Draft Water Resources Management Plan 2024

Section 7 – Appraisal of Resource Options

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Background and Introduction

Section 7 describes:

- How we have identified our Feasible List and Constrained List of water resource options
- The associated system elements that are required to deliver the Constrained List resource options into supply
- The further option development that has been conducted on the Constrained List options to inform programme appraisal

As part of our work with WRSE to develop a regional plan for the south east, we have collaborated with other water companies in the region to develop a consistent approach to options appraisal. We have also supported dedicated WRSE workstreams to look at the exploration and development of certain option types. These are: a) multi-sector options (for inclusion in the regional plan, rather than company WRMPs), b) intra-regional and inter-zonal transfers, c) catchment options and d) resilience options.

Changes since WRMP19:

The options appraisal work undertaken at WRMP19 followed a mature methodology to comprehensively identify a wide range of unconstrained options which were subject to screening and further development to form our constrained list of options. As such, our WRMP19 constrained options list has formed a solid foundation that we have built on for WRMP24. We have largely followed the same methodologies for WRMP24 and have identified in this document where these have been updated; examples include our generic options list and our approach to quantitative risk and optimism bias, both of which have been aligned with the WRSE's methodologies.

A notable update to this work has been in consideration of the fact that, for the first time, we are trying to compile an options list that satisfies a regional rather than company supply area needs. This means that we have submitted more options into the WRSE investment model than we would into our investment model, and we have used the WRSE model as a mechanism to further screen options based on the regional need.

We have included our existing intra-company transfers to help build connections within the WRSE investment model. In line with updates to the WRPG, we have also included our Temporary Use Bans and Non-Essential Use Bans as WRMP options, as well as those of our drought permits that are deemed to be minimally impactful in consultation with our regulators, which is a change from WRMP19.

We have worked extensively with WRSE to support the identification of new options that could better improve the connectivity and resilience across our region, improving our collective supply security. This innovative work has by its nature generated options which are entirely new. This has meant that they are not developed to the level we would usually seek to progress options before screening them to be included in the investment modelling, but we have included these options in the WRSE modelling to understand their potential benefit to the region. Where options have potential, they will be further developed and fed back into the WRSE model to develop the final regional plan and our final WRMP24.

In a new development for this planning cycle, water companies are required by Ofwat to have a Bid Assessment Framework (BAF), a public declaration outlining how third party offers of water resources, demand management or leakage solutions will be treated by us, ensuring

that all offers are considered equally as compared with solutions that have been developed in-house. We have ensured that our process is transparent, proportionate and non-discriminatory. Our BAF can be found on our website.

For WRMP24, Thames Water options have been identified as either Strategic Resource Options (SROs) or non-SRO options. SROs were identified by Ofwat in the PR19 Final Determination to be developed to be 'construction ready' for the 2025-2030 period. Their development funding was divided between companies who were required to work together and with regulators to deliver the work. Delivery of the SROs is subject to a formal gated process which is governed by the Regulators' Alliance for Progressing Infrastructure Development (RAPID)[1]. Detailed progress reports on the feasibility and design of these options are required at each gate to assess the merits of the options ongoing development. The gate one reports for our SROs were published in July 2021[2] and the gate two reports will be published around the same time as our dWRMP24.

[1] https://www.ofwat.gov.uk/regulated-companies/rapid
[2] https://www.thameswater.co.uk/about-us/regulation/regional-water-resources

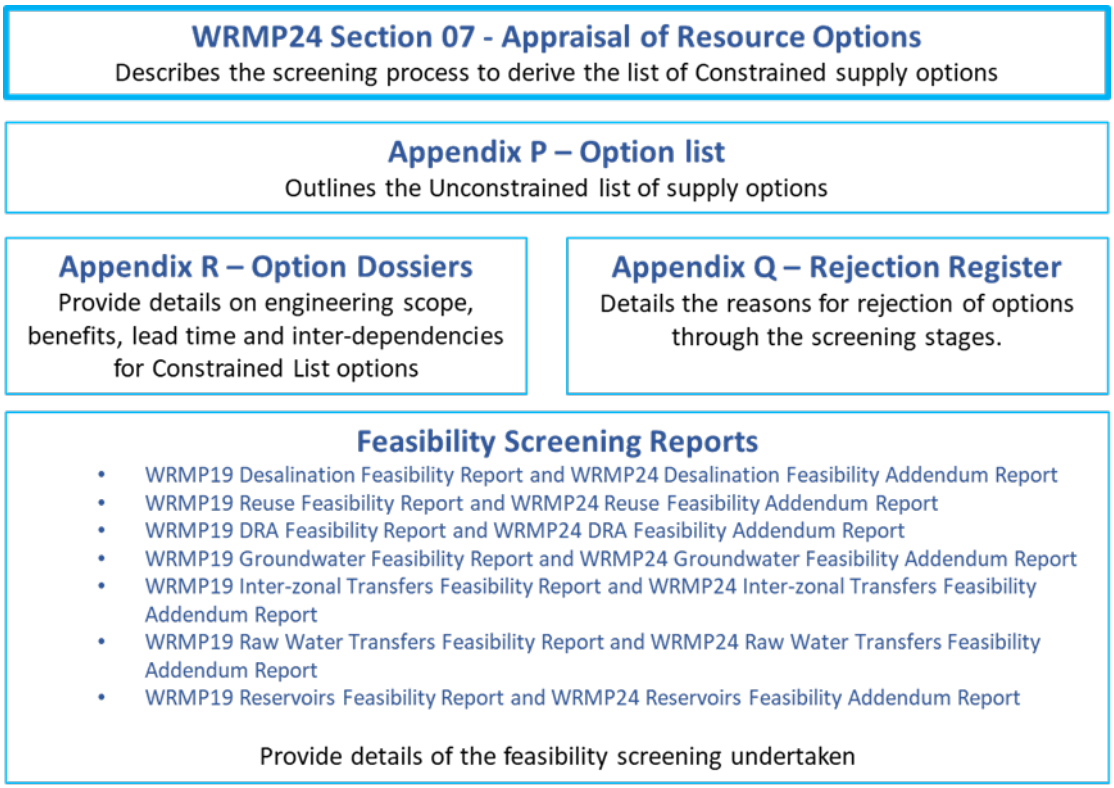
Introduction

Purpose of section

7.1 Section 7 summarises the approach that has been followed for identifying water resource options and how screening has been applied to determine the Constrained List of options that has been taken forward into programme appraisal to develop the regional plan. The section then summarises the information that has been gathered on the Constrained List of options.

7.2 Option dossiers have been prepared for the Constrained List of options. The dossiers should be read in conjunction with the reports as detailed in Figure 7-1.

Figure 7-1: Overview of draft WRMP24 Supply options reports



Structure of this section

7.3 Following this introduction, Section 7 summarises:

- The generic option type screening we have conducted
- The feasibility assessments we carried out to define the Feasible List of specific resource options
- The cross option studies we conducted to identify raw water system, treatment and network reinforcement requirements needed to deliver potable water to customers
- A further screening exercise that considered outputs of the feasibility reports to produce a Constrained List of elements to be carried forward for further development
- The further development conducted with regard to elements on the Constrained List to inform programme appraisal completed by Water Resources South East (WRSE) on a regional scale

- Drought Permit options considered as part of the WRMP24 process
- TUBs, NEUBs and media campaign options which have been identified and developed through the WRMP24 process
- Existing transfers which have been included in the WRSE modelling to allow flow of water around the Thames region and the WRSE region
- References to the sources of further information available in respect of the elements on the Constrained List and work carried out by WRSE for the region or by the Strategic Resource Option (SRO) teams

Approach to water resource option development

7.4 Following the principles of the Water Resources Planning Guideline[3] (WRPG), a phased approach to developing water resource options for WRMP24 has been undertaken so that effort on reducing uncertainties is focused on issues that could reasonably be expected to influence option screening decisions. An overview of the approach to reviewing and assessing resource options in the preparation of WRMP24 is shown in Figure 7 - 1. The approach comprises: option identification and definition; water company option screening; option development; and investment modelling. We have adopted a 2-stage approach to water company option screening; feasibility assessment by option type, followed by further option screening of all feasible options. These are described in more detail below.

7.5 The objective of option identification and definition was to:

- Review the water resource options carried forward from WRMP19
- Review options in our WRMP19 Rejection Register to identify any options which have the potential to provide benefit to other companies in the WRSE region, to achieve 1:500 drought resilience and long-term environmental benefits.
- Identify new options to be considered in addition to the existing WRMP19 options, including new offers of options from third parties.

7.6 The output of this stage is the Unconstrained List of options.

7.7 Feasibility Assessment: options on the Unconstrained List were assessed following the three-stage methodology in accordance with the WRMP19 approach:

- The WRMP19 screening of options was reviewed and updated, where new information was available
- New options were assessed using the WRMP19 Feasibility methodology
- Backchecking was undertaken to assess whether changes since WRMP19 impact on the WRMP19 screening decisions
- Where applicable, further stakeholder engagement was undertaken to identify if an option is feasible

7.8 Updates to the WRMP19 feasibility assessments, assessment of new options and backchecking are presented in Addendums to the WRMP19 Feasibility Reports which are published on our

[3] Environment Agency, 2022, Water Resources Planning Guideline, https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

website: https://www.thameswater.co.uk/about-us/regulation/water-resources. These should be read alongside our WRMP19 feasibility report for each type of option, please contact consultation@thames-wrmp.co.uk for access to these documents.

7.9 The output of this stage is the Feasible List of options.

7.10 Further Option Screening: further screening was undertaken where options were subject to a combined limit (for example, to protect the environment in the estuarine Thames, we consider that there is an upper limit to the total volume of desalination and recycling schemes that we could implement in the middle Tideway), or where an option would be mutually exclusive with another option (for example, options which use the same water source). Where possible, we have not screened options out where mutual exclusivities or combined upper limits exist and have instead represented these limits and constraints in our investment modelling. In some cases, however, we have either undertaken multiple scenario runs using our investment model to identify options which are universally preferred over other mutually exclusive options (and have screened out options which are not preferred in this case), or have undertaken detailed appraisal, for example through the gated Strategic Resources Options (SROs, see section below) development process, to find preferred option variants.

7.11 Feasible options which meet the criteria for Further Option Screening were passed through to the Constrained List of options.

7.12 The output of this stage is the Constrained List of options.

7.13 Option Development: Constrained List options were developed for inclusion in the investment model and WRMP24 documentation. In this context, development means determining as a minimum an indicative design of an option, and carrying out cost, carbon emissions, and environmental assessments based on these designs.

- Conceptual designs were prepared for new Constrained List options
- WRMP19 conceptual designs were updated, where there have been material changes.
- Costs have been updated using methodology developed by the All Company Working Group (ACWG, a group composed of all water companies who are developing major water resources options) and WRSE, in order that our option costs are developed in a consistent way and are comparable with option costs developed by other companies in the region and country
- Carbon emissions associated with the development and use of options have been updated, using the WRSE/ACWG Cost Consistency Methodology
- Environmental assessments, comprising Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA), Water Framework Directive (WFD), Invasive Non-Native Species (INNS), Natural Capital (NC), and Biodiversity Net Gain (BNG), have been updated or carried out in order that all option costs include necessary environmental mitigation measures, and in order that we can compare the environmental costs and benefits associated with different options, including rejection on environmental grounds where appropriate
- Deployable Output (DO) values, DO being a measure of the supply benefit that a given option brings under drought conditions, have been updated in accordance with the WRSE methodology

- Resilience assessment of options has been carried out in accordance with the WRSE Resilience Framework and the metrics generated by this assessment used to compare options as part of programme appraisal

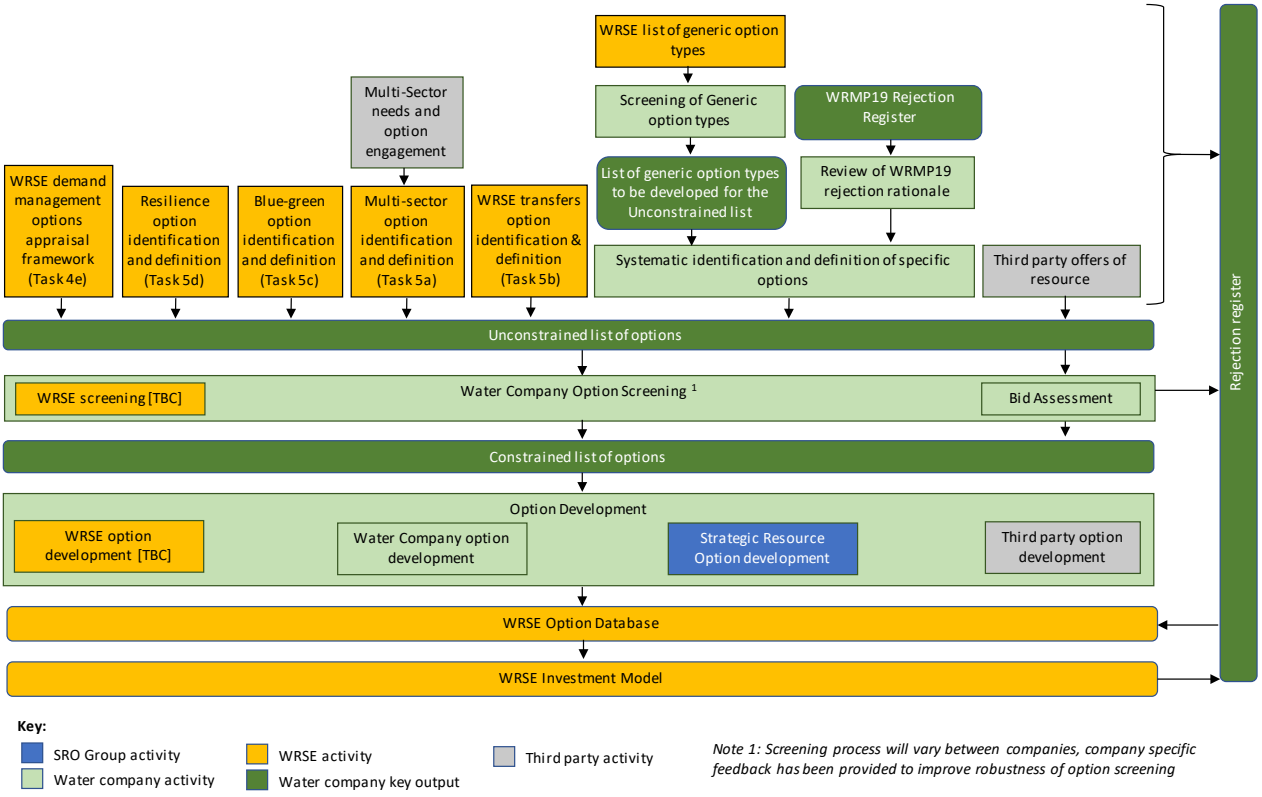
7.14 Options on the Constrained List have then been subject to programme appraisal using the WRSE investment model to determine the Best Value plan to the water supply/demand deficit to ensure that supply balances demand, taking account of relevant future forecast water resource scenarios. As described in Section 6 and Section 10, our investment modelling is now based on a fully adaptive approach, in order that our plan is sufficiently robust to the large future uncertainties that we face, and such that we make the right investments at the right time.

