Strategic regional water resource solutions: Preliminary feasibility assessment

Gate one submission for South East Strategic Reservoir Option (SESRO)

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Note: visualisation of SESRO conceptual design

Contents

Glossary	
Scheme Partners	Affinity Water and Thames Water
Abbreviations	
AA	Appropriate Assessment (under the Habitats Regulations Assessment)
ACWG	All Company Working Group
AFW	Affinity Water
AIC	Average Incremental Cost
AOD	Above Ordinance Datum
AONB	Area of Outstanding Natural Beauty
BNG	Biodiversity Net Gain
BNL	Biodiversity Net Loss
CCW	Consumer Council for Water
CPO	Compulsory Purchase Order
DAF	Dissolved Air Flotation
DCO	Development Consent Order
DNO	Distribution Network Operator
DPC	Direct Procurement for Customers
ECI	Early Contractor Involvement
ENCA	Enabling a Natural Capital Approach
GAC	Granular Activated Carbon
HRA	Habitat Regulations Assessment
ICA	Instrumentation, Control and Automation
ITT	Invitation to Tender
IP	Infrastructure Provider
LWS	Local Wildlife Site
M&E	Mechanical and Electrical
MCC	Motor Control Centre
MEICA	Mechanical, Electrical, Instrumentation, Control and Automation
Ml/d	Mega (million) Litres Per Day
NAU	Environment Agency, National Appraisal Unit
NPS	National Policy Statement (on Water Resources)
NPV	Net Present Value
OA	Operational Agreement
OBC	Outline Business Case (for a DPC process)
Ofwat	Water Services Regulation Authority
PA2008	Planning Act, 2008
PINS	Planning Inspectorate
PMB	Programme Management Board
PS	Pumping Station
RGF	Rapid Gravity Filter
SEA	Strategic Environmental Assessment
SoR	Statement of Response
SoS	Secretary of State for Environment, Food and Rural Affairs
SRO	Strategic Resource Option
SSSI	Site of Special Scientific Interest
STT	Severn to Thames Transfer
TPO	Tree Protection Order
TW	Thames Water
WFD	Water Framework Directive
WRMP	Water Resources Management Plan
WRSE	Water Resources South East
WRW	Water Resources West
WRZ	Water Resource Zone
WTW	Water Treatment Works

1. Executive summary

Overview

1.1 The South East Strategic Reservoir Option (SESRO) provides storage and a resilient supply of raw water to the River Thames during periods of low flow, for release and subsequent re-abstraction in London or for transfer to other water companies in the south-east. The SESRO partners have worked collaboratively to review this proposal and used the SRO consistent technical methodologies issued by the All Company Working Group (ACWG) to appraise the scheme and can confirm that it should advance to Gate 2 for further analysis and refinement.

1.2 The resource from SESRO could be re-abstracted by existing / new infrastructure on the River Thames for supply to Thames Water (TW) and Affinity Water (AFW) and potentially also for Southern Water (SWS), through integration of the Thames to Southern Transfer SRO, or South East Water (SEW), through their existing surface water intake on the River Thames at Bray.

1.3 The six variants of SESRO that were defined during WRMP19 are reviewed for the Gate 1 work. This includes four single phase variants and two dual phase:

- The single-phase variants are defined by the capacity of the reservoir. The capacities under consideration are: 75Mm^3, 100Mm^3, 125Mm^3 and 150Mm^3.
- The dual-phase variants are being considered to investigate whether it is appropriate to bring Phase 1 online to fill the anticipated shorter-term deficit followed, at a later date, with a Phase 2 reservoir on the remainder of the site.

