HOW CAN STRATEGIC WATER RESOURCE OPTIONS DELIVER BEST VALUE FOR CUSTOMERS, THE ENVIRONMENT, AND COMMUNITIES?

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STRATEGIC WATER RESOURCE OPTIONS

Jon Darwent, Principal Consultant at Stantec argues that for strategic resource options (SROs) to contribute to best value regional plans, they need to be developed with a focus on the objectives and criteria by which plans will be judged, avoid uneconomic investments, operational inefficiencies and enhance resilience. The impetus behind the current programme of water resources planning and the rationale for the new regional groups is explained. Jon then describes the challenges of designing schemes for infrequent extreme droughts, citing how local raw water storage can flatten peak events, thereby reducing upstream capacity requirements. Bringing all the data on needs and solutions together in a best value plan calls for new thinking on how schemes are designed, and how their costs and benefits are articulated and assessed.

Following the Water UK Long Term Planning Framework report in 2016, and the National Infrastructure Commission report on future water needs in 2018, the Government consulted on a draft National Policy Statement (NPS) on water resources infrastructure in 2019. The draft NPS sets out plans to develop new policies and legislation, ranging from measures to address climate change, demand management, catchment management, as well as new water resources infrastructure. The NPS is likely to be finalised in 2021. Ofwat's PR19 final determination notes that 'ensuring water resources supplies are resilient against droughts is becoming more challenging with pressures from climate change, population growth, societal expectations, and increasing environmental aspirations.'

The Environment Agency's long-term ambition for water resources in England was published in its water resource national framework document in March 2020. This identified the need for an additional 3,435 Ml/d of water by 2050. The build-up of the need and the Agency's assessment of the possible options to satisfy that need by 2050 is shown in the table below.

Need	Ml/d	Potential solutions	Ml/d
To increase resilience	1,130	Water efficiency	900
To address climate change	400	Leakage reduction	770
To protect the environment	720	Drought measures	0 - 710
Population growth	1,040	New resources and infrastructure	1,050 – 1,760
Other needs	140		
Total	**3,430**		**3,430**

Table 1 Possible 2050 Water Needs and Solutions

The Environment Agency also explored potential futures to ensure the environment is protected from possible flow reductions as a result of climate change and for enhanced environmental flows for sensitive/protected sites such as SSSI's, principal salmonid rivers, and chalk streams. These were assessed as scenarios to forecast water availability at the waterbody scale in 2050 relative to a 2025 baseline. Modelling suggested that to maintain the current level of environmental ambition for 2050 (without an enhanced approach to protected sites), the total reduction in abstraction would need to be in the order of 1,200 Ml/d across England. The figure below presents this information spatially.