7.15 Conceptual designs were developed for Constrained List options for inclusion in the WRSE investment model. Option development backchecking was then completed through inspection of investment programmes suggested by the WRSE Investment Model to identify changes to screening and as a result the feasible and constrained lists.

7.16 The steps above are broadly consistent with the options appraisal process carried out in producing our WRMP19. There are, however, several notable changes between our WRMP19 and WRMP24 options appraisal processes which are worth highlighting:

- Focus on Environmental Assessments: The use of Natural Capital accounting and assessment of the potential for mitigation measures needed to ensure the statutory minimum of 10% Biodiversity Net Gain for those options which require planning permission. This marks a step change in the environmental assessments that we have undertaken in our water resources option development. This work is described in further detail in Section 9
- Regional and National Consistency: The development and adoption of regionally and nationally consistent methodologies for cost and carbon assessment has driven a more comparable options development process across different companies
- Regional approach to Investment Modelling: In WRMP19, we appraised options and carried out investment modelling in order to determine the Best Value plan considering only the Thames Water supply area. In WRMP24 we have appraised options considering their potential utility for multiple companies in the WRSE region and have undertaken our investment modelling to ensure that WRSE companies' WRMPs present a Best Value plan for the region as a whole
- Strategic Resources Options Gated Process: As is described in the next section, in PR19, Ofwat allocated funding to develop several large, strategic, inter-company water resources solutions. These options have undergone a greater amount of development than would otherwise have been the case, leading to a greater degree of confidence in the cost, carbon and environmental assessment of these options.

Figure 7 - 1: WRMP24 Options Appraisal Process



Strategic resource options

7.17 For WRMP24, Thames Water options have been identified as either SROs or non-SRO options. "SROs" are those solutions that were identified as such by Ofwat in its PR19 Final Determination[4]. These options are large, strategic options, potentially shared by different water companies. Companies have been given ring-fenced funding to investigate and develop options through the SRO process. Other water resource options are referred to as non-SROs. Three SROs have been identified that will bring direct deployable output (DO) benefits to Thames Water:

- South East Strategic Reservoir Option (SESRO) or Abingdon Reservoir: a new reservoir in Oxfordshire, with different sizes being considered
- Severn to Thames Transfer (STT): a transfer of water from the River Severn to the River Thames, which could involve the use of resources owned and operated by United Utilities and/or Severn Trent Water to increase the resilience and supply benefit of such a transfer
- London Effluent Reuse: water recycling schemes whereby effluent from sewage treatment works would be treated to a very high standard, suitable for discharge to rivers and re-abstraction for drinking water purposes. Several different locations and technologies are being considered within the umbrella of the London Effluent Reuse SRO.

7.18 In addition to the three options which would bring resource to Thames Water, we are also involved in the development of two transfer SROs:

[4] Ofwat (2019), PR19 final determinations, Strategic regional water resource solutions appendix

- Thames to Affinity Transfer (T2AT): a transfer of water from the River Thames (facilitated by one or more of the new Thames resources highlighted above) to Affinity Water, who operate supplies in North London, and across parts of the Home Counties
- Thames to Southern Transfer (T2ST): a transfer of water from the Thames's region (again, facilitated by the new resources above) to Southern Water in Hampshire. Two smaller transfers from the T2ST pipeline are being explored to supply our Kennet Valley Water Resource Zone (WRZ); these transfers have been submitted into WRSE's investment model for programme appraisal.

7.19 Both of these transfer options bring the potential for 'conjunctive use', whereby water supply systems can be operated efficiently to bring about overall water resources benefits which are more resilient than the sum of their parts.

7.20 SRO options are subject to a gated regulatory process which has been defined by Ofwat. This chapter provides an overview of the SRO options and further information, at an equivalent level of detail to non-SRO options, is included in Appendix R, Option Dossiers. The more detailed work carried out by the SROs to meet the requirements of the gated process is contained in the Gate 1 and 2 reports. Gate 1 reports are publicly available on the Thames Water website (Gate one submissions and final decisions), and Gate 2 reports will be published around the same time as our dWRMP24.

Stakeholder engagement

7.21 As part of development of the South East regional plan and our draft WRMP24 we have worked closely with regulators and stakeholders and presented our approach in a report[5]. This section focuses on the engagement undertaken with stakeholders as part of the process to identify, appraise and evaluate resource options.

7.22 WRSE developed a technical method statement on option appraisal which set out the objectives and components of the options appraisal process; the range of options to be considered; the information required for the option assessment and the approach to assessment. WRSE consulted on the method statement, as part of the wider consultation on the technical method statements and held a targeted webinar[6] on option appraisal. Further to feedback, WRSE updated and republished[7] the method statement this included clarification on the rejection reasoning and the quality assurance process. The approach has been used consistently by WRSE and the water companies and is in line with regulatory guidance.

7.23 We put forward the Constrained List options included in WRMP19 to WRSE for consideration in the regional plan. We had followed a robust methodology to identify, screen and develop the options to prepare a Constrained List of options for WRMP19 and this work included close engagement with stakeholders as presented in WRMP19 Section 7 and Appendix S. We did not repeat this work but engaged with stakeholders by exception.

7.24 We also sought proposals from third parties via the Bid Assessment Framework (BAF)[8] which was used to administer the receipt and assessment of third party proposals and ensure consideration of these options was on an equal basis with other options.

[5] WRSE Stakeholder Engagement Report. January 2022
[6] Option Appraisal Technical Method Statement webinar, September 2020
[7] WRSE Method Statement Option Appraisal, September 2021
[8] https://www.thameswater.co.uk/about-us/regulation/water-resources - Bid Assessment Framework

7.25 WRSE identified a gap in the option set in respect of catchment solutions. This led to engagement with regulators, Rivers Trusts, catchment partnerships, and local authorities through a series of interactive workshops in early 2021 to identify potential catchment options and nature based solutions. Water companies collated the relevant information for their own supply areas, seeking further information from stakeholders as required. For Thames Water a total of 161 options were identified, around a quarter were river restoration measures, with substantial numbers of water retention measures (including natural flood management and wetland creation) and nutrient and sediment reduction measures. We assessed the options to establish their feasibility, indicative costs and wider socio-economic and resilience benefits[9]. Options with sufficient level of assessment and which meet the requirements for options to be included in the WRMP have been progressed through either the WRMP, DWMP or business plan pathways whilst those options that are less mature may be developed further to improve the quality of the information available and consideration in subsequent planning rounds.

7.26 WRSE worked closely with the Environment Agency and Natural England throughout the work on option appraisal and provided access to the option database to enable timely sharing of data and information.

7.27 As part of our pre-consultation activities on our draft WRMP24 we also worked closely with regulators to discuss and seek feedback on potential options.

- Discussions with the EA focused on the work to identify and update the options assessments including the rationale for rejection of options; potential groundwater options, catchment, drought, inter-regional transfers and resilience options; the update to the Feasibility Report and agreement on the status of Deephams recycling which was agreed to be incompatible with the environmental ambition flow targets that the Environment Agency is seeking for the Lower River Lee (the result being the Deephams option's inclusion on the Constrained List after 2060, but exclusion up to this point)
- Discussions with NE focused on the SEA, HRA and WFD assessments, the output of the assessment of options, and our reviews of emerging policy changes, particularly where this meant that options needed to be rejected on environmental grounds
- Discussions with DWI mainly focused on the work to examine the drinking water quality risks and ensure compliance with drinking water quality requirements

7.28 WRSE hosted a programme of webinars in May and June 2021 to present the work on option appraisal, share information with the wider stakeholder community on the option types and provide the opportunity for stakeholders to comment ahead of the start of investment modelling in Autumn 2021.

7.29 There has also been considerable engagement as part of the work to examine and develop the. SROs. This has included engagement with regulators, strategic and technical stakeholders to share the programmes of studies and seek input to specific workstreams. The engagement has included dialogue with the Cotswold Canals Trust on the Severn Thames Transfer; the Port of London Authority on London water recycling; and Group Against Reservoir Development, Wilts and Berks Canal Trust and local authority and parish council representatives in the proximity of the South East Strategic Reservoir Option. The nature of the engagement and response to stakeholder feedback is reported in detailed in the SROs Gate 1 reports which are publicly

[9] Further information provided in Framework for identifying and appraising existing and new catchment options, Water Resources south East, May 2022

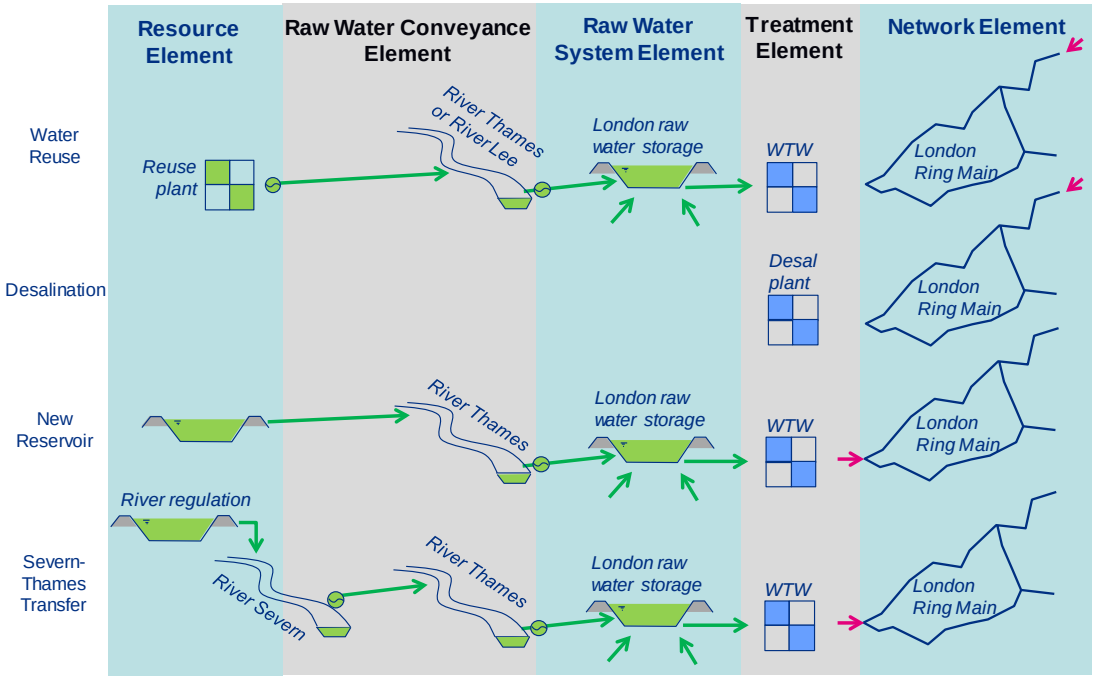
available on the Ofwat website (Gate 1 submissions and final decisions - Ofwat) and Gate 2 reports, which will be published around the same time as our dWRMP24.

Taking a system approach

7.30 For new water resources to be put into supply, reinforcements are often required to other parts of the water supply system downstream of the resource, including to the raw water conveyance system, water treatment works and water distribution infrastructure. In many cases these water supply system reinforcements are common to a number of different water resource options, for example water from a regulating reservoir such as SESRO or water from a Severn-Thames Transfer could both require treatment in west London. The supply system elements may also be implemented at a different time to water resource elements, for example if a zone is resource constrained and has sufficient treatment/network capacity in the short term but will require reinforcements in the medium-long term as demand increases. For these reasons separate supply system elements have been developed for new water resources, raw water conveyance, raw water system reinforcements, treatment reinforcements and treated water network reinforcements.

7.31 Cross option studies have been carried out to identify the supply system reinforcement elements required and to establish the system operating philosophy. Figure 7 - 2 illustrates examples of how the different supply system elements combine to make up an overall water resources option.

Figure 7 - 2: Separation of water resource options into supply system elements



Generic screening

7.32 The starting point for water resource option development is the generic list of resource option types (e.g. reservoirs, water transfers) as defined by WRSE based on the UKWIR Water Resources Planning Tools report. The list has been reviewed to identify option types that have potential for providing feasible specific water resource options for the Thames Water supply area. A summary of the results of the generic screening exercise that we carried out is shown in Table 7 - 1.

7.33 Water resource option types that have been rejected are marked with a cross in Table 7 - 1. A summary of reasons for rejection can be found in Table 7 - 2, with further detail provided in the rejection register (see Appendix Q).

7.34 Resource option types that were assessed as having potential to provide specific options for WRMP24 are marked with a tick in Table 7 - 1. For these option types the table also references the report that goes on to identify feasible specific options for our supply area.

7.35 Generic option types are split into Blue-Green infrastructure, Hard infrastructure, and Response to Regional Events. Refer to WRSE report for further description of the option types.

7.36 WRSE recommended that a review is undertaken by each water company to identify generic option types where options were not considered during WRMP19. As part of their recommendations, WRSE have provided a list of generic option types which is updated from the UKWIR list. Each generic option type has been reviewed and a decision has been made as to whether the option type has passed or failed the generic screening assessment for WRMP24. Table 7 - 1 includes the generic option type list together with a summary of the results of the screening assessment.