Key Facts, "At a Glance"

Parameter	Response for SRO	Section
Site Location	The reservoir site is located just south-west of Abingdon. The largest (150 Mm^3) footprint covers an area of just under 7 km^2.	4
Preferred option	The option chosen in WRMP19 was the largest (150 Mm^3) variant. This remains the most cost-effective solution. The results of the WRSE modelling are required to confirm SESRO's position within the optimal water resource solution for the south-east region.	10
Deployable Output (DO)	The different options could deliver a dry year annual average DO during a 1 in 500 year drought of between 68 Ml/d (30 Mm^3, Phase 1 of 2) and 293 Ml/d (150 Mm^3, single phase) for London. Modelling of the optimal combined operation of TW and AFW's supply systems shows promising initial results that could enhance the effective DO, as reported in the T2AT SRO Gate 1 submission. This will be developed further for Gate 2.	4
Earliest delivery date	Depending on size, SESRO could be available between mid-2036 and the end of 2037 (75 Mm^3 and 150 Mm^3 options respectively).	3
Cost	The largest single-phase option (150 Mm^3) has an AIC of £0.805 / m^3 and an NPV of £1.42Bn.	4, 10
Carbon	SESRO has a high embodied carbon footprint (lots of excavation required), but this can be mitigated through off-setting and implementation of low carbon construction techniques. The operational carbon is relatively low with limited power to refill and potential for energy recovery on release.	5, 10
Environmental Impacts	The scheme does have the potential for moderate adverse environmental effects. However, adverse effects can be addressed through mitigation. All options have the potential for a significant impact on the WFD	5

Parameter	Response for SRO	Section
	compliance of two waterbodies in the River Ock catchment, which will require further investigation as part of Gate 2. All options could provide a net increase in terrestrial biodiversity units of over 10% and a positive change in natural capital value at the site.	
Water Quality Risks	Measures have been identified to control all identified water quality risks. There are potential risks of algal growth within SESRO, but these can be mitigated through mixing. Modelling confirms that the discharge, in general, is likely to result in slightly better water quality in the River Thames.	5
Planning Issues	All SESRO options would qualify as Nationally Significant Infrastructure Projects (NSIP) and would therefore need to be consented through a Development Consent Order (DCO) under the Planning Act 2008 (PA2008).	7
Procurement	The two leading procurement options would be a late / very late DPC model or else a Joint Venture Collaboration between the partner companies.	6
Key Risks	The key risks identified for the scheme include programme risks associated with the integration of the WRSE, WRMP24 and subsequent DCO processes, risks with local stakeholder concerns and opposition, environmental risks with scheme consenting and planning risks linked to the NPS for Water Resources. Mitigation has been identified for all and further work to reduce uncertainty is planned for Gate 2.	9

Customer Preferences

1.4 Customers understand the need for large scale regional water resource solutions and, in principle, support the sharing water resources. However, customers have told us that companies need to get their "own house in order" prior to sharing resources. Customers prefer reservoirs to other new supply options, driven by familiarity and a view that reservoirs provided a 'natural' way to provide large volumes of water, as well as providing an asset for the local community with wildlife and amenity benefits alongside their functional purpose. The main concerns focused on cost, lead time, disruption during construction, land take and the impact on local communities.

1.5 This accords with our findings to date that SESRO offers significant opportunity for the sharing of water resources regionally, but will require very sensitive design and implementation to manage local stakeholder concerns and impacts.

Conclusions

1.6 The option proposed by both partners in their Final WRMP19, a 150 Mm^3 storage reservoir shared between TW's London WRZ and AFW's Central Region, remains at this stage of development, the preferred option. None of the investigations undertaken for Gate 1 change this conclusion although extensive further investigations are required to fully understand both impacts and benefits.

1.7 The wide range of alternative options at the site (different storage volumes and phased development) have been put forward to the regional WRSE modelling as alternatives, to test this previous preference and ensure the best value option is selected.

1.8 Our Boards have signed the Board Statement and recommend that development of the SESRO options should continue to Gate 2.

2. Solution description

Outline of the solution

2.1 The solution is for a fully-bunded raw water storage reservoir in the upper River Thames catchment. Water could be abstracted from the Thames during periods of high flow and pumped into the reservoir. When flow in the River Thames is low and water is required in London, water could be released back into the Thames for re-abstraction further downstream. SESRO could be used to supply various different customers across the south-east, including Thames Water (TW), locally and in London, Affinity Water (AFW), Southern Water (SWS) and potentially also South East Water (SEW).