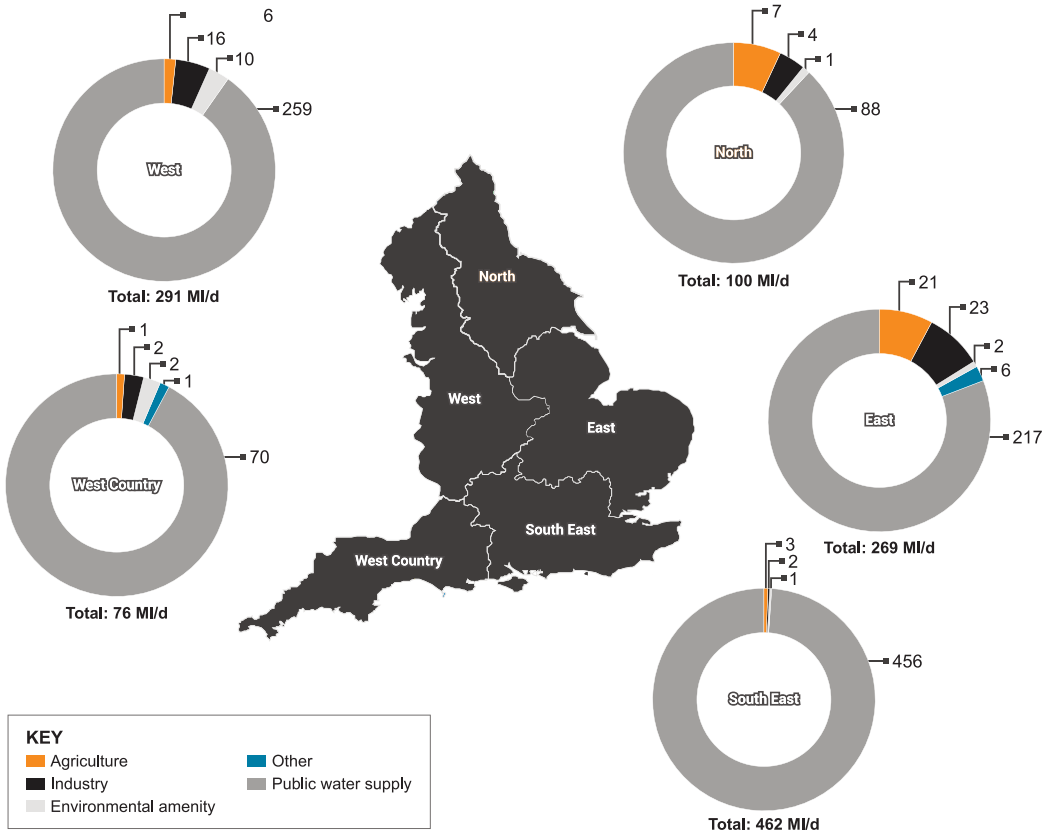

Figure 1 Indicative 2050 Regional Abstraction Reductions Required under a Business-as-Usual Scenario (Source: Environment Agency)

Under the enhanced environmental ambition (with higher environmental flows), the requirement increases to 2,200 Ml/d, again mainly in the South East (45%), West (15%) and East (26%). While this work is indicative, it provides a perspective of the pressures that are likely to be placed on future water resources and the associated planning challenges. The Environment Agency requires regional groups to define their own environmental ambition / destination for 2050 for the plans currently under development. New approaches are needed to resolve this challenge, looking beyond individual company boundaries and across sectors to deliver best value[1] for customers and the environment.

REGIONAL PLANS AND STRATEGIC RESOURCE OPTIONS

As part of its PR19 final determination, Ofwat allocated up to £469m to investigate strategic water resource options with a total capacity of up to 1,500 Ml/d to help achieve security of supply in the light of the aforementioned challenges. The 17 funded strategic resource options (SROs) cover a range of source and transfer schemes, predominantly to move water to the south and east of England. This will enable the nine water companies to develop 'construction ready' solutions for AMP8 that protect and enhance the environment and benefit wider society. The solutions being delivered through a formal, gated process comprise 11 source-type solutions (reservoirs, effluent reuse) and six transfer-type solutions (river, canal, and pipeline routes). Five regional planning groups (Water Resources North, Water Resources West, West Country Water Resources, Water Resources East, Water Resources South East) have been established to explore the potential for inter-company (regional) resource sharing. Each group is to set out a regional plan, which whilst not yet statutory, is to be reflected in each company's water resource management plan (WRMP) in 2024. Initial draft regional plans, to be consulted on in January 2022, will set out how the companies have considered making best use of their combined resources alongside managing demand and leakage to meet the needs of the environment, customers and ensuring resilient supplies. This understanding will be important in validating the water availability assessments of the SROs. With increasing environmental protection, regions such as the West Country may not have the surpluses predicted at PR19, and hence, the associated SROs which may be feasible to deliver, may not be able to progress as inter-regional solutions.

To facilitate the development of a best value set of options, the Regulators' Alliance for Progressing Infrastructure Development (RAPID) has been formed by Ofwat, the Environment Agency and the Drinking Water Inspectorate. RAPID is responsible for appraising the 17 SROs through a gated process and has, to date, evaluated the Gate 1 submissions on an accelerated timeline for Southern Water's pressing need to reduce abstractions in Hampshire.

[1]Where best value refers to the balance / trade-offs needed between economic efficiency, environmental costs and benefits and resilience.

The number and size of SROs needed will, in part, be dependent upon the success (or not) of water companies meeting their commitment to the National Infrastructure Commission's requirement to halve leakage by 2050 and to drive down consumption. Based on published data from water company revised draft plans, meeting leakage and demand targets would offset the impact of an additional 8.7 million consumers, potentially removing the additional 1,040 Ml/d required to meet growth. However, there are significant uncertainties around demand reductions of this scale and large reductions in per capita consumption will require government intervention on issues such as compulsory metering and appliance labelling. Furthermore, there will still be a spatial distribution issue to resolve e.g., leakage reductions in Cornwall will not offset population growth in Kent.

If future demand is capped at the current level, it could be argued that we have all the treatment and potable water infrastructure capacity required to meet forecast needs, and therefore, an underpinning philosophy of SRO development might be to use existing assets and supply them with replacement water wherever possible. It is acknowledged that this may not always be efficient, as some assets may be at end of life, or are not capable of treating water from a different source, or that new assets may provide wider resilience and service benefits.

SOLUTIONS NEED TO REFLECT REQUIREMENTS

If the key challenge to a resilient future is resource availability, then understanding the spatial and temporal dimensions of deficits is critical to finding a best value solution. Whether abstraction reductions are permanent or only during dry periods and, if so, in what severity of drought, will greatly influence the solution. WRMP baseline forecasts predict the potential magnitude of supply demand deficits and form the basis for identification, screening, and appraisal of options. For WRMP24, companies need to assess the resilience of their resources to a range of droughts, of differing severity, up to a return period of once in 500 years. Assessing deployable outputs under such extreme events is challenging, requiring the use of stochastic models as it goes well beyond historically recorded droughts.

