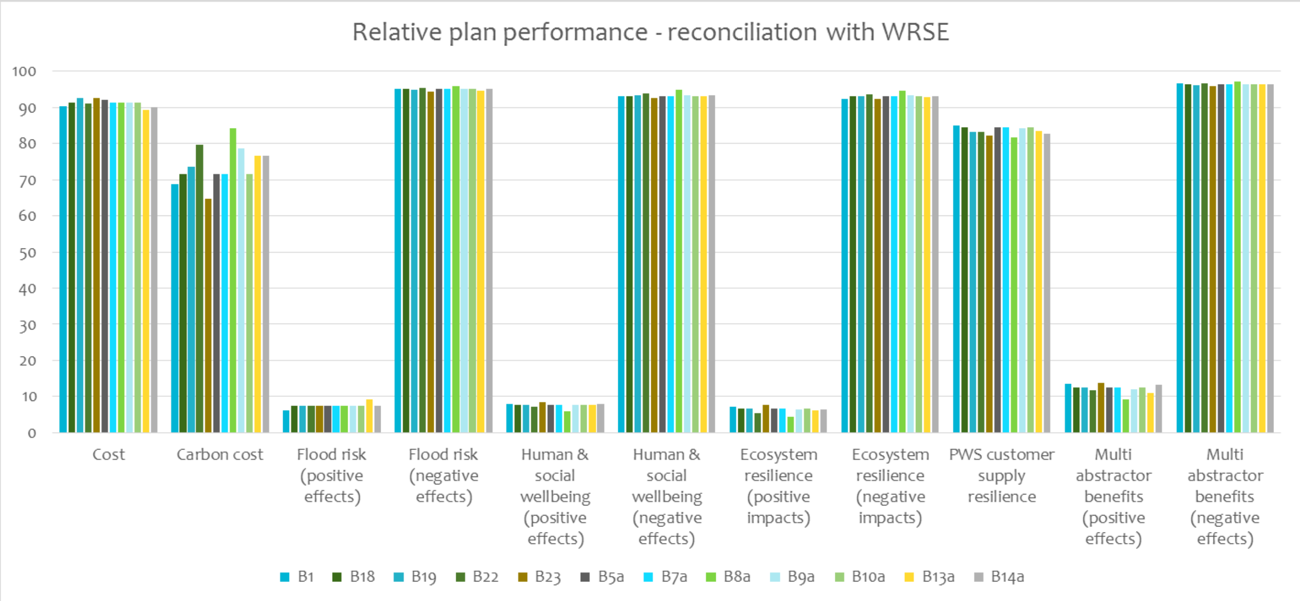


Table 8. Change in normalised performance score compared to B18 baseline, for the WRSE and River Severn scenarios.

Metric	Scenario									
	B19	B22	B23	B5a	B7a	B8a	B9a	B10a	B13a	B14a
Cost	1.2	-0.3	1.1	0.6	-	0.0	-0.1	-0.1	-2.2	-1.5
Carbon cost	2.1	8.0	-6.8	-	-	12.8	7.0	-	5.1	5.2
Flood risk (positive effects)	-	-	-	-	-	-	-	-	1.7	-
Flood risk (negative effects)	-0.1	0.5	-0.5	-	-	0.9	0.1	-	-0.3	0.2
Human & social wellbeing (positive effects)	-0.0	-0.6	0.7	-	-	-1.9	-0.2	-	-0.2	0.2

Metric	Scenario									
	B19	B22	B23	B5a	B7a	B8a	B9a	B10a	B13a	B14a
Human & social wellbeing (negative effects)	0.1	0.6	-0.5	-	-	1.7	0.3	-	0.0	0.2
Ecosystem resilience (positive impacts)	-	-1.3	0.9	-	-	-2.3	-0.3	-	-0.4	-0.2
Ecosystem resilience (negative impacts)	0.0	0.6	-0.7	-	-	1.6	0.3	-	-0.3	0.1
PWS customer supply resilience	-1.3	-1.2	-2.3	-	-	-2.9	-0.2	-	-1.2	-1.8
Multi abstractor benefits (positive effects)	0.1	-0.8	1.3	-	-	-3.2	-0.4	-	-1.5	0.7
Multi abstractor benefits (negative effects)	-0.0	0.5	-0.5	-	-	1.0	0.1	-	0.1	0.1