Options and configurations

2.2 The six variants of SESRO that were defined during WRMP19 are retained for the Gate 1 work. This includes four single phase and two dual phase variants:

- Single-phase, with storage volumes of 75Mm^3, 100Mm^3, 125Mm^3 and 150Mm^3.
- Dual-phase, with storage volumes of 30Mm^3 + 100Mm^3 and 80Mm^3 + 42Mm^3

2.3 We have also considered an option to enable the direct refill of SESRO using raw water from the STT SRO, using water transferred from the Severn catchment.

Relevant diagrams and schematics

2.4 A schematic representation of the 150Mm^3 variant is provided in Figure 1. The 150Mm^3 variant is illustrated, to reflect the largest footprint.

Overall economic and carbon costs

2.5 Capital cost estimates of the option variants have primarily been based on the high-level estimates that have been developed for previous WRMP submissions with some review and updates made for Gate 1. The costs are documented in Sections 4 and 10. Section 14 includes details of the costs to deliver subsequent RAPID gateways.

2.6 The economic Net Present Value (NPV) of the single-phase options is between £1.42Bn and £1.17Bn[1]. The phased options are less cost-effective, allowing more gradual investment, but ultimately at a much higher economic cost.

2.7 The capex costs have been benchmarked against independent cost intelligence, as part of our assurance activities. The findings are included in Section 4.

2.8 All of the options have a relatively high embodied carbon footprint, due to significant earth movements required. These impacts can be mitigated (see Section 5). Conversely, the operational carbon is low per unit of water supplied as power requirements are low. Further details are provided in Section 10.

[1] Based upon a nominal 100% utilisation of the scheme

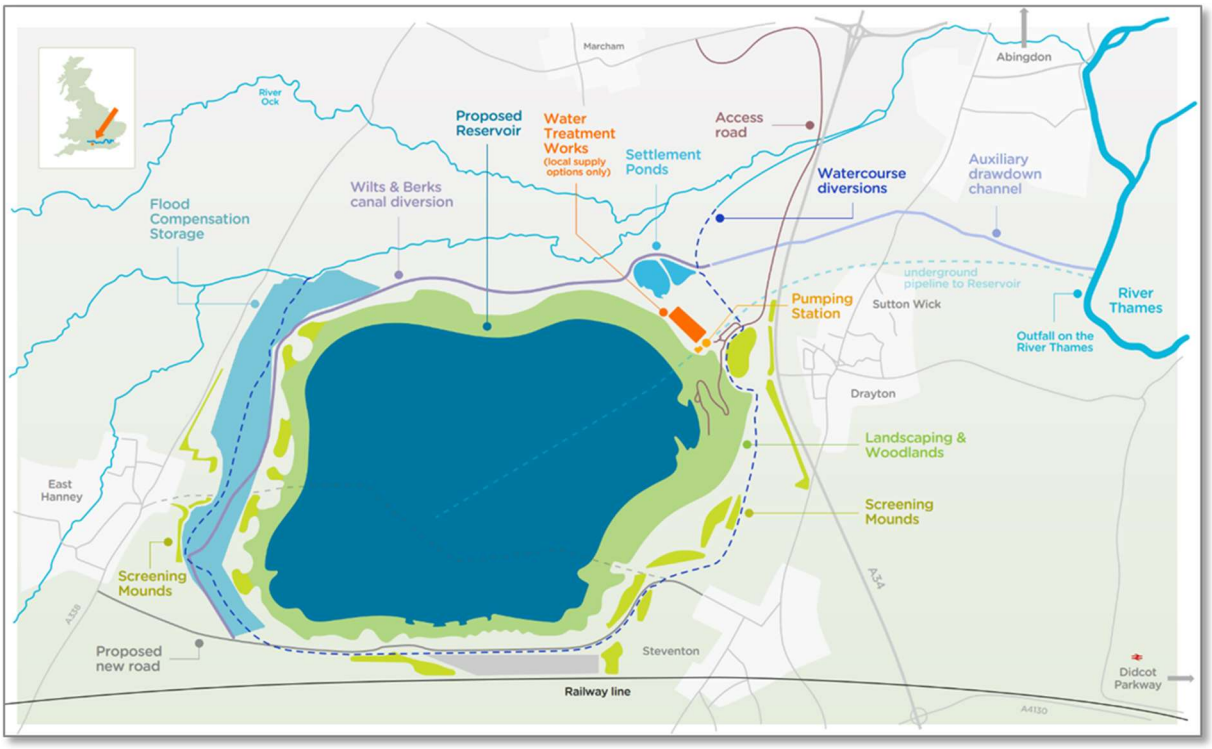


Figure 1 SESRO schematic illustration (150 Mm³ option)

Resource benefits

2.9 The different option configurations could deliver a dry year annual average deployable output for London during a 1 in 500 year drought of between 68 Ml/d (30 Mm³, Phase 1 of 2) and 293 Ml/d (150 Mm³, single phase). A summary is provided in Section 4.