The conditions giving rise to these droughts are not static with multiple components and highly variable impacts with potential deficits ranging greatly between average and severe drought years. WRMP supply demand balances give an indication of the extent of potential deficits however, they mask the seasonal timing, variability, and duration of the events. Consequently, the utilisation of SROs will vary greatly across the drought return periods and depending upon on how they are operated alongside other available supplies.

Within the overall derivation of an optimised, best value programme, options cost benefit analysis should be based on their forecast utilisation. Their lifetime costs and benefits per megalitre of water provided should be based on the annual average utilisation across the 500-year range, where each return period's total annual

volume is derived from the option's actual number of days of operation and flow on each day. In the example below, Option C is selected after Options A and B and designed to provide a required 100 Ml/d output to meet the 1:500-year deficit. However, the second chart shows that it is only used for approximately four months during that event and at an average of half its capacity. Utilisation is lower during less severe events and the option is not called upon at all in nine years in ten.

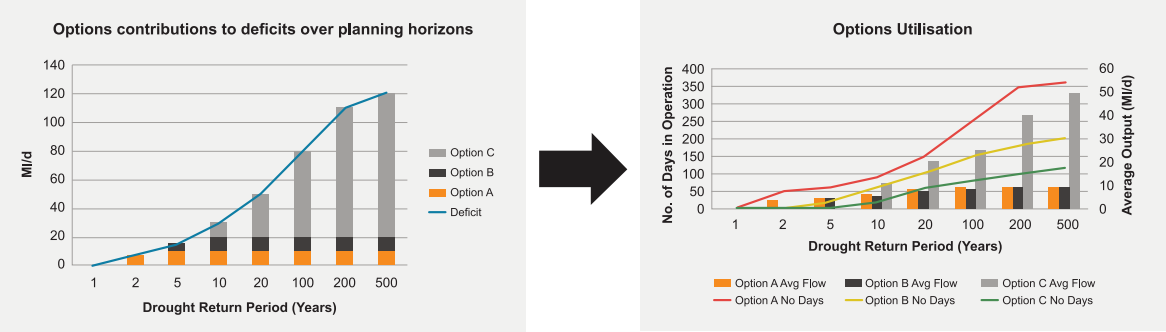

Figure 2 Example SDB Contribution and Utilisation of Options within an Initial Plan

Our analysis has highlighted examples where options are required only for the very infrequent events such that on average, their annual use is significantly lower than the required daily capacity in the design event. Consequently, the associated assets are likely to be significantly oversized for normal conditions and hence will have a high cost and operational challenges. Accordingly, it is vital that once plans have been formulated, the actual utilisation of individual options, across the 500-year range, is checked. Options initially picked to meet the deficit in a severe drought may not necessarily provide the best value per megalitre of water required over the entire planning horizon.

Alongside understanding the deficits in the target region, the impact in the donor region needs to be considered to ensure the anticipated water will be available as a sustainable resource. With increasing national environmental ambition, the WRMP19 basis of some of the SROs may change, with previously identified surpluses being required to address local, emerging needs. On the face of it, a short and infrequent need would suggest a low capex/higher opex solution would be of least whole life cost. However, further investigation may reveal such a solution requires a minimum, continuous level of operation to ensure its availability when needed, greatly increasing the overall cost due to the high ongoing opex. Other practical issues should also be considered, such as operators wishing to avoid expensive running and maintenance costs on assets not contributing to efficient, normal service provision.

Ofwat has suggested that the default route for the delivery of SROs is the use of Direct Procurement for Customers. The attractiveness of any such opportunity to potential providers and the efficiency it can bring to customers is dependent upon a utilisation profile and hence revenue stream that makes best use of capital investment. This may mean water companies and their customers paying for standby capacity or buying more expensive water as part of their baseload daily operations.

ARE RESERVOIRS THE ANSWER?

If the problem is one of resource availability during infrequent and intermittent events, then abstracting water when plentiful and storing it for use when needed is a potential option. The problem, complexities and extent of factors that determine a best value regional plan mean such as a solution cannot be assumed, however, the approach warrants investigation in options development.

Two examples of reservoir developments in the current programme are included below:

- Havant Thicket reservoir. The new reservoir in Portsmouth Water's area will store excess spring flows to provide a year-round base load bulk supply of 21 Ml/d. An alternative operating pattern was proposed in the Gate 1 submission by Southern Water, whereby the reservoir would also be used as a drought resource, at high flows, for short periods in extreme droughts. This might enable one of the higher capex strategic solutions to be deferred.