Table 7 - 1: Summary of generic water resource option type review

Scheme Type / Sub type	Screening decision	Report containing option identification
Catchment management schemes - Flow augmentation and licensing	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Terrestrial habitat creation/management	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Natural water retention measures	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Fisheries management	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - River Restoration	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Sustainable Urban Drainage Systems (SUDS)	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022

Scheme Type / Sub type	Screening decision	Report containing option identification
Catchment management schemes - Nutrient and sediment reduction	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Pesticide reduction	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Integrated catchment management	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Catchment management schemes - Knowledge exchange, education and agricultural activity	✓	Framework for identifying and appraising existing and new catchment options, WRSE, May 2022
Desalination	✓	WRMP19 Desalination Feasibility report and WRMP24 Desalination Feasibility addendum.
Groundwater sources	✓	WRMP19 Groundwater Feasibility report and WRMP24 Groundwater Feasibility addendum.
Artificial Storage and Recovery wells (or Aquifer Storage and Recovery (ASR))	✓	WRMP19 Groundwater Feasibility report and WRMP24 Groundwater Feasibility addendum.
Aquifer recharge /Artificial recharge (AR)	✓	WRMP19 Groundwater Feasibility report and WRMP24 Groundwater Feasibility addendum.
Tidal barrage	×	Appendix Q: Rejection Register
Conjunctive use operation of sources	✓	Appendix R: Option Dossiers
Joint (“shared asset”) resource	✓	Gate 2 SRO documents
Asset Transfers	✓	Third party option type. This generic option type was not rejected however no options were received through the Bid Assessment Framework (BAF)
Options to trade other (infrastructure) assets	✓	Third party option type. This generic option type was not rejected however no feasible options were received through the BAF
Abstraction licence trading	✓	Third party option type. This generic option type was not rejected however no options were received through the BAF (one offer received and rejected on environmental grounds)
Distribution capacity expansion	×	Appendix Q: Rejection Register WRMP19 network reinforcement cross option report
Redevelopment of existing resources with increased yields	✓	WRMP19 Groundwater Feasibility report and WRMP24 Groundwater Feasibility addendum
Increase water treatment works (WTW) capacity	✓	WRMP19 Water treatment works cross options report

Scheme Type / Sub type	Screening decision	Report containing option identification
New reservoir	✓	WRMP19 Reservoir Feasibility report and WRMP24 Reservoir Feasibility addendum. SESRO Gate 1 and 2 submissions
Reclaimed water, water re-use, effluent re-use	✓	WRMP19 Water Reuse Feasibility report and WRMP24 Water Reuse Feasibility addendum. London Effluent Reuse SRO Gate 1 and 2 submissions
Direct river abstraction	✓	WRMP19 DRA Feasibility report and WRMP24 DRA Feasibility addendum.
Bulk transfers into region	✓	WRMP19 Raw Water Transfers Feasibility report, WRMP24 Raw Water Transfers Feasibility addendum STT Gate 1 and 2 submissions
Bulk transfers within region	✓	WRMP19 Interzonal Feasibility report, WRMP24 Interzonal Feasibility addendum.
Drought intervention - Drought order	✓	Drought Plan 2022 https://www.thameswater.co.uk/about-us/regulation/drought-plan Our drought plan | Regulation | About us | Thames Water Drought orders are considered as options in the Drought Plan however none of these Drought Orders were identified as WRMP options.
Drought intervention - Drought permit	✓	Drought Plan 2022 https://www.thameswater.co.uk/about-us/regulation/drought-plan
Change in Level of Service to enhance water available for use (WAFU)	✓	Drought Plan 2022 https://www.thameswater.co.uk/about-us/regulation/drought-plan
Imports (icebergs)	×	Appendix Q: Rejection Register
Rain cloud seeding	×	Appendix Q: Rejection Register
Drought intervention - recommission abandoned sources	✓	Drought Plan
Tankering of water - Road Tankering	×	Appendix Q: Rejection Register
Tankering of water - Sea Tankering	×	Appendix Q: Rejection Register
Drought intervention - Temporary transfer	×	Appendix Q: Rejection Register

Table 7 - 2: Rejection reasoning for generic water resource option types

Scheme	Screening decision	Rejection reasoning
Tankering of water - Sea Tankering	✘	A proposal by Waterlevel for tankering from sources in Norway has been considered by WRSE. This concluded that while technically feasible at full utilisation (one tanker per day) it would be excessively costly, in particular for use in London where use over a long duration (up to 18 months) is required to deliver the full resource benefit. As a drought measure at very low utilisation, sea tankering could become economical and it is therefore included as a potential 'More Before Level Four' drought measure in Thames Water's Drought Plan, though the long lead time for preparatory works (6-9 months or greater) limits this option's applicability to only those events where potentially very severe drought risk exists in the winter before a summer drawdown. The decision was made by WRSE that options from this generic option type should not be included in the investment model as a range of operational costs had not been included in the cost submission (e.g. pipelines and treatment in receiving WRZs) and because the utilisation was not properly accounted for in option costing.[10]
Tankering of water - Road Tankering	✘	It is difficult to plan road tankering options significantly in advance, as the locations of likely available resource and the location of the water shortage are not known. Nevertheless, it is an option that has been employed in previous droughts such as in Yorkshire in 1995. It is included as a potential 'More Before Level Four' drought measure in Thames Water's Drought Plan. This option type's applicability is, however, limited to response to local, temporary drought 'hot-spots', with road tankering being infeasible across large WRZs. The decision was made by WRSE that options from this generic option type should not be included in the investment model.
Icebergs	✘	The option to import icebergs has been rejected on the basis that the techniques involved are not sufficiently advanced for commercial use and because of the high level of uncertainty around scheme yield. Also, as the Thames Estuary is designated under the EA Habitats Directive, an Appropriate Assessment is likely to be required. As part of this, the company would be required to demonstrate that there are no feasible alternative options, which is not the case.
Rain cloud seeding	✘	Rain cloud seeding has been rejected on the basis that the techniques involved are not sufficiently advanced for commercial use and because there is a high level of uncertainty that the scheme would provide significant yield.

[10] Discussions are ongoing to confirm if there is any change to the status of the Waterlevel tankering option. Any changes will be reflected in the Final WRMP.

Scheme	Screening decision	Rejection reasoning
Tidal barrage	✘	The option for the use of the Thames Barrage to impound fresh water has been rejected as this option would limit the navigation of the River Thames to both private and commercial traffic resulting in disproportionate social and economic costs. It would also limit the passage of aquatic life which would cause significant ecological damage. The option could also result in raising the groundwater levels in the surrounding areas which could increase the incidence of flooding and cause damage to services and historic buildings in London.
Redevelopment of existing resources with increased yields	✘	We rejected redevelopment of reservoirs' storage on the basis that it is not possible unless sufficient surplus reservoirs are available to compensate for the loss of storage and the consequent risks to security of supply that would therefore result whilst the reservoir is being redeveloped. While short term outages may be managed, it is expected that redevelopment of existing resources would require longer term periods of outage. The provision of the surplus resources would be likely to be required for several years to allow the redevelopment of existing sources. Redevelopment of existing groundwater options within the existing licences is considered under the groundwater feasibility report. Redevelopment of existing resources with increased yield options are constrained by existing abstraction licences. We review asset performance against abstraction licences through ongoing operational procedures and consider that there are no current constraints which could be addressed through WRMP options.
Drought intervention - Temporary transfer	✘	A range of transfers have been identified as potential water resources options. In the event of a severe drought, consideration would be given as to whether there are surplus resources available from neighbouring WRZs that could be made available through other transfer pipelines. The location of these zones with available resource is not known in advance. The decision was made by WRSE that options from this generic option type should not be included in the investment model.

Water resource feasibility assessment

Approach to feasibility assessment

7.37 For the water resource option types that have passed the generic screening, feasibility assessments have been conducted. A staged approach has been adopted for the feasibility assessment:

- Stage 1: a systematic search was conducted to identify potential new resources of each type; these collectively form the Unconstrained List of resource elements (see Appendix P) that were then screened against absolute constraints (pass/fail)
- Stage 2: the performance of each potential new resource was evaluated qualitatively against a number of criteria that enabled differentiation between options of that type
- Stage 3: the performance of the potential new resources was assessed in further detail (e.g. including costing)
- Validation: verification and review of the final list of specific resource elements was undertaken to determine the Feasible List

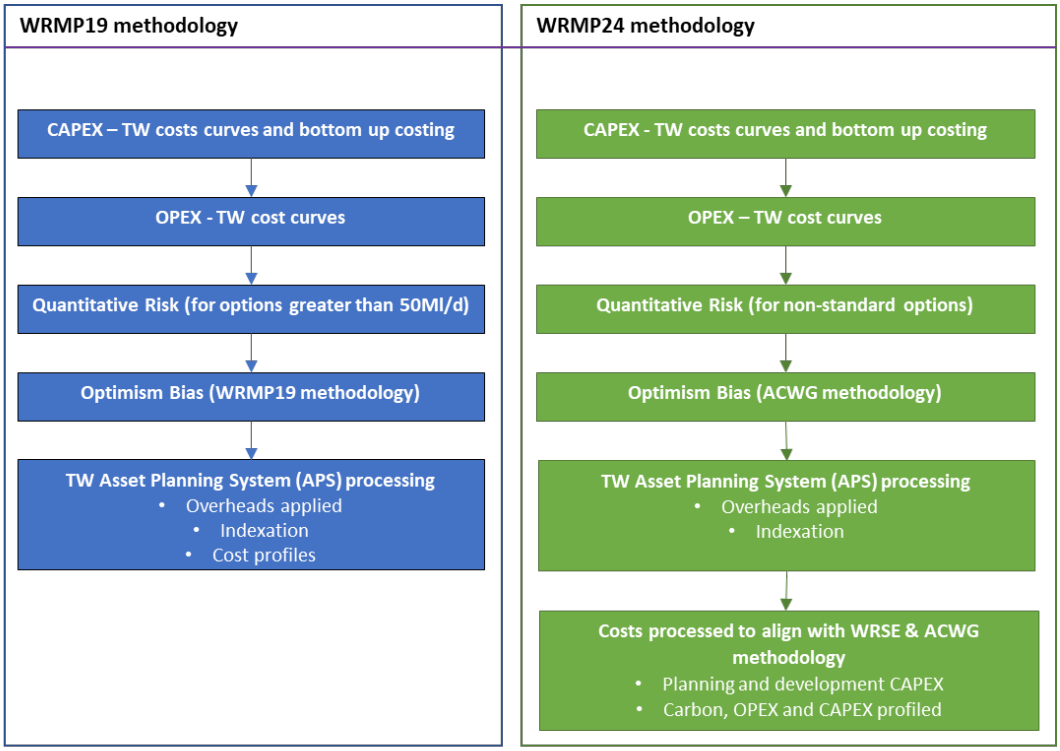
7.38 Further detail relating to the criteria used at each stage of the feasibility assessment can be found within each of the feasibility reports referred to in section 7.

7.39 The costing methodology used for WRMP24 is substantially the same as the WRMP19 methodology, however updates have been made to the following key areas of the estimations in order to ensure consistency with the other WRSE companies and to bring costs up to current rates:

- General updates to the costs to incorporate any updates to TW cost models and to update the inflation index date
- Option names and IDs have been updated to align with WRSE approach
- Following the All Company Working Group (ACWG) Cost Consistency Methodology Costs have been reviewed and updated for all existing WRMP19 options, and costs have been developed for all new options identified in WRMP24
- Optimism bias has been updated to use ACWG methodology
- Quantitative risk has been applied to all non-standard options as per ACWG methodology
- Planning and development costs have been identified separately from construction costs for large options, following the WRSE methodology and as required for the purposes of programme appraisal.

7.40 Figure 7 - 3 shows the costing processes followed for WRMP19 and WRMP24. Key updates for WRMP24 as outlined above will be explained in further detail throughout this section.

Figure 7 - 3: WRMP19 and WRM24 Approach Comparison



7.41 Options identified by Ofwat at PR19 as SROs have been developed through the Gated process in parallel to the WRMP24 process, as a result SRO options are further developed than other WRMP options. As the SRO options have been developed backchecking has been completed to ensure there is no change to feasibility assessments. Any changes made are reported in the feasibility addendums. Details of the SRO option development can be found in the Gate 1 and 2 reports published on our website[11].

7.42 New resource elements have been carried forward from the feasibility assessment on to the Feasible List for further screening. Further screening has been carried out on options which are subject to a combined limit, are mutually exclusive with another option or required further stakeholder engagement to determine viability. Multiple scenario runs of the WRSE investment model have been used to inform the further screening. The output of this stage is the Constrained List of options. Feasible options which did not meet the criteria for further option screening were rejected and are not included on the Constrained List of options.

Identifying third party options

7.43 We have sought to identify potential third party water resource options through three main approaches:

1) Request for proposals for water resources through the Bid Assessment Framework (BAF) [Bid Assessment Framework (thameswater.co.uk)] and the UK Find a Tender Service, used to notify the market of our interest in being offered new water resources and demand management options

2) Bilateral discussions with other water companies

[11] https://www.thameswater.co.uk/about-us/regulation/regional-water-resources

3) Active engagement with regional water resource planning groups including the Water Resources in the South East Group (WRSE), Water Resources West (WRW), Water Resources East Group (WRE) and the West Country Water Resources Group (WCWR)

7.44 Where we have been offered new options by third parties, we have taken them through a fair, proportionate evaluation process as laid out in our BAF.

Request for proposals for water resources

7.45 In preparation for WRMP24, on 16 March 2020 we published a Periodic Indicative Notice via OJEU to invite third party organisations to register interest in providing a water resources or demand management option. We regularly update this notice, updating via the UK Find a Tender service (UK FAT) post Brexit (26 March 2021 and 06 April 2022). A summary of the responses received related to new water resource options is set out in Table 7 - 3.

Table 7 - 3: Status of OJEU/UK FAT water resource options

Company	Nature of supply option	Volume (Ml/d)	WRMP24 status
Tankering by sea			
Albion Water	Raw water tankering by sea from Norway	30 - 440	Assessment at WRMP14 found tankering by sea to be excessively costly to supply our geographic area. Albion (now WaterLevel) engaged further with us and with WRSE during preparation of WRMP24 through the stakeholder engagement process. However the assessment of the option remains that it is excessively costly as a water resource option. Tankering has therefore not been developed as a water resources option.
Raw Water Purchase			
RWE Generation UK	Temporary agreement in relation to Didcot power station abstraction licence.	18 Ml/d	Extension to existing (AMP7) agreement over temporary transfer of 18 Ml/d. Included in Programme Appraisal.
Pump House Water Ltd	Offer of a bulk supply from an existing pumping station served by multiple boreholes in Upton which is under private ownership. This source was previously under Thames Water ownership.	Unknown	The bidder made contact with Thames Water by email on the 18th May 2021. After consideration of the bid in line with our BAF process, the option was rejected owing to material concerns that, based on the site's history, the abstraction would be unacceptable on environmental grounds. This decision was communicated to the bidder on the 25th May 2021.

Bilateral discussions with other water companies

7.46 Since WRMP19 we have continued to engage on a bilateral basis with other water companies (and via WRSE and other regional groups) to identify and develop potential new resource options in the form of:

- Inter-company raw water transfers[12] – these are assessed in the WRMP19 Raw Water Transfers Feasibility Report and WRMP24 Addendum
- Inter-company treated water transfers[13] – these are assessed in the WRMP19 Inter-Zonal Transfer Feasibility Report and WRMP24 Addendum

7.47 Companies that are willing to offer water to supply us include: Wessex Water, South East Water, Severn Trent Water, SES Water, Canal and River Trust, RWE Generation UK and United Utilities.

7.48 With the regional planning groups we have also engaged with other companies concerning their future deficits and how we may be able to provide water to address these.

Regional groups (WRSE)

Overview of WRSE

7.49 Our approach to water resources planning has moved from one of being company focussed in WRMP19 to being regionally focussed in WRMP24. Our supply forecast, demand forecast, allowance for uncertainty, and approach to options development and appraisal have all followed regionally aligned methods, and our investment modelling approach is to determine the Best Value plan for the WRSE region, rather than considering Thames Water customers in isolation.

7.50 Regarding feasibility assessment of water resources options, WRSE has introduced new initiatives to ensure that all feasible options are considered. The first of these was the analysis of company rejection registers to identify options rejected by one company which could be feasible for a different company, while the second was the identification and development of option types with specific potential benefit to regional planning. These were: a) Multisector options (for inclusion in regional rather than company WRMPs), b) intra-regional, inter-zonal transfers, c) Catchment options and d) Resilience options. These workstreams are described in further detail in WRSE reports published on their website. WRSE also encouraged the proposal of options from third parties.