2.10 As reported in the T2AT SRO Gate 1 submission (Section 4), initial modelling work concludes that the combined operation of TW's and AFW's systems indicates that if AFW needed 50Ml/d of DO from SESRO then this may actually only require between 25 and 45 Ml/d of the yield of the reservoir. Further work to explore and optimise this conjunctive use modelling is planned for Gate 2.

Social, environmental and economic assessment

2.11 As shown in Table 5, and common to all options, various moderate adverse environmental effects have been identified, particularly for the construction phase. However, many of these adverse effects can be addressed through mitigation. Further details can be found in Section 5.

2.12 The options do cause a physical loss of habitat for the River Ock catchment. There are two watercourses in the reservoir footprint which may experience a deterioration of WFD status and there is the potential for a derogation to be required under Article 4.7 of the WFD in respect of these two waterbodies. This will require detailed discussions with the Environment Agency and design of suitable mitigation for Gate 2. We will engage early and in detail with the EA and

other stakeholders in relation to such a derogation whilst continuing with optioneering, and will seek as far as possible to avoid any requirement for an Article 4.7 derogation.

2.13 However, habitat creation, including grassland and aquatic habitat, should result in a Major Beneficial effect on biodiversity across each of the reservoir options. A net increase in terrestrial biodiversity units of over 10% and a positive change in natural capital value could be achieved for any of the options.

Wider benefits

2.14 An assessment of wider benefits of SESRO has identified a wide array of opportunities to develop beneficial synergies between SESRO and other parties. We plan to develop a future collaborative partnership for the SESRO scheme.

Drinking water quality

2.15 Although a number of water quality hazards scored high in the risk assessment, nothing was identified that cannot be controlled or which undermines the feasibility of any of the options, at this stage. The water quality assessment has, however, validated the potential risks of algal growth within SESRO, which can be mitigated through mixing. In general, modelling shows that the discharge is likely to result in slightly better water quality in the River Thames.

Scheme interdependencies

2.16 SESRO is not itself dependent on any other SROs or other company options. However, there are other water resource options that could either benefit, or be dependent on, raw water supply from SESRO. Relevant options include:

- Thames to Affinity Transfer (T2AT) SRO: Depends on SESRO (or Severn to Thames Transfer (STT) or London Re-use) SROs for raw water resources.
- Thames to Southern Transfer (T2ST) SRO: A potential intake and a water treatment works on the SESRO site or use of shared raw water storage.
- Thames Water non-SRO options: Could rely on raw water stored at SESRO to supply WRZs in the Thames Valley including a WTW at the SESRO site.

2.17 A concept design has combined SESRO and STT, via a pipeline to enable STT to flow directly into SESRO. However, the modelling completed suggests that there would be no material water resource benefit from combining the two schemes.

National and regional planning context

2.18 The National Framework[2] sets out the challenge for water resources in England for the next generation, showing that if no action is taken by 2050 there is a regional need for public water supply in the South East of England of 1,765 Ml/d. This framework identifies the need for regional transfers to help meet this

[2] Environment Agency, 16/03/20, "Meeting our Future Water Needs: a National Framework for Water Resources"

challenge. The SESRO option provides a feasible way for large volumes of raw water to be stored and then utilised by various companies to manage pressures on public water supply in the South East.

2.19 The regional water resources plans are tasked with identifying the best value solutions to meet the national challenge. Through identifying a wide range of possible SESRO options at Gate 1, we have maximised the potential to identify a regional best value solution across the partner companies' supply areas.

3. Outline project plan

Programme overview

3.1 Up to Gate 1, the scheme development has proceeded to plan with all key milestones met, including regional submissions with WRSE.