Carbon

The metric which shows the most significant variation is carbon. For the transfers to WRSE we are only showing half the picture, i.e. the increase in carbon emissions from the options developed in WRW to support the transfer. The offsetting carbon reduction from not needing other options in the South East was not available to us through reconciliation, but it was considered by WRSE. Carbon performance shown here therefore gets better with less transfer to WRSE, particularly the North West Transfer, as seen in scenarios B22 and B23. However, for tests which consider the North West Transfer within WRW, i.e. B13a and B14a there is more of a mixed picture. Carbon performance improves when the North West Transfer goes to South Staffs as it offsets other options. Conversely, when the North West Transfer doesn't go to Severn Trent carbon performance improves as the other options Severn Trent selects have less carbon, but are more expensive. This highlights the importance of considering carbon at both sides of the transfer.

Cost

Scenarios which involve more transfer to WRSE, namely B19 and B23, perform better on cost terms due to the additional cost recovery from the South East. This benefit would be magnified further if economic gains were shown. Scenarios which vary the use of the North West transfer within WRW also show some differences in the cost metric. If Severn Trent doesn't take water from the North West transfer (B13a), the cost performance is worse (Severn Trent's costs become higher due to the other options Severn Trent would select). If South Staffs takes water from the North West transfer (B14a), the cost performance is worse (South Staffs costs are higher for this option compared to its other options).

Impact of no North West transfer (scenario B8a)

Looking across the range of metrics, there is noticeable change across the full range for scenario B8a. In this scenario the North West transfer is not available to either WRSE or Severn Trent. Ecosystem resilience (positive effects), PWS customer supply resilience and multi-abstractor benefits all show relatively large reductions in performance compared to the other scenarios shown here. Other metrics show some improvement, most notably carbon but as mentioned above the offsetting change in carbon in WRSE is not shown here.

It should be remembered that on the 0 to 100 range of performance between the best and worst possible plans all the differences noted above are relatively small. Nevertheless, the comparisons affirm that the options selected in scenario B18 are good candidates for the preferred plan.

This approach to comparing relative plan performance was also used for sensitivity analysis of the plans as shown in the following section.

O.5. Sensitivity analysis

We used six 'what-if' scenarios to test the preferred and alternative plans. These represent plausible future states of the world driven by factors outside the control of the abstractors and are defined in Section 5.5.3 of the draft regional plan main report. They are based on Ofwat's proposals for common scenarios to be used for long term planning and were agreed for use with the other regions through reconciliation.

Results of the options selection and the ValueStream best value scores calculated using customer weights are shown in Table 9. Relative plan performance across the normalised ValueStream metrics is shown in Table 10.

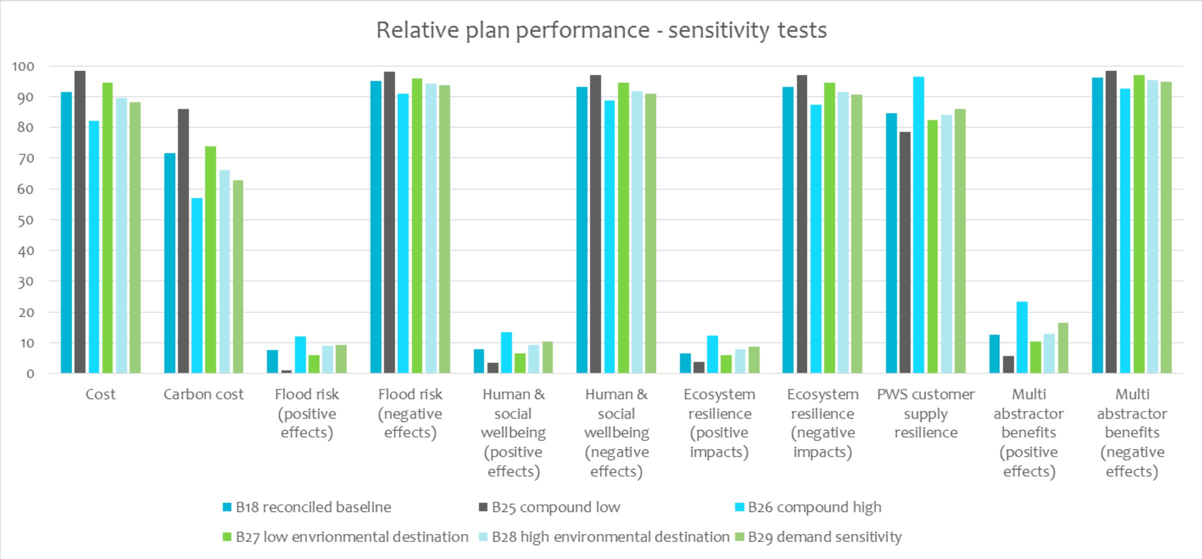
As expected the compound low scenario and the low environmental destination scenario represents better plan performance, due to fewer supply options being needed in a more favourable future. The compound high, demand sensitivity and high (enhanced) environmental destination show the opposite effect.