- As part of the West Country North (WCN) SRO study for the accelerated Gate 1 submission, a raw water transfer option was assessed to provide raw water to Testwood water treatment works (WTW), replacing the local sources when in constraint. As the scheme would be operated only after local, lower-cost solutions had reached their limits, it would be needed infrequently, at high flows to meet the residual deficit at its peak. The high flows would necessitate a large diameter pipeline, which because of its length and being a raw water transfer, would require a significant, continuous sweetening flow. The volume of the sweetening flow would, however, be so large that the source, Cheddar 2 Reservoir, would have insufficient water remaining to be transferred to meet the need in a drought. In this case, a reservoir remote from the point of an infrequent need was not feasible. However, the option of potentially using a small lake next to the receiving works was identified. Initial analysis suggested that by using the lake as a buffer, the raw water transfer capacity could be greatly reduced. The smaller pipeline would have lower construction and operating financial and carbon costs and a much lower sweetening flow requirement, potentially leaving sufficient water in the reservoir for when needed. In its determination of the Gate 1 submission, RAPID has asked that the raw transfer option be considered further.

A BEST VALUE PLAN NEEDS OPTIONS DESIGNED TO DELIVER MULTIPLE BENEFITS

Stakeholders are requiring companies and the regional groups to extend historical planning approaches to seek best value for society and the environment. Best value option and programme appraisal extends beyond financial costs, as borne out by the industry's increasing adoption of multiple capitals approaches and the recent updates to the Treasury's Green Book. The new approach seeks to address potentially competing objectives. Stakeholder engagement will be key to agreeing a preferred plan, balancing environmental improvements, enabling social enterprise and providing affordable and resilient water supplies.

To enable planners to derive best value solutions, both SROs and companies' WRMP options should be developed with a clear understanding of the water resource needs and what stakeholders' value. Leaving these considerations to the programme appraisal stage will mean the options being presented are sub-optimal and inevitably so will be the resulting solution. To avoid this, the next stage of development for those SROs that progress through Gate 1 needs to use the outputs of the regional models and adopt their investment appraisal criteria. As such, further SRO development should consider:

- Water available to the SRO, in the light of the originating region need.
- Intended utilisation:
    - Operating constraints and opportunities for alternative deployment
    - Water quality risks and required mitigation
    - Potential to address multiple needs
    - Impact of sweetening flows on resource availability.
- Contribution to environmental net gain.
- Resilience - how can scope refinement deliver wider resilience in both the donor and receiving region?
- Component optimisation:
    - How can abstraction, storage, treatment, and transfer components of the option be designed to provide best value through consideration of the above.
- Customer preferences.
- Government policy.

MULTI-SECTOR AND STAKEHOLDER APPROVED PLANS

Water Resources South East (WRSE) is developing a holistic planning framework to establish a regional resilience plan, addressing a range of multi-sector risks and stakeholder objectives. Within this, options to maintain the supply-demand balance are to be appraised individually and in combination to determine the best value, adaptive pathway to managing long term water supplies and delivering the region's environmental ambition. Alongside the public water supply needs of the water companies and their customers, the regional plan is also considering the future water resource needs of industry, agriculture and power companies. Including these demands enables the plan to account for them in assessing available abstractions alongside meeting the environment's water needs.

Options and programmes can be assessed across future scenarios to assess suitability against a range of criteria and forecast uncertainties. The ability to undertake multiple runs with different priority objectives will enable comparisons of programmes focussed on, for example, cost, environmental net gain or resilience. Through the application of objective weightings an overall best value programme can be derived and information on the trade-offs between objectives shared with stakeholders to gain acceptance.

TAKING SROS BEYOND GATE 1

The initial outputs of the first runs of the WRSE planning models will be eagerly anticipated to see which of the SROs appear to best support the region's long-term plans, how RAPID uses this information in its assessments of the existing schemes, and whether there is a case for including others, in addition to those in Ofwat's final determination appendix.

Will the investments required to meet environmental targets and provide resilience to extreme droughts be seen by some as excessive and unaffordable? Will the solution entail unnecessary additional costs to normal operations to ensure resources are available in extreme events or run the risk of assets being uncommissionable when needed?

To answer these questions, it will be important that the predicted use of all components of the plan, across the range of forecast scenarios, is carefully considered and presented. This will provide the focus for further refinement of schemes, to form regional and company plans that achieve the ambitious objectives without creating white elephants, whilst still providing resilience to shocks and stresses.

For those working on the development of the schemes, the outputs should provide a focus for the next stages of development, ensuring that the options do not just answer the supply resilience question but deliver a lasting legacy for customers, the environment and communities.

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Design with
community in mind