3.2 On the basis that the water resources plan requires the scheme, and the critical dependencies and assumptions are resolved (see Table 2), then it is on track to proceed through the gated process to allow construction to start during Asset Management Plan (AMP) 8, 2025 to 2030. The outline programme to 2030 is illustrated in Figure 2 below. The key phasing of subsequent activities and decisions beyond Gate 1 are outlined in Table 1 below. More detail of the tasks to be completed for Phase 2 may be found in Section 15.

Table 1 Programme Phasing Overview (through to commissioning)

Phase	Description	Summary of activities and decisions
2	To RAPID Gate 2 in October 2022	Continued work on options refinement, scheme feasibility and concept design, with associated regulator and technical stakeholder engagement. Requiring the timely confirmation of the preferred option, timing and need for the scheme within both the WRSE regional plan and the Draft WRMP24 for both partners. This phase will also require the progression of the draft Statement of Case and value for money assessment for a DPC and the development of the overarching strategy and timeline for DCO application.
3	To RAPID Gate 3 in summer 2023	Development of the chosen option. Expected to include conclusion of the public consultation and subsequent approval of draft final WRMP24, subsequent notification of the DCO to the Planning Inspectorate (PINS), further outline design and initial EIA scoping studies and initial informal pre-application consultation for the planned DCO. It is planned that this phase will coincide with Ofwat's DPC control points B&C (approval of Statement of Case and Procurement timetable). It may be noted that the critical decision point for SRO progression was identified in both partner companies' WRMP19 documents was in 2023, during Phase 3.
4	To RAPID Gate 4 in summer 2024	Continued refinement and optimisation of the chosen option, including design development and refinement to reflect known impacts and stakeholder concerns, EIA scoping and commencement of EIA studies and additional informal pre-application consultation for the planned DCO. It is possible that direction for the publication of the final WRMP24 will be received during Phase 3, which would enable the acceleration of the formal consultation and DCO process. It is planned that this phase will coincide with Ofwat's DPC control point D (Ofwat's approval of the DPC ITT).
5	DCO application	Following publication of the partner companies' WRMP24, will include the formal consultation on and submission of a DCO application and the

Phase	Description	Summary of activities and decisions
		associated formal examination and decision-making process, followed by the Secretary of State's decision. During this period, the Outline Business Case (OBC) would be developed, enabling Ofwat's Control Point E to be approved and the procurement process to be started in parallel to the DCO application.
6	Final procurement	Ofwat's approval of the DPC Final Business Case (Control F) and subsequent award of a Competitively Appointed Provider (CAP) enabling scheme delivery to commence.
7	Construction & Commissioning	The draft construction programme identifies that, overall, a programme of approximately 10 years is required between the completion of the DPC / DCO process and the subsequent commissioning of the 150 Mm^3 SESRO option.

3.3 Our current plan therefore illustrates that construction is expected to commence in 2028, which assumes the 'worst-case' programme with publication of the final WRMP in 2025. Approximately 10 years is required for construction, which will enable the current preferred option to be commissioned in line with the required dates from WRMP19 of 2038. This earliest available date may be accelerated if a number of the constraints discussed in Table 2 are eased or avoided. Therefore, an earliest available date is defined between April 2036 and December 2037 (75 Mm3 and 150 Mm3 options respectively).

Dependencies and Assumptions

3.4 The delivery plan will be dependent upon a number of critical dependencies and assumptions, which will be monitored and managed through the programme risk management process. These are summarised in Table 2 below.

Progress review and lookahead to future RAPID Gates

3.5 The programme is on track to deliver the future RAPID gateways as originally planned. The publication of a final WRMP24 will influence the conclusions that can be drawn at Gates 3 and 4 regarding the need for the scheme and hence the timing of these reviews might need revision. This will be discussed with RAPID as part of the process to Gate 2.