7.51 A summary of third party options submitted to WRSE is described in Table 7 – 4.

Table 7 - 4: Summary of Third Party Options Submitted to WRSE

Option	Organisation	Description	Assessment
RWE raw water purchase	RWE Generation UK	RWE made an offer through the WRSE stakeholder engagement tool of up to 45 Ml/d of resource in the River Thames.	Options have been included by Thames Water and Affinity Water to make full use of the resources offered by RWE
Mendip quarries	Quarry in Mendips	RAPID's gap analysis identified potential for redevelopment of a quarry in the Mendips as a potential reservoir	Pre-feasibility report and Gate 1 submission have been prepared by Wessex Water and South West Water to include the option

[12] Raw Water Transfers Feasibility Report, Mott MacDonald, September 2018
[13] Inter-zonal Water Transfers Feasibility Report, Mott MacDonald, February 2018

			as a potential resource for either WCWR, or WRSE.
Extreme Drought Resilience Service	Waterlevel	Proposal for sea tankering of water from Norway to London and Kent for use in extreme drought. Includes for insurance premium to cover costs of up to 6 months of daily deliveries of up to 60 Ml/d.	Categorised as a 'more before 4' option and as such has not been included in the Feasible List for the regional plan, but the option has been uploaded to the options database so that a scenario can be run to confirm whether the option would be selected, if it was able to do so. [14]
Community water recycling scheme for new developments	Albion Water	Community water recycling scheme for new developments	Water companies are not submitting individual demand management options to WRSE for the regional plan but instead are providing combined demand management strategies. The proposals should be considered by companies as part of delivery of those strategies.
Community engagement	South East Rivers Trust	Collection of suggestions around demand management and catchment management	Water companies are not submitting individual demand management options to WRSE for the regional plan but instead are providing combined demand management strategies. The proposals should be considered by companies as part of delivery of those strategies.
Nitrate Treatment	Agua GB	Nitrate treatment solution which could provide cost efficiencies for schemes which require nitrate treatment in the future	Where companies are developing nitrate removal schemes then the option provides an opportunity that could be reviewed by companies when estimating option costs.

7.52 The WRSE regional investment model incorporated the constrained list of options from the six WRSE water companies to develop a cost-efficient adaptive programme, as well as alternative programmes which have been appraised to determine the regional Best Value plan (see WRMP24 Sections 10 and 11). Further details on the WRSE regional model can be found in the published document.

[14] Discussion on Waterlevel is ongoing and any changes will be reflected in the Final WRMP.

WRSE Regional Approach

7.53 As has been described, investment modelling has been carried out at the regional level, rather than the company level. As such, while option development has been carried out by Thames Water, information from this option development exercise has been fed into the WRSE 'Data Landing Platform' (DLP), a database which stores option data. The DLP is then used to provide inputs to the WRSE investment model, ensuring smooth and reliable data input to the investment model.

7.54 Resource options and associated system elements have been developed to be used in the WRSE investment model such that single resource options could be used by any company for whom such use is feasible. For example, the Teddington DRA has been developed by Thames Water (through the London Effluent Reuse SRO), but conveyance elements exist within the investment model such that the option could be used by Affinity Water, if this presents a cost effective solution.

7.55 Regional transfer options have been developed through WRSE to move water around the south east more easily by 2060, making use of surplus where it exists in the region, and allowing new resource to be transferred across the region. These options work alongside the resource options to supply the south east region. We have screened regional transfer options identified through work completed by WRSE, that could transfer water into the Thames Water area.

7.56 In some cases, the high-level options development process followed by WRSE has resulted in transfer options which would require system enhancements that have not been developed. In other cases, risk-based screening decisions have been taken, for example screening out newly developed WRSE transfers which would be reliant on the implementation of TUBs/NEUBs by the donor company, or where the ability of a company to supply water through a transfer in the future would be solely dependent on the success of demand reduction activities.

7.57 Further information on WRSE work on transfer options can be found in WRSE regional plan. We have taken one option forward from this work, a transfer from SES from Reigate to Guildford of either 5 or 20 Ml/d, as detailed in Table 7 - 5. Further work is needed to develop this option and this will be carried out as part of preparation of our Final WRMP24.

7.58 Through WRSE, catchment option ideas for delivery in our supply area were identified through a number of means including:

- Liaison with water companies, and other stakeholders such as local rivers trusts and catchment partnerships, the Environment Agency and Local Councils
- Collation of all catchment options included on WRMP19, Company Business Plans, Drinking Water Safety Plans and other plans and programmes
- Catchment mapping to identify additional options outside of WRSE, including a number of workshops with key stakeholders

7.59 As part of the regional planning process we have engaged with multi-sector partners and environmental stakeholders across our catchments to identify novel solutions to improve the connectivity and resilience of the region. WRSE ran a series of workshops with stakeholders with an interest in catchments across the region to gather their ideas for nature-based solutions to benefit their local environment. A total of 161 options were identified (124 options proposed by stakeholders, we identified 37 options from our potential programmes for AMP8). Around a quarter of the options identified were river restoration measures, with substantial numbers of

water retention measures (including natural flood management and wetland creation) and nutrient and sediment reduction measures. Smaller numbers of integrated catchment management and terrestrial habitat creation measures were proposed.

7.60 The catchment options were subject to screening and assessment to establish their wider socio-economic and resilience benefits[15], and their overall feasibility, as far as was permitted by the information available for each option. An initial exercise was also carried out to estimate the cost of delivering these options on a consistent basis. This work will be developed further over this and successive planning cycles to improve the quality of the information available for the proposed options and mature the screening and development process for catchment options.

7.61 The options that were progressed through this screening process were then compiled into catchment portfolios to compare the proposed options with regards to their contribution to current and future catchment challenges, targeting catchment deficits, catchment issues, problem characterisation and future problems. Standard options (Portfolio 1) were those identified to address the deficit issues and environmental need, both now and with any predicted changes in the future, and these portfolios of options were inputted into WRSE's investment model to develop to regional plan.

7.62 We have identified three schemes (below) within our nature-based solutions programmes that may offer a deployable output benefit over the longer term. These schemes involve working with farmers to provide support and advice to implement environmental interventions, including measures to reduce the potential for nitrate to leach into groundwater. These schemes have been included within our catchment options longlist to be screened and modelled by WRSE to develop the draft Regional Plan. As with the other catchment options on our longlist, the information for these options is less mature and the option type itself generates less certain water resources benefits. This means that a high degree of uncertainty remains around the deliverability of the estimated deployable output benefits from these options. Through our existing programmes to improve the environment and our WINEP and PR24 process we are working as a business to better understand the benefits of these options and support their implementation. Our existing programmes to support development and delivery of catchment options are described in Section 2.

Table 7 - 5: Nature-based solutions programme options

Water Source	Water Resource Zone	Maximum Potential Deployable Output Benefit	Water Quality Risks
Bean Wellfield (Groundwater)	London	0.1 Ml/d	Nitrates, turbidity
Green Street Green (Groundwater)	London	0.3 Ml/d	Nitrates
Wilmington (Groundwater)	London	0.2 Ml/d	Nitrates

[15] Further information provided in Framework for identifying and appraising existing and new catchment options, Water Resources South East, May 2022

Option DO Assessment

7.63 In order to determine the benefit that different options would bring, we determine their Deployable Output (DO) benefits. Deployable Output is a measure of the supply capability of a water resource system under specified (generally drought) conditions and our option DO assessment involves determining how much more water we could supply from a WRZ if that option were available. Our Baseline DO assessment is described in Section 4, with further detail in Appendix I.

7.64 Our option DO assessment follows methods set out in the WRSE method statement on Deployable Output[16]. This involves triaging options to identify an appropriate level of sophistication to apply in option DO calculation. We have a large number of potential options, and the calculation of DO can be very computationally intensive, and so we need to identify those options where effort is needed, and those options where a more simplified approach will give an acceptable answer.

7.65 Tier 1: For large options where the DO benefit is very dependent on the weather (for example, new reservoirs and the Severn-Thames Transfer) we have applied the same methods as our baseline DO assessment when determining option DO benefits. This involved the use of stochastic datasets, and the determination of a '1 in 500-year' Deployable Output. For these options we have also conducted a climate change impact assessment using the same methods as applied in our baseline DO assessment.

7.66 Tier 2: For smaller options where the DO is dependent on the weather, or for large options where DO is not very dependent on the weather (for example effluent reuse or desalination schemes), we have conducted a DO assessment using historical weather datasets (historical weather datasets being around 100 years in length, compared to 19,200 years for stochastic datasets), with our assumption being that these options' supply capability will be approximately the same under 1 in 100-year (worst historical) and 1 in 500-year (the standard of resilience against which we are required to measure our supply capability) drought events.

7.67 Tier 3: For small options where the DO is not particularly dependent on the weather, option DO has been simply assumed to be equal to that option's 'yield' capability, where the yield is the amount of water that it is assumed could be produced by a scheme. In these cases, no water resources modelling has been carried out.

7.68 As described in this chapter, we have assessed the system reinforcements that may be needed to enable supply options to release their full supply benefit. As such, we have calculated the DO benefit of options assuming that all necessary system reinforcements are in place, later ensuring that option dependencies are set up such that resource options are dependent on required system reinforcements.

Feasible List

7.69 The output from the feasibility reports was the Feasible List of water resource options. The specific options in the Feasible List are summarised in Table 7 - 6 below. The table features some options which are phased – these are options which can be built in a modular way, which gives us flexibility to meet incremental increases in need over time.

7.70 For those options that have not been carried forward to the Constrained List an explanation of the reasons for rejection is included in Appendix Q: Scheme rejection register.

[16] Water Resources South East, 2021, Method Statement: Calculation of deployable Output, https://www.wrse.org.uk/media/sbblilys/method-statement-depolyable-output-aug-21.pdf

Table 7 - 6: Feasible List of resource options

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
London WRZ						
Reuse	Reuse Beckton - 380 Ml/d[18]	380	316	316	316	There are no critical changes since screening at WRMP19. Refer to London Effluent Reuse Gate 2 submission for development of the engineering design and environmental assessment since WRMP19.
	Reuse Beckton - 300 Ml/d[19]	300	252	252	252	
	Reuse Beckton - 200 Ml/d	200	172	172	172	
	Reuse Beckton - 150 Ml/d	150	130	130	130	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed that climate change does not impact DO benefit as reuse scheme yield is resilient up to Level 4 restrictions.
	Reuse Beckton - 100 Ml/d	100	89	89	89	
	Reuse Beckton - 50 Ml/d	50	46	46	46	
	Reuse Mogden - 200 Ml/d[19,20]	200	169	169	169	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed
	Reuse Mogden - 150 Ml/d	150	130	130	130	
	Reuse Mogden - 100 Ml/d	100	88	88	88	

[17] Capacity is stated in Ml/d unless stated otherwise.

[18] A WRMP19 review of cumulative effects of Thames Water WRMP19 options on the receptor environment in the Middle Thames Tideway identified that if there is more than a 15-20% decrease (275-366 Ml/d) in freshwater inputs to the Middle Tideway normal salinity patterns could be substantially affected. The London Effluent Reuse SRO has therefore considered options up to 300 Ml/d, however at WRMP19 a maximum capacity of 380 Ml/d was assessed as feasible for Beckton Reuse. The 380 Ml/d option remains on the Feasible List while further work is ongoing to review the cumulative impact of options on the Middle Tideway salinity. Through the SRO package of work the cumulative effects have continued to be investigated and any developments will be included in the Final WRMP.

[19] Option is phased in WRSE investment model option, see Appendix R for details of phasing

[20] Further modelling has shown that a maximum capacity of 200 Ml/d has a high risk of breaching Environment Agency guidance but does not risk breaching the Water Framework Directive (WFD) threshold, this option will therefore has a maximum of 150 Ml/d in the Gate 2 Report. Further work will continue to develop an operational philosophy to mitigate this risk this may result in further changes to the maximum capacity. Any changes will be reflected in the final WRMP documents

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Reuse Mogden - 50 Ml/d	50	46	46	46	that climate change does not impact DO benefit as reuse scheme yield is resilient up to Level 4 restrictions.
	Deephams Reuse – 46.5 Ml/d [21]	46.5	42	42	42	The option is on the Feasible List with the constraint that the scheme is not implemented till post 2060 due to the option presenting a substantial environmental risk if implemented prior to this period. Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed that climate change does not impact DO benefit as reuse scheme yield is resilient up to Level 4 restrictions.
	Crossness Reuse - 190 Ml/d	190	164	164	164	Rejected at further screening, therefore not included on Constrained List. Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed that climate change does not impact DO benefit as reuse scheme yield is resilient up to Level 4 restrictions. This applied to schemes below.
	Crossness Reuse - 150 Ml/d	150	130	130	130	Rejected at further screening, therefore not included on Constrained List
	Crossness Reuse - 100 Ml/d	100	89	89	89	Rejected at further screening, therefore not included on Constrained List

[21] Following completion of the further studies by Thames Water, a joint review of the findings with the Environment Agency has established that a Deephams STW Reuse option is incompatible with the environmental ambition flow targets that the Environment Agency is seeking to deliver for the Lower River Lee through WRSE and the Environment Agency's Environmental Destination work. The option has been included on the Constrained List for implementation after 2060 as it could be considered following delivery of measures under the EA's Environmental Destination work

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Crossness Reuse - 90 Ml/d	90	79	79	79	Rejected at further screening, therefore not included on Constrained List
	Crossness Reuse - 50 Ml/d	50	46	46	46	Rejected at further screening, therefore not included on Constrained List
	Reuse Mogden S Sewer	50	46	46	46	Dry Weather Flow (DWF) monitoring data was gathered during the London Effluent Reuse SRO Gate 2 stage, which showed DWF values of 33 to 36 Ml/d. This is substantially below a DWF of 60 Ml/d required to support a 50 Ml/d Mogden South Sewer scheme. As a result, only a smaller deployable output c.25 Ml/d is possible; however the option is retained while the additional wastewater benefits of the option are reviewed. Refer to London Effluent Reuse Gate 2 submission for development of the engineering design and environmental assessment since WRMP19.
Desalination	Crossness Desalination (Blended) – 300 Ml/d[22]	300	267	267	267	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed that climate change does not impact DO benefit as reuse scheme yield is resilient up to Level 4 restrictions.
	Crossness Desalination (Blended) – 250 Ml/d	250	222	222	222	
	Crossness Desalination (Blended) – 200 Ml/d	200	178	178	178	
	Crossness Desalination (Blended) – 150 Ml/d	150	133	133	133	
	Crossness Desalination (Blended) – 100 Ml/d	100	89	89	89	

[22] Option is phased in WRSE investment model option, see Appendix R for details of phasing.