Table 9. Stress-test scenarios used to test regional plans. For Welsh Water the options selection remains as per the preferred plan for all scenarios. For Hafren Dyfrdwy no supply options are selected in any of the scenarios.

Scenario	Summary of options selected in each scenario relative to the preferred plan			Best value scores from supply options £m
	Severn Trent	South Staffs	United Utilities	
Compound low B25	Less options required and changes to timing of selection: 117 & 523 in 2025 123B in 2035 128 & 301B in 2044 79A in 2045 103 in 2069	Less options required and changes to timing of selection 2.2.2.1 in 2068 7.1.2.1 in 2081	Changes to the timing of selection for 3 options in the preferred plan: WR107a2 in 2031, WR11 in 2060 and WR113 in 2061.	1,305
Low ED B27	Reduced selection of options compared to preferred plan and changes to the timing of selection	As preferred plan with changes to timing of options selection 2.2.2.1 in 2047 7.1.2.1 in 2063 7.1.3 in 2071	No difference to preferred plan	3,154

Scenario	Summary of options selected in each scenario relative to the preferred plan			Best value scores from supply options £m
	Severn Trent	South Staffs	United Utilities	
Baseline B18	No difference to preferred plan	No difference to preferred plan	No difference to preferred plan	4,358
High ED B28	Reduced selection of options compared to preferred plan and changes to the timing of selection	As preferred plan with changes to timing of options selection 2.2.2.1 in 2039 7.1.2.1 in 2051 7.1.3 in 2060	No difference to preferred plan	5,638
Compound high B26	Reduced selection of options compared to preferred plan and changes to the timing of selection	Same as High ED	Additional options required and changes to the timing of selection of options already in the preferred plan: WR049d, WR107a2, WR077c, WR102e, WR141, WR017 in 2031 WR113, WR800, WR122 in 2030 WR076 in 2060 WR077a in 2072 WR813 in 2075 WR065a in 2085.	8,285
Demand sensitivity B29	Additional options required and changes to the timing of selection of options already in the preferred plan	As preferred plan with changes to timing of options selection 2.2.2.1 in 2036 7.1.2.1 in 2046 7.1.3 in 2055	Additional options required and changes to the timing of selection of options already in the preferred plan: WR107a2, WR076, WR077c, WR800 in 2031 WR111 in 2060 WR813 in 2063 WR077a in 2035 WR102e in 2084 WR141 in 2080 WR122 in 2078 WR065a in 2077.	5,941

Table 10. Relative changes in plan performance metrics under the sensitivity test scenarios



Annex. Transfer options selection in reconciliation and sensitivity test scenarios

The table below shows the selection of the transfer options across the scenarios. In the table, the baseline (B1) and updated baseline (B18) are shown in black. Scenarios below each baseline in the table may be thought of as tests relative to that baseline. Options selected in the same way are shown in green and those options which differ are shown in blue. A cross (×) indicates that the option was not selected in this scenario.