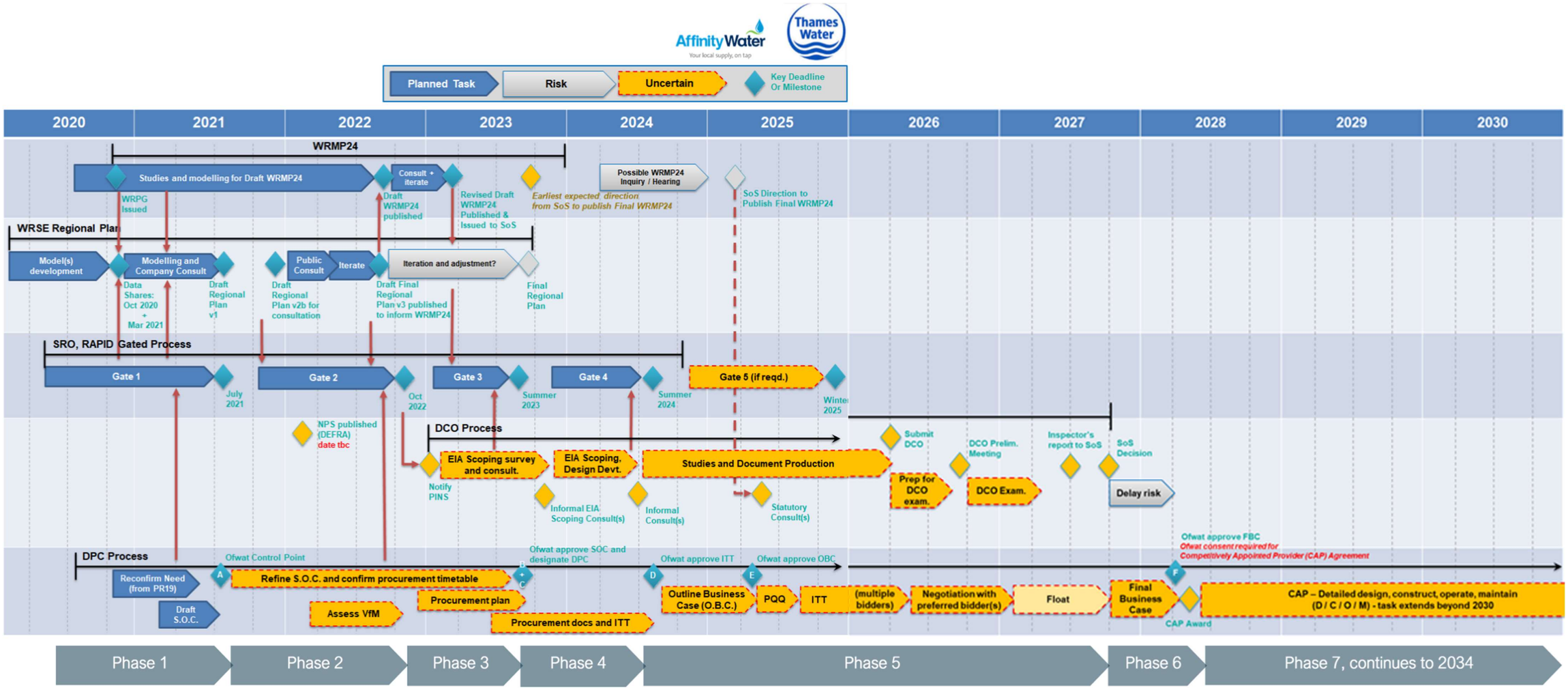
Issues and missing information

3.6 The dependencies and assumptions noted previously are to be explored and better understood ahead of Gate 2. There is no other critical missing data to report at Gate 1. The confirmation of the preferred option and the need for the scheme is to be provided by the WRSE regional modelling process during Gate 2.

Recommendation

3.7 The programme analysis work undertaken to support the Gate 1 submission, confirm that the scheme is feasible and can be delivered by the current required date of 2038 as set out in WRMP19. It is, therefore, recommended that the scheme continue to Gate 2, for the further assessment of the alternative options and scheme configurations, and assessment of these within the WRSE regional plan.