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Crossness Desalination (Blended) –50 Ml/d	50	44	44	44	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed that climate change does not impact DO benefit as desalination scheme yield is resilient.
	Beckton Desalination - 150 Ml/d	150	133	133	133	
	Beckton Desalination – 100 Ml/d	100	89	89	89	
	Beckton Desalination – 50 Ml/d	50	44	44	44	
Raw Water Transfer	Mythe abstraction reduction - 15 Ml/d – STT resource	15	10	10	14	Rejected at further screening, therefore not included on Constrained List See STT Unsupported
	Minworth STW effluent diversion Phase 2 – 115 Ml/d – STT resource	115	70	70	99	See STT Unsupported
	Minworth STW effluent diversion Phase 1 – 58 Ml/d– STT resource	58	35	35	49	See STT Unsupported
	Netheridge STW effluent diversion - 35 Ml/d – STT resource	35	24	24	34	See STT Unsupported
	Shrewsbury Redeployment – 25 Ml/d – STT resource	25	14	14	19	Rejected at further screening, therefore not included on Constrained List See STT Unsupported
	Lake Vyrnwy - 50 Ml/d – STT resource	50	29	29	41	See STT Unsupported

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Lake Vyrnwy - 75 Ml/d – STT resource	75	43	43	61	See STT Unsupported
	Lake Vyrnwy - 100 Ml/d – STT resource	100	57	57	81	See STT Unsupported
	Lake Vyrnwy - 135 Ml/d – STT resource	135	77	77	110	See STT Unsupported
	Lake Vyrnwy - 155 Ml/d – STT resource	155	86	86	122	See STT Unsupported
	Lake Vyrnwy - 180 Ml/d – STT resource	180	103	103	146	See STT Unsupported
	Oxford Canal – Farmoor reservoir	15	12	12	12	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Yield previously been found to be resilient to 1 in 200-year drought, but not investigated further.
	Oxford Canal - Cropredy resource[23]	15	10.3	10.3	10.3	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Yield previously been found to be resilient to 1 in 200-year drought, but not investigated further.
	Oxford Canal – Farmoor reservoirs conveyance	15	n/a	n/a	n/a	Tunnel element – DO benefit associated with resource element
	Oxford Canal - Cropredy resource conveyance	15	n/a	n/a	n/a	Tunnel element – DO benefit associated with resource element

[23] Two Oxford Canal options have been identified. The Cropredy option supplies the London Water Resource zone by transfer of water to canal at Cropredy for discharge to River Cherwell and subsequent discharge to the River Thames. The second option supplies SWOX through a conveyance pipeline from Duke's Cut on the Oxford Canal to the River Thames upstream of the existing Farmoor intake.

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	STT - Raw Water Transfer Deerhurst to Culham - 300 Ml/d	300	80	80	80	Commentary reflects all STT options, i.e., unsupported pipeline and support options. Tier 1 DO calculation undertaken using WRSE Pywr model, involving a 'full stochastic' DO assessment, and incorporating the impact of climate change as per the WRSE standard approach to climate change assessment. For support sources, DO benefit values incorporate assumptions around losses in the River Severn between release point and Deerhurst. Unsupported STT has been assumed to give supply benefit to London WRZ only, unless accompanied by SESRO. Support sources can give benefit to Southern, Affinity, and Thames Valley zones as needed. The London WRZ has large reservoirs and is vulnerable to long (12-18m) periods of drawdown, whereas other TW zones and Affinity/Southern WRZs do not have as large an amount of storage and so are more vulnerable to short drought periods, during which the unsupported STT has risk of giving no benefit.
	STT - Raw Water Transfer Deerhurst to Culham 400 Ml/d	400	107	107	107	
	STT - Raw Water Transfer Deerhurst to Culham - 500 Ml/d	500	134	134	134	
	STT - Cotswold Canal - 300 Ml/d	300	78	78	78	Rejected at further screening, therefore not included on Constrained List
Reservoir	SESRO / Abingdon Reservoir - 150 Mm^3	150 Mm^3	271	271	271	Tier 1 DO calculation undertaken using WRSE Pywr model, involving a 'full stochastic' DO assessment, and

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	SESRO / Abingdon Reservoir - 125 Mm^3	125 Mm^3	230	230	230	incorporating the impact of climate change as per the WRSE standard approach to climate change assessment.
	SESRO / Abingdon Reservoir - 100 Mm^3	100 Mm^3	185	185	185	
	SESRO / Abingdon Reservoir - 75 Mm^3	75 Mm^3	149	149	149	
	SESRO / Abingdon Reservoir – 50 Mm^3	50 Mm^3	103	103	103	Rejected at further screening, therefore not included on Constrained List
	SESRO / Abingdon Reservoir – 30 Mm^3	30 Mm^3	66	66	66	Rejected at further screening, therefore not included on Constrained List
	SESRO / Abingdon Reservoir Phased - 80 + 42 Mm^3	80 Mm^3 + 42 Mm^3	224 (155.1 + 68.9)	224 (155.1 + 68.9)	224 (155.1 + 68.9)	Tier 1 DO calculation undertaken using WRSE Pywr model, involving a 'full stochastic' DO assessment, and incorporating the impact of climate change as per the WRSE standard approach to climate change assessment.
	SESRO / Abingdon Reservoir Phased – 30 + 100 Mm^3	30 Mm^3 + 100 Mm^3	238 (65.5 + 173.1)	238 (65.5 + 173.1)	238 (65.5 + 173.1)	
	Site 41 - Chinnor Reservoir 30 Mm^3	30 Mm^3	66	66	66	Values as modelled for SESRO option adopted for other reservoir locations. As such, Tier 1 DO calculation undertaken using WRSE Pywr model, involving a 'full stochastic' DO assessment, and incorporating the impact of climate change as per the WRSE standard approach to climate change assessment.
	Site 36 - Marsh Gibbon Reservoir - 75 Mm^3	75 Mm^3	149	149	149	
	Site 36 - Marsh Gibbon Reservoir - 50 Mm^3	50 Mm^3	103	103	103	
	Site 36 - Marsh Gibbon Reservoir - 30 Mm^3	30 Mm^3	66	66	66	
	Site 37 - Ludgershall - 50 Mm^3	50 Mm^3	103	103	103	Rejected at further screening, therefore not included on Constrained List

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Site 37 - Ludgershall - 30 Mm^3	30 Mm^3	66	66	66	Rejected at further screening, therefore not included on Constrained List
	Site 43 - Aylesbury - 50 Mm^3	50 Mm^3	103	103	103	Rejected at further screening, therefore not included on Constrained List
	Site 43 - Aylesbury - 30 Mm^3	30 Mm^3	66	66	66	Rejected at further screening, therefore not included on Constrained List
	Site 42 - Haddenham - 30 Mm^3	30 Mm^3	66	66	66	Rejected at further screening, therefore not included on Constrained List
Direct River Abstraction	Teddington DRA – 50 Ml/d [24]	50	46	46	46	Tier 2 DO calculation carried out, and so DO benefit is WRMP19 DO benefit, reduced to reflect removal of demand savings during a drought from DO. Assumed that climate change does not impact DO benefit as reuse scheme yield is resilient up to Level 4 restrictions.
	Teddington DRA – 75 Ml/d	75	67	67	67	
	New river abstraction from River Lee at Three Mills Lock and transfer to Lockwood Thames-Lee Tunnel Extension	35	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List
Raw Water Purchase	Didcot Raw Water Purchase	22.6	0	22.6	22.6	Tier 2 DO calculation carried out. Amended version of AR22 option DO benefit used. Assumed that climate change does not impact DO benefit.
	Chingford Raw Water Purchase	20	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List

[24] Since the WRMP24 feasibility assessment London Effluent Reuse SRO has continued to undertake environmental investigations and river modelling; any changes to option feasibility as a result of this work will be reflected in the final WRMP24

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
Aquifer Recharge	Kidbrooke Aquifer Recharge/Aquifer Storage and Recovery (SLARS1)	8	8	8	8	Tier 3 DO Approach used. Several DO benefits not reappraised between WRMP19 and WRMP24. DO benefits not reappraised through water resources modelling, and are either WRMP19 values, or nominal scheme yields.
	South London Artificial Recharge Scheme (SLARS) – Merton Abbey	6	6	6	5	
	South London Artificial Recharge Scheme (SLARS) - Streatham	7	5	5	7	
Aquifer Storage and Recovery	South East London (Addington) Aquifer Storage and Recovery	3	3	3	5	
	Thames Valley Central Aquifer Storage and Recovery	3	3	3	5	
	ASR Horton Kirby[25]	5	5	5	5	
Groundwater[26]	Groundwater Addington	2.7	2.7	2.7	5.7	
	London Confined Chalk (north)	2	2	2	2	

[25] ASR Horton Kirby and Southfleet & Greenhithe Groundwater schemes were included in the WRMP19 Preferred Programme for London for delivery in AMP7 (2020-25). Since WRMP19 the delivery of these options has been deferred beyond the end of AMP7 as the supply demand balance in the London WRZ is in surplus. They are therefore included as WRMP24 Options

[26] New River Head groundwater scheme was included in the WRMP19 Preferred Programme for London for delivery in AMP7 (2020-25). This option is therefore not included in the Draft WRMP plan however since this decision the option has been deferred beyond the end of AMP7 as the supply demand balance in the London WRZ is in surplus. The option will therefore be included in the Final WRMP24 options list.

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Southfleet/Greenhithe (new WTW)[25]	8.8	8.8	8.8	8.8	
	Merton Recommissioning	2	2	2	6	
	GW – Honor Oak	1.4	1.4	1.4	2.7	
	Honor Oak Increase DO	1.7	1.7	1.7	1.7	
Catchment Management[27]	Bean Wellfield (Groundwater)	0.1	n/a	n/a	n/a	DO benefit based on estimated reduction in process losses from reduced contamination enabled through catchment management scheme
	Green Street Green (Groundwater)	0.3	n/a	n/a	n/a	
	Wilmington (Groundwater)	0.2	n/a	n/a	n/a	
Inter-Company Transfers[28]	Cheam to Merton Transfer (15 M/d)	Cheam to Merton Transfer was identified late in the WRMP process and has therefore not been screened at the time of issuing the draft WRMP document. This will be further developed before the final issue of the WRMP.				
	Thames to Affinity Transfer - Conjunctive Use Benefit	25 Ml/d per 50 Ml/d of T2AT transfer capacity up to a maximum benefit of 50 Ml/d. Derived through modelling study carried out as part of T2AT SRO scheme. See T2AT SRO scheme documentation for details.				
	SESRO / STT interconnector - Conjunctive Use Benefit	At the time of uploading information to the WRSE investment model it was understood that there would be no DO benefit from the STT / SESRO link, however subsequent work has shown in that there is a small DO benefit of 11 Ml/d, this is further reported in Gate 2 Reports and will be included in the Final WRMP documents.				
SWOX WRZ						

[27] Only Catchment Management Options with a DO benefit have been included on the Feasible list.
[28] Modelling has been undertaken to understand the conjunctive use benefit from Thames to Southern Transfer (T2ST) this was not completed at the time of upload of information to the WRSE investment model, this is therefore not included in the draft WRMP24 documents. The T2ST conjunctive use benefit will be reflected in the final WRMP24.

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
Raw Water Transfer (resource)	Oxford Canal - Duke's Cut (SWOX) - Resource	15	12	12	12	Scheme DO not reappraised between WRMP19 and WRMP24 See description of Oxford Canal options for London WRZ
	Oxford Canal (CRT BCN Surplus) - Farmoor Reservoir (SWOX)	15	n/a	n/a	n/a	Scheme DO not reappraised between WRMP19 and WRMP24 See description of Oxford Canal options for London WRZ
Raw Water Transfer (conveyance)	Severn Thames Transfer, Deerhurst – Culham: see London WRZ for sizes		n/a	n/a	n/a	
	Oxford Canal - Duke's Cut (SWOX) – Conveyance	15	n/a	n/a	n/a	
	Oxford Canal (CRT BCN Surplus) - Farmoor Reservoir (SWOX) - Conveyance	15	n/a	n/a	n/a	
New Reservoir	Abingdon Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	
	Chinnor Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Marsh Gibbon Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	
	Ludgershall Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List
	Aylesbury Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List
	Haddenham Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List
Groundwater	Moulsford 1	2	2	2	3.5	Scheme DO not reappraised between WRMP19 and WRMP24 Scheme DO not impacted by climate change
	Woods Farm Increase DO	2.4	2.4	2.4	2.9	Scheme DO not reappraised between WRMP19 and WRMP24 Scheme DO not impacted by climate change
Removal of Constraints to DO	Ashton Keynes borehole pumps - Removal of Constraints to DO	2	0	0	2.04	Scheme DO not impacted by climate change.
	Britwell Removal of Constraints	1.3	1.3	1.3	1.3	Scheme DO not reappraised between WRMP19 and WRMP24. Scheme DO not impacted by climate change
	Henley to SWOX – 2.4 Ml/d	2.4	n/a	n/a	n/a	

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
Internal Inter-Zonal Transfer	Henley to SWOX – 5 Ml/d	5	n/a	n/a	n/a	
	Kennet Valley to SWOX - 6.7 Ml/d	4.5	n/a	n/a	n/a	
	Kennet Valley to SWOX - 2.3 Ml/d	2.3	n/a	n/a	n/a	
Inter-Company Transfers	Wessex to SWOX Charlton WTW to Minety SR and from there to Flaxlands SR in South Swindon.	2.9	2.9	2.9	2.9	Note: earliest operational date for option is 2040.
SWA WRZ						
Raw Water Transfer	Severn Thames Transfer, Deerhurst – Culham: see London WRZs for sizes					
New Reservoir	Abingdon Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	
	Chinnor Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	
	Marsh Gibbon Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	
	Ludgershall Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Aylesbury Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List
	Haddenham Reservoir: see London WRZs for sizes and DO	n/a	n/a	n/a	n/a	Rejected at further screening, therefore not included on Constrained List
Groundwater	Taplow Increase DO	5.7	0	0	5.7	Scheme DOs not impacted by climate change. Tier 3 DO assessment, so DO benefit based on Source DO benefit.
	Datchet Increase DO	1.6	1.6	1.6	6.2	
	Dorney Increase DO	4.3	0	0	4.3	
Internal Inter-Zonal Transfer	Henley to SWA - 2.4 Ml/d	2.4 Ml/d	n/a	n/a	n/a	
	Henley to SWA – 5 Ml/d	5 Ml/d	n/a	n/a	n/a	
Guildford WRZ						
Groundwater	Dapdune Licence Disaggregation	2.2 Ml/d	0	0	2.2	Scheme DO not reappraised between WRMP19 and WRMP24. Not impacted by climate change.
Removal of Constraints to DO	Dapdune Removal of constraints to DO	1 Ml/d	0	0	1	Scheme DO not reappraised between WRMP19 and WRMP24. Not impacted by climate change.
Inter-Company Transfers	SEW to Guildford Hogsback SR (SEW) to Mount SR (TW-Guildford)	10Ml/d	10	10	10	Scheme DO not reappraised between WRMP19 and WRMP24.
	Reigate to Guildford - 5 Ml/d[29]	5 Ml/d	n/a	n/a	n/a	

[29] Reigate to Guildford option included in investment modelling however due to reliance on demand reduction option is currently considered to be high risk. Option has therefore not been assessed against feasibility criteria at this time. This will be further developed before the final issue of the WRMP.