Scenario		Nether'ge to WRSE via STT	Mythe to WRSE via STT	Minworth to WRSE via STT	Minworth to WRSE via GUC	North West Transfer: Vyrnwy raw water to Severn Trent	North West Transfer: Vyrnwy to South Staffs	North West Transfer: Vyrnwy to WRSE via STT	North West Transfer to WRSE via Shrewsb'y and STT	North West Transfer to Severn Trent via Vyrnwy Aqueduct	Other UU to ST options	Cease existing Derwent Valley Transfer to WReN	Nether'ge to West Country	Mythe to West Country	Minworth to West Country	North West Transfer to West Country	Kielder transfer from WReN to WRW
B1	BVP for April reconciliation (Baseline with options)	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and further 50 Ml/d in 2060	75 Ml/d in 2040	×	50 Ml/d in 2041, further 25 Ml/d in 2051, further 20 Ml/d in 2055, further 10 M/d in 2056	25 Ml/d in 2065	×	×	×	×	×	×	×	×
B2	Cease Derwent Valley transfer (but retain Derwent reservoir raising)	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and further 50 Ml/d in 2060	75 Ml/d in 2040	×	50 Ml/d in 2041, further 25 Ml/d in 2051, further 20 Ml/d in 2055, further 10 M/d in 2056	25 Ml/d in 2065	×	×	40 Ml/d selected in 2035	×	×	×	×	×
B3	Include Kielder transfer to WRW	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and further 50 Ml/d in 2060	75 Ml/d in 2040	×	50 Ml/d in 2041, further 25 Ml/d in 2051, further 20 Ml/d in 2055, further 10 M/d in 2056	25 Ml/d in 2065	×	×	×	×	×	×	×	Selected in 2040
B4	Include River Severn to West Country Transfer	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and further 50 Ml/d in 2060	75 Ml/d in 2040	×	50 Ml/d in 2041, further 20 Ml/d in 2051	5 Ml/d in 2051 and 20 Ml/d in 2055	×	×	×	×	×	×	35 Ml/d in 2030	×
B11	Remove Derwent Valley	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and	75 Ml/d in 2040	×	50 Ml/d in 2041,	25 Ml/d in 2065	×	×	×	×	×	×	×	×

Scenario		Nether'ge to WRSE via STT	Mythe to WRSE via STT	Minworth to WRSE via STT	Minworth to WRSE via GUC	North West Transfer: Vyrnwy raw water to Severn Trent	North West Transfer: Vyrnwy to South Staffs	North West Transfer: Vyrnwy to WRSE via STT	North West Transfer to WRSE via Shrewsb'y and STT	North West Transfer to Severn Trent via Vyrnwy Aqueduct	Other UU to ST options	Cease existing Derwent Valley Transfer to WReN	Nether'ge to West Country	Mythe to West Country	Minworth to West Country	North West Transfer to West Country	Kielder transfer from WReN to WRW
	Storage Increase (and retain Derwent Valley transfer)				further 50 Ml/d in 2060			further 25 Ml/d in 2051, further 20 Ml/d in 2055, further 10 M/d in 2056									
B12	Remove Derwent Valley Storage Increase (and cease Derwent Valley transfer)	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and further 50 Ml/d in 2060	75 Ml/d in 2040	×	50 Ml/d in 2041, further 25 Ml/d in 2051, further 20 Ml/d in 2055, further 10 M/d in 2056	25 Ml/d in 2065	×	×	40 Ml/d selected in 2035	×	×	×	×	×
B17	Include River Severn to West Country Transfer (temporary)	35 Ml/d in 2040	×	115 Ml/d in 2044	50 Ml/d in 2049 and further 50 Ml/d in 2060	75 Ml/d in 2040	×	50 Ml/d in 2041, further 25 Ml/d in 2051, further 20 Ml/d in 2055, further 10 M/d in 2056	25 Ml/d in 2065	×	×	×	×	×	×	35 Ml/d in 2030, then stopping in 2040	×
B18	Updated baseline with WRSE selection as per 25.05.22	35 Ml/d in 2050	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B19	Updated baseline with WRSE selection as per no SESRO scenario	35 Ml/d in 2040	×	58 Ml/d in 2050; 57 Ml/d in 2055	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2049/50	×	25 Ml/d in 2048, further 80 Ml/d in 2050;	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×