Option type	Name	Capacity[17] (Ml/d)	Deployable Output Benefit (Ml/d) 1 in 2 average	1 in 500 average	1 in 500 peak	Commentary
	Reigate to Guildford - 20 Ml/d	20 Ml/d	n/a	n/a	n/a	
Kennet Valley WRZ						
Groundwater	Mortimer Disused Source (Recommission)	4.5 Ml/d	4.5	4.5	4.5	Scheme DO not reappraised between WRMP19 and WRMP24. Not impacted by climate change.
Removal of Constraints to DO	East Woodhay borehole pumps Removal of Constraints to DO	2.1 Ml/d	0	0	2.1	Scheme DO not reappraised between WRMP19 and WRMP24. Not impacted by climate change.
Thames to Southern Transfer	T2ST Spur: Culham to Newbury (Potable)	10 Ml/d	n/a	n/a	n/a	
	T2ST Spur: Culham to Fobney (Potable)	40 Ml/d	n/a	n/a	n/a	

System reinforcements

7.71 At WRMP19 cross-option studies were conducted to identify the water treatment, raw water system and treated water transmission reinforcements required to deliver the new resources into distribution. These are described below. In many cases the same system reinforcements are required for a number of different water resources and the timing of the need for the system reinforcements may also not coincide with the need for water resources. The system reinforcements were therefore developed as separate system elements that can be combined with water resource elements when developing an overall programme. Demand management options that are selected also have a significant impact on the requirement for additional system reinforcements.

7.72 The WRSE investment model is not, at present, able to distinguish between supply-demand balance benefits brought through new resources and those brought through demand reductions measures. This has implications for system reinforcement selection because, in a large conjunctive use zone such as London WRZ, the required amount of treatment is dependent on the volume of demand present, rather than the volume of resource present.

7.73 The approach taken in the WRSE investment modelling has been a conservative one in which new resource must be treated at new treatment elements (aside from a small 'spare' drought capacity associated with existing treatment assets), which in turn triggers network reinforcement elements. This means that required system reinforcement elements will be included, but that excess investment in the longer term may be being assumed in our resultant investment programmes.

7.74 An additional challenge in determining required system reinforcements is posed by the large, uncertain potential future licence reductions that have been developed into 'Environmental Destination scenarios. We do not yet know which sources will be subject to future licence reductions as investigations need to be carried out in AMP8 and AMP9 to determine which licence reductions would result in ecological benefits (see Section 5). Different future scenarios of licence reduction would, however, result in very different needs for system reinforcement.

7.75 The WRSE investment model considers each of our WRZs as a lumped entity and so is not able to distinguish between, for example, loss of licence at south east London groundwater sources or north east London surface water sources. The system reinforcement requirements associated with loss of over 100 Ml/d of licence in south east London (as could occur under some environmental destination scenarios) would be entirely different to those required to offset licence reductions at surface water abstractions in north east London, but due to the uncertainty associated with these licence reductions and the structure of the WRSE investment model we are not able to consider these system reinforcements within our optimisation exercise. We are able to consider additional required system reinforcements through subsequent 'post-processing' activities (see below) but cannot include these within the main optimisation exercise. Environmental Destination licence reductions would need to be made by 2050, and so we will have time to consider appropriate system reinforcements in the future, when we are able to observe how population growth and demand reduction has impacted demand at a sub-zonal level, alongside knowledge of which licence reductions will be required.

7.76 For options selected in the first 10 years of the plan period as part of the Best Value Plan, we will be updating our post-processing work to further consider which system support elements are required to enable these options to provide benefit to the system. The results of this work will be

made available as part of our final WRMP24. The environmental impacts of any needed support elements will be assessed as per our existing methodologies and the results incorporated into the HRA in-combination and SEA and WFD cumulative effects assessments of the preferred plan.

Water treatment cross option study

7.77 A cross-option study has been undertaken to investigate feasible options for additional treatment capacity. The WRSE investment model selects WTW based on the modelled water resource options that are selected. Two options have been identified in London, with sites at:

- Kempton WTW for additional resources from the west (e.g. SESRO, Severn Thames Transfer, Oxford Canal Transfer, Marsh Gibbon Reservoir), including a new connection into the Thames Water Ring Main (TWRM)
- East London WTW for additional resources from the east (e.g. Beckton and Deephams reuse) – this could entail redevelopment of the existing Coppermills works or development of a new WTW at alternative sites in East London, as there is no further space on the existing Coppermills site

7.78 For the SWOX WRZ two sites have been identified for additional treatment:

- Abingdon WTW for resources from the SESRO / Abingdon Reservoir
- Radcot WTW for resources from the Severn-Thames Transfer

7.79 For the SWA WRZ two options have also been identified for additional treatment of resources from either the SESRO / Abingdon reservoir or the Severn-Thames Transfer:

- Abingdon WTW for treated water transfer into the north of the SWA area via SWOX
- A new river abstraction from the River Thames and treatment works in the vicinity of Medmenham supplying the south of SWA.

Network reinforcement cross option study

7.80 A cross-option study has been undertaken to identify supply network reinforcement requirements for London. The report identified six interventions that could be required, including two extensions to the TWRM, with the necessary reinforcements dependent on whether the additional water resource is treated in east or west London. The network reinforcement requirements identified are:

1) Replace pump infrastructure at New River Head
2) Replace pump infrastructure at Barrow Hill
3) TWRM extension - Hampton to Battersea
4) TWRM level controlled by new header tank and pumping station at Coppermills WTW
5) TWRM extension - Coppermills to Honor Oak
6) Resolve issues with supply to Surbiton during TWRM outage

7.81 The matrix in Table 7 - 7 shows which of these reinforcements would be required for different combinations of new treatment capacity, depending upon whether the additional water resource is available for treatment to the east or the west of the existing TWRM. It can be seen that initially no reinforcement may be required. The precise timing of the requirement for individual network

reinforcements is optimised as part of programme appraisal but will also depend on the demand management options selected as part of the programme appraisal process.

Table 7 - 7: Network reinforcement requirements for additional water resources treated in east or west London

		East Ml/d								
		0	100	200	300	400	500	600	700	800
West (Ml/d)	0	-	-	5	4,5	4,5	4,5	4,5	1,4,5	1,4,5
	100	1	1	3,4,5	3,4,5	3,4,5	3,4,5	4,5	1,4,5	
	200	1,3	1,3	3,4	3,4,5	3,4,5	3,4,5	3,4,5		
	300	1,3	1,3	1,3,4	3,4,5	3,4,5	3,4,5			
	400	1,3	1,3	1,3,5	3,4,5	3,4,5				
	500	1,3,5,6	1,3,5,6	1,3,5	1,3,5					
	600	1,2,3,5,6	1,3,5,6	1,3,5,6						
	700	1,2,3,5,6	1,2,3,5,6							
	800	1,2,3,5,6								

7.82 Additional network reinforcement elements have been identified that are specific for individual options. These include:

- Tunnel from Beckton to Coppermills WTW for blending of water from Beckton and Crossness desalination options
- Tunnel from Crossness desalination plant site to Beckton to extend the Beckton-Coppermills tunnel to Crossness so that it can transfer resource from the proposed desalination plant at Crossness
- Pipeline from the proposed Abingdon WTW to Long Crendon to supply SWA

7.83 Further work is being undertaken to identify local supply network reinforcements required to accommodate growth however these interventions are outside the scope of the WRMP and so are not included as specific reinforcement elements.

Raw water system cross option study

7.84 A cross-option study has been undertaken to identify supply reinforcements required to the raw water system (between the point of abstraction and the WTW inlet) for the different water resource options. This is of particular relevance for options that augment resources in the River Thames or the River Lee (including new reservoir options, raw water transfers, effluent reuse and some direct river abstraction options). The study used currently available models of the raw water system for the River Thames and River Lee abstractions.

7.85 The study identified ten interventions that may be required, the most significant including an extension to the Thames Lee Tunnel, a second Spine Tunnel and additional conveyance from Queen Mary Reservoir to Kempton WTW. The necessity for the reinforcements will be dependent on the water resource options selected and whether they enter the raw water system in east or west London. The identified raw water system reinforcements, divided between east and west London, are:

East London

1) King George V Reservoir intake capacity increase
2) Chingford South intake capacity increase
3) Thames Lee Tunnel extension from Lockwood pumping station to King George V Reservoir intake
4) Thames Lee Tunnel upgrade to remove existing constraints to maximise transfer capacity (not shown in Table 7 - 8)
5) Additional conveyance from King George V Reservoir to break tank
6) Second Spine Tunnel from break tank to Reservoir 5 upstream of Coppermills WTW.

West London

7) Datchet intake capacity increase with transfer to Queen Mother and Wraysbury Reservoirs
8) Littleton intake capacity increase with transfer to Queen Mary Reservoir
9) Surbiton intake capacity increase with transfer to Walton inlet channel
10) Additional conveyance from Queen Mary Reservoir to Kempton WTW

7.86 The matrix in Table 7 - 8 shows which of these reinforcements are required depending upon the additional water resource added to the east and west London raw water systems. It can be seen that initially no reinforcement may be required. The precise timing of the requirement for individual reinforcements is optimised as part of programme appraisal.

Table 7 - 8: Raw water system reinforcement requirements for additional water resources in east or west London

		Additional Raw Water Resource in East (Ml/d)								
		0	100	200	300	400	500	600	700	800
Additional Raw Water Resource in West (Ml/d)	0	-	3	1,3,5	1-3,5,6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6
	100	-	3	1,3,5	1-3,5,6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	
	200		3	1,3,5	1-3,5,6	1-3, 5,6	1-3, 5, 6	1-3, 5, 6		
	300		3	1,3,5	1-3,5,6	1-3, 5, 6	1-3, 5, 6			
	400	7	3,7	1,3,5,7	1-3,5-7	1-3, 5-7				
	500	7/8,10	3,7/8,10	1,3,5,7/8,10	1-3,5-7/8,10					
	600	7/8,10	3, 7/8,10	1,3,5,7/8,10						
	700	7/8,10	3, 7/8,10							
	800	7/8,10								

7.87 For the Deephams Reuse option two alternative conveyances have been considered, depending upon whether the Thames Lee Tunnel extension is developed. If the extension is developed then Deephams reuse would discharge into it, otherwise a separate pipeline conveyance element has been included from Deephams to King George V Reservoir intake.

7.88 Additional potential raw water systems upgrades have been identified for Thames Valley WRZs:

- A new river abstraction from the River Thames to supply a new WTW near Medmenham, as above
- A new river abstraction from the River Thames to as an alternative supply to the existing Fobney WTW
- A new transfer from Abingdon WTW to Farmoor Services reservoir to transfer water from SESRO / Abingdon Reservoir

Further screening of water resource options

Approach to further screening

7.89 The water resource elements that passed the validation stage of the feasibility assessments form the Feasible List. Where these elements were subject to a combined limit or were mutually exclusive with another option they have then been subjected to a further screening stage to produce the Constrained List of options for investment modelling in the WRSE model. The further screening process used the WRSE investment model to identify options which performed well and were selected for a range of different planning scenarios.

7.90 This screening process brought together all water resource option types and compared them using a consistent set of criteria. Where options have been rejected an explanation is provided in the Rejection Register (Appendix Q: Scheme rejection register).

7.91 The further screening process compared water resource options using the WRSE investment model.

7.92 Backchecking was undertaken following completion of the SRO's appraisal of alternative options within the SROs. The backchecking reviewed the feasibility assessments in light of any new information and, where appropriate the feasibility assessments were updated. The SRO appraisals are presented in the Gate 1 and Gate 2 submissions. Any updates to the feasibility assessment as included in the WRMP24 Feasibility Report Addendums.

7.93 Backchecking was also undertaken following the inter-regional reconciliation of the regional plans to reflect any change in status of the options on the Feasible List.

7.94 Feasible options which meet the criteria for Option Further Screening are included in Constrained List of options.

Results of further option screening

7.95 To arrive at the Constrained List of options from the Feasible List, further option screening decisions have been made by analysing WRSE model scenario runs. Rather than imposing rigid rules to make screening decisions, the focus has been on ensuring that there is a clear and robust reasoning for each screening decision which has then been recorded in Appendix Q: Scheme rejection register and WRSE's exclusion record.

7.96 Options were further screened where they were subject to a combined limit, mutually exclusive with another option or required further stakeholder engagement (including inter-regional reconciliation) to confirm feasibility. Table 7 - 9 provides a summary of the options subject to a combined limit which were rejected at further option screening. Through this process the following option have been rejected and are not included on the Constrained List of options:

- Crossness Reuse
- Ludgershall Reservoir
- Aylesbury Reservoir
- Haddenham Reservoir

Table 7 - 9: Further Screening of options subject to a combined limit

Option	Commentary on further screening
Crossness Reuse (up to a capacity of 190 Ml/d)	Investigations at WRMP19 identified that the cumulative impact of developing multiple water reuse, desalination and DRA schemes could increase salinity in the Thames Tideway, resulting in moderate, probably reversible impacts on potentially sensitive ecological receptors as a result of disruption of communities. To mitigate this the decrease in freshwater inputs to the Tideway should be limited to no more than 275-366 Ml/d. The total additional capacity of water reuse and desalination options, that remove fresh water from the Thames Tideway, has therefore been limited to a maximum of 366 Ml/d in the regional water resources plan. Beckton, Crossness and Deephams indirect reuse options would all convey treated water to the same discharge location on the River Lee upstream of the intake to King George V reservoir. It is envisaged that indirect reuse at Beckton would require the construction of a conveyance tunnel from Beckton to Lockwood Shaft on the TLT Extension, while direct reuse would require a tunnel from Beckton to Coppermills WTW for blending. The water conveyance distance, whether to Lockwood Shaft or to Coppermills WTW is greater from Crossness than it is from Beckton and it is envisaged that the Crossness reuse treated water would be conveyed to Beckton STW from where it would utilise the same conveyance as Beckton Reuse. Deephams reuse could also utilise the Beckton reuse conveyance as it is expected to pass close to the Deephams site. The combined maximum capacity of Beckton and Deephams reuse options exceeds the 366 Ml/d combined limit. Crossness reuse has been rejected on the basis that there are more water reuse options than could reasonably be required and it is the least favourable reuse option measured against the cost dimension on the Feasible List. **Consideration of other options subject to the combined limit** Options have been included in the investment model such that supply up to the combined limit could be provided in full by either desalination or reuse. Crossness Desalination and Beckton Desalination options have therefore been included on the Constrained List without further screening. This is to allow the model with maximum possible flexibility in option selection.
Beckton Reuse (380 Ml/d)	Investigations at WRMP19 identified that the cumulative impact of developing multiple water reuse, desalination and DRA schemes could increase salinity in the Thames Tideway, resulting in moderate, probably reversible impacts on potentially sensitive ecological receptors as a result of disruption of communities. To mitigate this the decrease in freshwater inputs to the Tideway should be limited to no more than 275-366 Ml/d. The total additional capacity of water reuse and desalination options, that remove fresh water from the Thames Tideway, has therefore been limited to a maximum of 366 Ml/d in the regional water resources plan. The London Effluent Reuse SRO has therefore considered options up to 300 Ml/d for Beckton Reuse, however at WRMP19 a maximum capacity of 380 Ml/d was assessed as feasible. The 380 Ml/d option remains on the Feasible List while further work is ongoing to review the cumulative impact of options on the Middle Tideway salinity.

Option	Commentary on further screening
Ludgershall - 30 & 50 Mm^3	The options feeding into the upper Thames River are subject to a combined discharge limit of 600 Ml/d. This limit applies to STT, SESRO, Chinnor Reservoir, Marsh Gibbon Reservoir, Ludgershall Reservoir, Aylesbury Reservoir and Haddenham Reservoir. Scenario runs of the investment model were undertaken to assess which options within the combined limit are selected. STT and SESRO were selected as preferred options and in combination reach the 600 Ml/d discharge limit.
Aylesbury - 30 & 50 Mm^3	Marsh Gibbon and Chinnor have been included on the Constrained List to provide reservoir options up to the discharge limit, in combination with SESRO, this is to allow the model maximum possible flexibility in option selection. These reservoirs were selected in preference to Ludgershall, Aylesbury and Haddenham as they perform better against Stage 3 Feasibility criteria. Ludgershall, Aylesbury and Haddenham reservoirs have therefore been rejected at Further Screening.
Haddenham - 30 Mm^3	

7.97 Table 7 - 10 details the options which were rejected at Further Screening due to mutual exclusivity with other options. SESRO / Abingdon Reservoir (50 Mm^3 and 30 Mm^3 options) and River Lee DRA were rejected at Further Screening.

Table 7 - 10: Further Screening of options which are mutually exclusive

Option	Commentary on further screening
SESRO / Abingdon Reservoir– 50 Mm^3 SESRO / Abingdon Reservoir– 30 Mm^3	At WRMP19 SESRO / Abingdon Reservoir 30 Mm^3 and 50 Mm^3 options were rejected as these options would limit development of larger capacity options on the same site. This rejection reasoning was backchecked at WRMP24 and found to remain valid. The investment model continues to select larger capacity SESRO / Abingdon Reservoir options confirming the reason for rejecting these options. For further details on rejection reasoning refer to Appendix Q – Rejection Register.
River Lee DRA (New river abstraction from River Lee at Three Mills Lock and transfer to Lockwood Thames-Lee Tunnel Extension)	River Lee DRA is mutually exclusive with Deephams Reuse. At WRMP19 River Lee DRA was rejected following fine screening as Deephams Reuse was found to be the preferred option. This was backchecked at WRMP24. Deephams Reuse was again found to be the preferred option and River Lee DRA was rejected as a result. Neither Deephams Reuse of Lower Lee DRA can be delivered before 2060, this does not change the screening decision. For further details on rejection reasoning refer to Appendix Q – Rejection Register.
Cotswold Canal 100 Ml/d Cotswold Canal 300 Ml/d	At WRMP19 both 100 Ml/d and 300 Ml/d the Cotswold Canal STT was rejected by comparison with the Deerhurst Pipeline STT option for the following reasons: • Higher Normalised Cost

Option	Commentary on further screening
	• Greater operational complexity • Greater construction complexity • Higher risk of spread of non-native invasive species than the pipeline. For the RAPID Gate 2 design stage, a study was undertaken by STT SRO to identify a preferred Interconnector option which would provide 'best value' to water company customers when considering environmental and social impacts and benefits, resilience and cost. The study assessed a range of site and route options including direct pipeline options and other options utilising reconstructed sections of the Cotswold Canals supplemented with pipeline to create alternative route options. The assessment identified a preferred interconnector option, based on the information available at Gate 2 and subject to further engagement and public consultation, that would transfer water from the River Severn to the River Thames through a direct pipeline from Deerhurst to Culham (see STT SRO Gate 2 submission for more information). The study recognised that options that utilised reconstructed sections of the Cotswold Canals could provide opportunities for enhancement of tourism and recreation. However, it was concluded that selecting a canal-based option for water transfer would not provide best value, with a direct pipeline option: • Performing better overall against a range of environmental and resilience criteria • Having the lowest Net Present Cost (including monetised social, natural capital and carbon impacts and benefits), being approximately 25% cheaper than other options A further assessment was also undertaken to assess the potential opportunities for tourism and recreation that could be realised with the full restoration of the canal. This concluded that the additional benefits gained by integrating canal restoration with a water supply transfer are outweighed by the impacts and costs. To test this conclusion, across a range of different planning scenarios, the Cotswold Canal has been included in WRSE investment model. The investment model consistently selects the pipeline interconnector in preference to the canal interconnector. Furthermore, the draft WRSE best value regional plan selects a 400 or 500Ml/d capacity pipeline transfer in many scenarios, including the WRSE preferred

Option	Commentary on further screening
	plan (options incorporating sections of canal would be limited to 300Ml/d maximum capacity). The Cotswold Canal is therefore rejected at Further Screening. Whilst this reflects the assessment and findings for Gate 2 and WRMP24, before any final decisions are made and as part of any future phases of the STT development, the preferred option and other alternatives considered would be subject to further engagement and consultation with stakeholders and also reaffirmation/back checking.

7.98 Table 7 - 11 details the options which were rejected at Further Screening following further stakeholder engagement. Chingford Raw Water Purchase was rejected at Further Screening.

Table 7 - 11: Further Screening of options which requiring further stakeholder engagement

Option	Commentary on further screening
Chingford Raw Water Purchase -	Chingford is an existing agreement to export water from east London to Essex and Suffolk Water. There is an agreed reduction in the transfer that provides a benefit to London. This option is for continuation of the agreed reduction in the export quantities from 2035/36, providing c.20 Ml/d deployable output for London. Further discussions were undertaken with Essex and Suffolk at WRMP24. Through these discussions it was confirmed that Essex and Suffolk would not be able to continue the agreement, this option is therefore rejected from Thames Water's WRMP24 options. For further details on rejection reasoning refer to Appendix Q – Rejection Register.
Shrewsbury (STT Resource)	A backchecking exercise was carried out following reconciliation of the regional plans. Mythe and Shrewsbury are required to meet the needs of WRW and are therefore not available to WRSE. These options are therefore rejected at further screening and are not on our Constrained List.
Mythe (STT Resource)	

Constrained List

7.99 Programme appraisal has considered both resource elements from the Constrained List and system elements to provide the best value 50 year programme to address future water supply requirements. A summary of the elements included on the Constrained List is provided in Table 7 - 12 for the London WRZ and in Table 7 - 13 for the Thames Valley WRZs. The tables indicate how the system elements combine with each resource element to provide an overall supply option.

Table 7 - 12: Constrained List for London WRZs

Constrained List - London WRZ

Option Type	Resource Element		Conveyance Element		Raw Water System	Treatment Element	Network Element
	Location	DO DYAA Ml/d	Location	Nominal Capacity Ml/d		Location	
Water reuse	Deephams	42	Deephams to KGV	60	See raw water system matrix	East London	See network reinforcement matrix
			Deephams to TLT extension				
	Beckton 50 Ml/d	46	Beckton to Lockwood shaft	800		East London	
	Beckton 100 Ml/d	89					
	Beckton 150 Ml/d	130					
	Beckton 200 Ml/d	172					
	Beckton 300 Ml/d	252					
	Beckton 380 Ml/d	316					
	Reuse Mogden - 200 Ml/d	170	Mogden to Walton	200		Kempton	
	Reuse Mogden - 150 Ml/d	130					
	Reuse Mogden - 100 Ml/d	88					
	Reuse Mogden - 50 Ml/d	46					
	Reuse Mogden S Sewer	46				Kempton	
DRA	Teddington DRA – 50 Ml/d	46	Teddington Outfall	75	See raw water system matrix	Kempton & East London	See network reinforcement matrix
	Teddington DRA – 75 Ml/d	67	Teddington to Thames Lee Tunnel	75			
Raw Water Transfer	Vyrnwy	29/43/57/78/86/103	Deerhurst to Culham	300/400/500	See raw water system matrix	Kempton	See network reinforcement matrix
	Netheridge to River Severn	24					
	Minworth (Phase 1 and 2)	70					
	Oxford Canal	10.3					
Desalination	Beckton Desalination - 150 Ml/d	133	N/A		N/A	N/A	See matrix plus Beckton to Coppermills
	Beckton Desalination – 100 Ml/d	89					
	Beckton Desalination – 50 Ml/d	44					
	Crossness Desalination (Blended) – 300 Ml/d	267	N/A		Beckton-Crossness	N/A	As above plus Crossness to Beckton
	Crossness Desalination (Blended) – 250 Ml/d	222					
	Crossness Desalination (Blended) – 200 Ml/d	178					
	Crossness Desalination (Blended) – 150 Ml/d	133					
	Crossness Desalination (Blended) – 100 Ml/d	89					
	Crossness Desalination (Blended) –50 Ml/d	44					
New Reservoir	SESRO / Abingdon Reservoir - 150 Mm^3	271	N/A		See raw water system matrix	Kempton	See network reinforcement matrix
	SESRO / Abingdon Reservoir - 125 Mm^3	230					
	SESRO / Abingdon Reservoir - 100 Mm^3	185					
	SESRO / Abingdon Reservoir - 75 Mm^3	149					
	SESRO / Abingdon Reservoir Phased - 80 + 42 Mm^3	224 Ml/d (155.1 + 68.9)					
	SESRO / Abingdon Reservoir Phased – 30 + 100 Mm^3	238 Ml/d (65.5 + 173.1)					
	Chinnor Reservoir 30 Mm3	66				Kempton	
	Marsh Gibbon Reservoir - 75 Mm^3	149				Kempton	
	Marsh Gibbon Reservoir - 50 Mm^3	103					
	Marsh Gibbon Reservoir - 30 Mm^3	66					
Aquifer Recharge	AR/SLARS - Kidbrooke (SLARS1)	8	N/A		N/A	N/A	N/A
	AR Merton (SLARS3)	6					
	AR Streatham (SLARS2)	7					
Aquifer Storage and Recovery	ASR South East London (Addington)	3	N/A		N/A	N/A	N/A
	ASR Thames Valley/Thames Central	3					
	ASR Horton Kirby	5					
Groundwater	GW - Addington	2.7	N/A		N/A	N/A	N/A
	GW - London Confined Chalk (north)	2					
	GW - Southfleet/Greenhithe (new WTW)	8.8					
	GW - Honor Oak	1.4					
	Honor Oak Increase DO	1.7					
Raw Water Purchase	Didcot Raw Water Purchase	22.6	N/A		N/A	N/A	N/A
Catchment Management	Bean Wellfield (Groundwater)	0.1	N/A		N/A	N/A	N/A
	Green Street Green (Groundwater)	0.3					
	Wilmington (Groundwater)	0.2					
Inter-co. transfers			Cheam to Murton	15	N/A	N/A	N/A

Table 7 - 13: Constrained List for Thames Valley WRZs

Preliminary Constrained List - Thames Valley

	Option Type	Resource Element Location	Resource Element DO Ml/d ADPW	Conveyance Element Location	Conveyance Element Nominal Capacity Ml/d	Raw Water System	Treatment Element Location	Network Element Location
Swindon & Oxfordshire (SWOX)	Raw Water Transfer	Severn Thames Transfer (See London WRZ for support elements)	See London Constrained list table	Deerhurst to Culham	300 400 500	N/A	Radcot WTW 24 Ml/d each phase	Transfers to service reservoir included in WTW elements
		Oxford Canal	12	Dukes Cut to Farmoor	15			
	New Reservoir	SESRO / Abingdon Reservoir - 150 Mm3	271	Abingdon to Farmoor Reservoir (if treatment capacity not required	24	N/A		
		SESRO / Abingdon Reservoir - 125 Mm3	230					
		SESRO / Abingdon Reservoir - 100 Mm3	185					
		SESRO / Abingdon Reservoir - 75 Mm3	149				Abingdon SWOX WTW (if treatment capacity rqd) 24 Ml/d each phase	Transfers to service reservoir included in WTW elements
		SESRO / Abingdon Reservoir Phased - 80 + 42 Mm3	224 Ml/d (155.1 + 68.9)					
		SESRO / Abingdon Reservoir Phased – 30 + 100 Mm3	238 Ml/d (65.5 + 173.1)					
		Chinnor Reservoir 30 Mm3	66	N/A			TBC	TBC
		Marsh Gibbon Reservoir - 75 Mm3	149					
		Marsh Gibbon Reservoir - 50 Mm3	103					
		Marsh Gibbon Reservoir - 30 Mm3	66					
	Groundwater	Woods Farm Increase DO	2.9	N/A		N/A	N/A	N/A
		GW - Moulsford 1	3.5	N/A		N/A	N/A	N/A
	Removal of constraints to DO	Ashton Keynes borehole pumps	2.04	N/A		N/A	N/A	N/A
		Britwell	1.3					
	Inter-zonal transfers			Henley to SWOX	2.4	N/A	N/A	N/A
					5			
		GW - Mortimer disused source	4.5	Kennet Valley to SWOX	6.7			
					2.3			
	Inter-company transfer		2.9	Wessex Water to SWOX (Flaxlands)	2.9	N/A	N/A	N/A
Slough, Wycombe & Aylesbury (SWA)	Raw Water Transfer	Severn Thames Transfer# (See London WRZ for support elements)	See London Constained list table	Deerhurst to Culham	300/400/500	N/A New intake 80 / 53	Abingdon SWA WTW Medmenham WTW	Abingdon to north SWA Transfers to service reservoir included in WTW elements
		Oxford Canal	12					
	New Reservoir#	SESRO / Abingdon Reservoir - 150 Mm3	271	N/A		N/A	Abingdon SWA WTW	Abingdon to north SWA
		SESRO / Abingdon Reservoir - 125 Mm3	230					
		SESRO / Abingdon Reservoir - 100 Mm3	185					
		SESRO / Abingdon Reservoir - 75 Mm3	149			New intake 80 / 53	Medmenham WTW	Transfers to service reservoir included in WTW elements
		SESRO / Abingdon Reservoir Phased - 80 + 42 Mm3	224 Ml/d (155.1 + 68.9)					
		SESRO / Abingdon Reservoir Phased – 30 + 100 Mm3	238 Ml/d (65.5 + 173.1)					
		Chinnor Reservoir 30 Mm3	66	N/A		New intake 80 / 53	Medmenham WTW	
		Marsh Gibbon Reservoir - 75 Mm3	149	N/A				
		Marsh Gibbon Reservoir - 50 Mm3	103					
		Marsh Gibbon Reservoir - 30 Mm3	66					
	Raw Water Purchase	Didcot	22.6	N/A		New intake 80 / 53	Medmenham WTW	Transfers to service reservoir included in WTW elements
	Groundwater	Taplow Increase DO	5.7	N/A		N/A	N/A	N/A
		Datchet Increase DO	6.2					
		Dorney Increase DO	4.3					
	Inter-zonal transfers			Henley to SWA	2.4 / 5	N/A	N/A	N/A
Guildford	Groundwater	Dapdune licence disaggregation	2.2	N/A		N/A	N/A	N/A
	Removal of constraints to DO	Dapdune removal of constraints	1	N/A		N/A	N/A	N/A
	Inter-co. transfers			SouthEast Water to Guildford	10	N/A	N/A	N/A
Kennet Valley	Groundwater	GW - Mortimer disused source (recommission)	4.5	N/A		N/A	N/A	N/A
	Removal of constraints to DO	East Woodhay borehole pumps	2.1	N/A		N/A	N/A	N/A

Further option development for the Constrained List

Conceptual design

7.100 For water resource elements on the Constrained List, Conceptual Designs have been prepared[30]. The Conceptual Designs provide information on the location of the works, engineering and land requirements, dependencies with other elements, construction impacts, environmental and social mitigations, DO, programme assumptions and risks.