Scenario		Nether'ge to WRSE via STT	Mythe to WRSE via STT	Minworth to WRSE via STT	Minworth to WRSE via GUC	North West Transfer: Vyrnwy raw water to Severn Trent	North West Transfer: Vyrnwy to South Staffs	North West Transfer: Vyrnwy to WRSE via STT	North West Transfer to WRSE via Shrewsb'y and STT	North West Transfer to Severn Trent via Vyrnwy Aqueduct	Other UU to ST options	Cease existing Derwent Valley Transfer to WReN	Nether'ge to West Country	Mythe to West Country	Minworth to West Country	North West Transfer to West Country	Kielder transfer from WReN to WRW
								(total 105 Ml/d)		starting 2050/51 plus 1 Ml/d starting in 2060/61							
B22	No transfers from WRW to WRSE	×	×	×	×	75 Ml/d from 2030/31 to 2059/60	×	×	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B23	Max transfers from WRW to WRSE from 2035	35 Ml/d in 2035	15 Ml/d in 2035	115 Ml/d in 2035	100 Ml/d in 2035	×	×	180 Ml/d in 2035	25 Ml/d in 2035	×	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B5a	Add Minworth (STT source)	35 Ml/d in 2050	×	115 Ml/d in 2050	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B7a	Include Mythe (STT source)	35 Ml/d in 2050	15 Ml/d in 2050	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B8a	Remove North West Transfer	35 Ml/d in 2050	×	×	100 Ml/d in 2031	×	×	×	×	×	North Shropshire	Selected in 2035 as per	×	×	×	×	×

Scenario		Nether'ge to WRSE via STT	Mythe to WRSE via STT	Minworth to WRSE via STT	Minworth to WRSE via GUC	North West Transfer: Vyrnwy raw water to Severn Trent	North West Transfer: Vyrnwy to South Staffs	North West Transfer: Vyrnwy to WRSE via STT	North West Transfer to WRSE via Shrewsb'y and STT	North West Transfer to Severn Trent via Vyrnwy Aqueduct	Other UU to ST options	Cease existing Derwent Valley Transfer to WReN	Nether'ge to West Country	Mythe to West Country	Minworth to West Country	North West Transfer to West Country	Kielder transfer from WReN to WRW
	(Vyrnwy Aqueduct and UU Sources)										1 Ml/d starting in 2050/51	WReN reconciled plan					
B9a	Remove Severn Thames Transfer (STT) interconnector	not selected	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	×	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B10 a	Remove Grand Union Canal (GUC) option	35 Ml/d in 2040	×	×	×	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B13 a	Remove North West transfer to Severn Trent (but retain others)	35 Ml/d in 2050	×	×	100 Ml/d in 2031	×	×	135 Ml/d in 2060	×	×	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B14 a	Add in North West transfer to South Staffs	35 Ml/d in 2050	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	15 Ml/d in 2040, further 30 Ml/d in 2056 45 Ml/d in 2058, 75 Ml/d in 2061 (total 165 Ml/d)	unable to be met	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B25	Compound Ofwat low - inter-regional transfers as B18	35 Ml/d in 2050	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×

Scenario		Nether'ge to WRSE via STT	Mythe to WRSE via STT	Minworth to WRSE via STT	Minworth to WRSE via GUC	North West Transfer: Vyrnwy raw water to Severn Trent	North West Transfer: Vyrnwy to South Staffs	North West Transfer: Vyrnwy to WRSE via STT	North West Transfer to WRSE via Shrewsb'y and STT	North West Transfer to Severn Trent via Vyrnwy Aqueduct	Other UU to ST options	Cease existing Derwent Valley Transfer to WReN	Nether'ge to West Country	Mythe to West Country	Minworth to West Country	North West Transfer to West Country	Kielder transfer from WReN to WRW
										starting 2050/51 plus 1 Ml/d starting in 2060/61							
B26	Compound Ofwat high - inter-regional transfers as B18	35 Ml/d in 2050	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B27	Low ED (Ofwat low) - inter-regional transfers as B18	35 Ml/d in 2050	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×
B28	High ED (enhanced) - inter-regional transfers as B18	35 Ml/d in 2050	×	×	100 Ml/d in 2031	75 Ml/d from 2030/31 to 2059/60	×	135 Ml/d in 2060	×	25 Ml/d starting 2040/41, plus 6.5 Ml/d starting 2050/51 plus 1 Ml/d starting in 2060/61	North Shropshire 1 Ml/d starting in 2050/51	Selected in 2035 as per WReN reconciled plan	×	×	×	×	×