7.101 Conceptual Design were developed for options which are Further Screened in order to understand factors which are used in the model scenario runs including Deployable Output benefit (DO), lead time, Capital Expenditure (CAPEX), Operating Expenses (OPEX), costed risk, carbon impact, customer preference, environmental scoring and resilience scoring. Further details on the WRSE regional investment model can be found in the published WRSE draft regional plan documents.

7.102 The information gathered from the Conceptual Designs was used as the basis for updating cost estimates, developing a risk register, and for conducting the Environmental Assessment of options.

Cost and risk

7.103 For all elements on the Constrained List a review of feasibility stage costs was conducted. Costs were updated to reflect conceptual designs, where these have changed from the feasibility stage. Unit rates were updated for material cost items where confidence in the feasibility stage estimates was low. We take the conceptual design of an option and break it down into its constituent parts. We then take unit rates for the costs of different components of a water resources option, for example pumps, filters, and tunnels, and bring these together to estimate a total cost for each option.

7.104 The categorisation of options as standard or non-standard has been defined for WRMP24 by the All Company Working Group Cost Consistency Methodology to ensure consistency across Water Companies. Quantitative Cost Risk Assessments (QCRA) have been completed for all non-standard options on the Constrained List. A risk register was developed and estimates of likelihood and consequence of risks occurring (in terms of additional costs above those initially estimated) were assigned. Monte Carlo analysis was used to combine these estimates to provide a probability distribution for risk.

7.105 An allowance for optimism bias was applied to all elements at feasibility stage to reflect the potential cost implications of as yet unknown factors. This optimism bias assessment is based on the maturity of option design (there being greater potential for additional costs when option designs are immature) and our experience in delivering such options (a greater optimism bias being needed for more innovative option types where we may have underestimated cost elements based on our and/or UK water industry inexperience). The optimism bias allocation from the feasibility stage assessment for each option was scaled back to reflect the level of confidence around solution delivery at conceptual design stage. For elements where a risk allowance was applied from the risk register, the scaling back of optimism bias was revisited following completion of the risk register to avoid double counting of risk between optimism bias and the bottom-up

[30] Conceptual design has been prepared except in the case of Reigate to Guildford, Cheam to Murton and Thames to Southern Transfer spurs options where a need for new water resource was identified late in the planning process, this will be reviewed after the draft issue of the WRMP documents

allowance of risk identified through the risk register. Optimism bias was calculated using the All Company Working Group methodology.

Strategic environmental assessment

7.106 For all elements on the Constrained List an SEA was conducted. Further information on the Strategic Environmental Assessment appraisal (and all environmental assessments undertaken on our options) can be found in WRMP24 Section 9: Environmental appraisal. For options with sufficient information available, an HRA and WFD were also conducted, and NC and BNG assessments where these options are expected to change the land use of a site. INNS assessments were carried out in response to a risk assessment across our constrained list options identifying those that required more detailed assessment. These assessments were not undertaken for less mature options (new regional transfers and catchment options) because the option information currently available for these emerging options is not sufficiently detailed to make these assessments meaningful. We will develop this information as we continue to screen these options.

7.107 The environmental assessments have been used to help us identify any further mitigation required to reduce the impact of our options as needed. Should any of the options have failed these assessments as a result of not being able to sufficiently mitigate adverse impacts, they would have been rejected and placed on the rejection register.

7.108 We have included the costs of this mitigation within our option costs, as well as accounting for the cost of delivering 10% biodiversity net gain as mandated for options requiring planning permission. The cost of delivering 10% BNG has been accounted for within the optimism bias included within our option costs. We are working with WRSE to further develop our understanding of the costs and strategies available to us to deliver this gain. The environmental assessments of our options have been used to generate environmental metrics (SEA+, SEA -, BNG and NC) that have been used in the WRSE investment model to identify our Best Value plan.

7.109 For further detail on environmental assessments carried out please refer to Section 9. The suite of environmental metrics can be found in the Thames Water WRMP24 supporting information technical note: Environmental and Resilience Metrics Summary Table.

Resilience assessment

7.110 All of the elements on our Constrained List were subject to a resilience assessment in line with WRSE's resilience assessment framework. These assessments have been used to generate metrics that have been used in the WRSE investment model to identify our Best Value plan.

7.111 Environmental and resilience metrics have also been defined for feasible options where the investment model was used as part of further screening.

7.112 The suite of metrics (environmental, resilience, and customer preference) have been defined for supply-side options. For a description of the process followed to derive resilience metrics please see WRSE Resilience Method Statement Report. The suite of environmental and resilience metrics can be found in the supporting information technical note: Environmental and Resilience Metrics Summary Table.

Further investigations into Constrained List options

7.113 The options on the Feasible List and Constrained List are assessed as being feasible based upon existing knowledge. At this stage of project development, it is inevitable that uncertainties will exist and a number of investigations are ongoing to further reduce uncertainty.

Drought permits

7.114 We have identified a number of drought permit options that could be used to augment existing water supplies in the event of a severe drought. Drought permits are options that enable water companies to abstract more water than permitted by their abstraction licences. These options are only available in drought situations and require the water company to demonstrate that there has been an exceptional shortage of rainfall. They are initially issued for a six month period but may be extended for a further six months if the drought persists. These drought permit options are set out in more detail in our Drought Plan and its appendices[31].

7.115 In our WRMP19 we did not consider drought permits as options that we should rely on to provide security of supply, due to the fact that drought permit applications can be declined (i.e., these options do not provide a secure source of supply), and due to the negative environmental impacts that they bring. As such, we effectively rejected drought permits at the generic screening stage.

7.116 In line with updates to WRPG to permit the use of drought options as WRMP options, through the WRSE regional planning process we have engaged with the Environment Agency to identify those drought permits which we could reasonably consider as sources to rely upon in a drought in the shorter term and which have a minimal environmental impact, and so we have included a small number of drought permit options as supply-side options in our investment modelling.

7.117 The volumes associated with each drought permit are uncertain because the yields will be subject to the impact of the severe drought that would trigger their implementation. The Drought Plan provides an indication of the yield that would be expected from each option. An estimate of this yield has been produced for each feasible drought permit option, and the associated resource benefit volumes used for modelling of scenarios by WRSE. The drought permit options generally exist where we have water sources that are restricted or have been closed because of their potential to exacerbate low flows in rivers. Therefore, the options, in most cases, would have some adverse environmental impact if implemented. In each case the environmental impact has been assessed and Environmental Assessment Reports produced, and these have been used in the production of a Habitats Regulations Assessment and a SEA for the Drought Plan. These assessments have been used to generate environmental metrics for the WRSE modelling as above. The prolonged use of drought permits during severe drought events would be likely to cause significant environmental damage. This is discussed in our Drought Plan and Appendices.

7.118 These drought permit options do currently provide an important resource to ensure continuity of supply in the event of severe drought. It is also important to consider that the yield of these options would decrease through time as the drought severity intensifies. In addition, there is a risk that drought permits may not be granted or renewed for a further period of six months if the Environment Agency / Secretary of State consider the actual or potential environmental impact would be too great.

7.119 Our drought plan contains an assessment of actions that we would seek to take in the event of a severe drought. These actions include applying for and implementing drought permits. The assessment that we have undertaken for our drought plan assumes that we would apply for, and have granted, all drought permits that we could apply for, with a prioritisation process included whereby we would apply for less damaging permits first.

[31] Thames Water draft Drought Plan, 2022

7.120 To plan for a resilient water supply system that relies on the frequent use of drought permits is not appropriate in the long term, due to their association with environmental damage. We have appraised each of our drought permits to identify whether each of them would be reasonable to rely on in the shorter term, considering the potential for environmental damage that they pose. We have shared this appraisal with the Environment Agency and have agreed a small number of drought permits that could be relied upon in the short term, and these are therefore considered as options, as outlined in Table 7 - 14.

7.121 Aside from the small number of drought permit options identified through this process, these temporary supply options are not taken forward for inclusion in our programme appraisal. However, they do provide a short term unsustainable option which would need to be implemented in the event that a severe drought occurs in the near-term. We believe that, in the long term, alternative options should be developed to provide resilience to more severe droughts. In this respect our approach is consistent with that adopted by other water companies and set out in the Water Resources Planning Guideline.

7.122 Our WRMP24 ensures a reduction in the frequency of reliance on drought permits by increasing resource availability and becoming resilient to 1 in 200 year and 1 in 500-year drought events. The company will only rely on drought permits during severe drought events, i.e. events which, as they begin to unfold, suggest that they could be very severe in terms of the incidence of occurrence.

Table 7 - 14: Summary of Drought Permit Options

Drought Permit	WRZ	Yield (Ml/d), assumed as DO benefit for DYAA and DYCP conditions
Gatehampton	SWOX	3.5
Playhatch	Kennet Valley	4.1
Shalford	Guildford	5
Sheeplands/Harpsden	Henley	5.6

Demand Restrictions During a Drought Event

7.123 As described in our drought plan, during droughts, we seek to manage demand for water initially through media campaigns to increase awareness of drought, highlighting things that customers can do to use water more efficiently. We can also put in place temporary use bans (TUBs, previously known as hosepipe bans) to restrict water use and restrictions on non-essential use (NEUBs) by commercial customers. We lay out in our drought plan the maximum frequencies with which we expect to implement these measures, in accordance with customer preference; these are known as our Levels of Service.

7.124 The WRPG for this planning cycle, unlike at WRMP19, requires that we consider options related to our Levels of Service as feasible options to be considered through the options appraisal and programme appraisal process, rather than being incorporated into either our baseline demand or supply forecasts.

7.125 As such, we have calculated the benefits for these options and included them in our investment modelling as part of our constrained list of options. A description of these options for each Level of Service is below:

7.126 Level 1 (1 year in 5 on average)

- Media campaign: Wide-scale communications activity to encourage voluntary reduction in water usage

7.127 Level 2 (1 year in 10 on average)

- Temporary Use Bans (TUBs): 11 categories of use (largely domestic), banning the use of a hosepipe
- Enhanced media campaign: Enhancement of above activity

7.128 Level 3 (1 year in 20 on average)

- Non-Essential Use Bans (NEUBs): Application to Defra to grant 10 categories of non-essential use restrictions affecting commercial businesses

7.129 A full TUB would be implemented at Level 2 of our levels of service. This is aligned with all water companies in the south east who all implement TUBs as a Level 2 drought measure. We have worked with the other WRSE water companies to align our implementation of specific demand restrictions and associated exemptions.

7.130 An option per level for each WRZ was added to the constrained list of options to be considered in our investment modelling. All options were selectable by the model under 1 in 10 (average) and 1 in 500 (average and peak) scenarios, with dependencies built in such that media campaigns had to be selected first, followed by TUBs, followed by NEUBs.

7.131 We have assessed the benefit that we get from these options. For annual average conditions, this includes consideration of how long during a drought some measures would be in place (e.g., if an option has a 10 Ml/d impact but would only be implemented for half a drought, it would only have a 5 Ml/d benefit). In addition, we have considered that measures that we can implement during drought periods may have reducing benefits as society's overall water efficiency improves. The demand reduction we see during drought periods is associated with reduced discretionary consumption, and if people are generally more water efficient the benefit of reductions in

discretionary use will be reduced. Table X shows the benefits associated with these options at the beginning of our planning period. The benefit of these options over the planning period can be seen in our WRMP tables.

	L1 (Ml/d SDB benefit)		L2 (Ml/d SDB benefit)		L3 (Ml/d SDB benefit)	
	DYAA	DYCP	DYAA	DYCP	DYAA	DYCP
London	17.2	N/A	79.5	N/A	6.6	N/A
SWOX	2.5	10.8	10.5	40.0	0.7	3.5
SWA	2.8	5.7	8.2	21.2	0.6	1.9
Kennet Valley	1.8	3.7	5.2	13.7	0.4	1.2
Guildford	0.8	1.9	2.3	6.8	0.2	0.6
Henley	0.2	0.6	0.7	2.2	0.1	0.2

Existing transfers

7.132 We have included our existing intra-company transfers to help build connections within the WRSE investment model.

Table 7 - 15: Summary of Existing Transfer Options

Option Name	Option Description	Capacity (Ml/d)
Thames Water (SWA) to Thames Water (SWOX)	Potable Water Transfer - Thames Water (SWA) to Thames Water (SWOX)	1.91
Thames Water (Kennet Valley) to Thames Water (Henley)	Potable Water Transfer - Thames Water (Kennet Valley) to Thames Water (Henley)	1.78

Sources of further information

7.133 The following supporting information is available:

- Feasibility reports
  - WRMP19 Raw Water Transfer Feasibility report, Mott MacDonald, September 2018 and WRMP24 Raw Water Transfer Feasibility Addendum, Mott MacDonald November 2022
  - Groundwater Feasibility report, Mott MacDonald, September 2018 and WRMP24 Groundwater Feasibility Addendum, Mott MacDonald November 2022
  - New Reservoirs Feasibility report, Mott MacDonald, July 2017 and WRMP24 New Reservoirs Feasibility Addendum, Mott MacDonald November 2022
  - Water Reuse Feasibility report, Mott MacDonald, September 2018 and WRMP24 Water Reuse Feasibility Addendum, Mott MacDonald November 2022
  - Desalination Feasibility report, Mott MacDonald, February 2018 and WRMP24 Desalination Feasibility Addendum, Mott MacDonald November 2022
  - Direct River Abstraction Feasibility report, Mott MacDonald, September 2018 and WRMP24 Direct River Abstraction Feasibility Addendum, Mott MacDonald November 2022
  - Inter-Zonal Transfer Feasibility report, Mott MacDonald, February 2018 and WRMP24 Inter-Zonal Transfer Feasibility Addendum, Mott MacDonald November 2022
- Network Reinforcement Cross Option study, Mott MacDonald, January 2018
- Raw Water System Cross Option study, Mott MacDonald, January 2018
- Water Treatment Cross Option study, Mott MacDonald, January 2018
- Discharge Design Standards Cross Option study, Mott MacDonald, February 2018
- Operating Philosophy, Mott MacDonald, February 2018
- Conceptual Design Reports – these are available at our offices in Reading (Clearwater Court) by appointment
- Constrained List Scheme Dossiers, Appendix R
- A full list of related WRSE reports is available at https://www.wrse.org.uk/

7.134 Please contact consultation@thames-wrmp.co.uk for access to any of these documents.


Thames
Water