Figure 2 SRO Overview Programme to approval of DCO and appointment of CAP[3]



[3] Note: "Risk" refers to an additional activity that might need to occur; "Uncertain" refers to an activity that is expected to be required, but timing and duration are currently uncertain

Table 2 Key programme dependencies and proposed mitigation / action(s)

Critical assumption / dependency	Proposed actions and mitigations
The publication of the National Policy Statement (NPS) on Water Resources Infrastructure by Defra. The timing and content of this is currently uncertain. The NPS is expected ahead of Gate 2 and to confirm that the need for a scheme would be determined largely by the approved company WRMP.	Subject to an ongoing 'watching brief' by the scheme partners and their legal advisors
The timing of any direction by the Secretary of State to the scheme partners, to publish a final WRMP24, is currently uncertain. It is expected that this could be as early as Autumn 2023, occurring at the end of Phase 3. However, there is a risk that a formal Public Inquiry or Hearing process could delay the direction until Spring 2025. This is the worst-case scenario for our future programme.	Ongoing dialogue between the partner companies, the EA and Defra throughout the WRMP24 process, during Phases 2 and 3.
Based upon previous assumptions[4], it is assumed that the formal consultation on any DCO application would not commence until the partner companies had received direction to publish their final WRMP24. This results in an assumed DCO consultation commencing in March 2025 at the earliest, with a subsequent DCO application 12 months later; hence, an expected decision by the Secretary of State in the second half of 2027. This would mean that the scope of work associated with scheme consent applications that can be delivered in time for RAPID Gate 4 is reduced from that outlined in RAPID's published expectations.	We have taken legal advice on this matter and will continue to collect further information and refine our understanding of this issue during subsequent project stages. This assumption will continue to be challenged to assess whether the DCO application timing may be accelerated and clearly is dependent upon the timing of the final publication of WRMP24 noted previously.
It is expected that SESRO will provide a source of raw water for other regional transfers (e.g. the Thames to Affinity transfer SRO). The current transfer options rely upon a new source of raw water into the fluvial Thames or one of the London effluent re-use schemes. It is currently assumed that all of these options will also need to follow a formalised DCO consenting route and the DCO application for the transfer scheme will need to be pursuant (and probably subsequent) to that for the associated source water scheme. This means the exact timing of the DCO application is dependent not only upon the publication of the Final WRMP24 but also on the timing of the DCOs for any subsequent transfer schemes that utilise the shared water resources.	The current programme assumes that the DCOs will be largely concurrent, and this will be confirmed during Phase 2 once the scheme timings and interdependencies are confirmed by the WRSE regional modelling process.
It is currently assumed that Ofwat's approval point F, approval of the Final Business Case and final contract documents would need to be pursuant to the consenting (DCO) approval for the same scheme. In order to de-risk the future delivery programme, it will be necessary to start the formal procurement of a CAP (PQQ, ITT and negotiation) before the DCO is approved, but not appoint the CAP until the DCO is duly made. It is noted that this may bring significant additional commercial risk to bidders and to the partner companies if the procurement process was delayed or (in the worst-case) aborted, due to the DCO not being approved. However, this risk is considered acceptable at this stage to ensure future scheme delivery.	Will continue to collect further information on this matter as we develop the procurement strategy to Gate 2 (see Section 6). It is planned to discuss this issue with Ofwat, via RAPID, during Phase 2 to confirm their position on this dependency.
One possible option is that the scheme will be procured through a DPC process, following Ofwat's standard control points and process. A late or very late DPC is one of the leading options recommended in Section 6 of this report. However, as noted in Section 6, there are variant models (and alternatives) to be considered, but the current programme assumes that a late DPC model will be applied, subsequent to the securing of the scheme's DCO by the partner companies.	This will continue to be reviewed, as the commercial model is developed in Phase 2 and the subsequent programme dependencies challenged.

[4] [4] Thames Water, 2020, Final WRMP19, Section 11.259

4. Technical information

Alternative site selection and appraisal

4.1 The assessment of alternative sites for a raw water storage reservoir in the Thames Valley has been the subject of numerous previous studies[5]. The alternative locations did not have a choice of water sources, all needing to make use of the River Thames, and there was not a wide range of third-party beneficiaries between the options. As a result, this options appraisal was focused on limiting negative aspects to ensure the best site was identified.

4.2 The latest iteration of this study, which was undertaken for WRMP19, applied a common methodology to assess and screen potential options. With regard to the SESRO site, the conclusions reached were that:

- The assessment identified SESRO as the best performing site against the criteria, across all reservoir capacities from 30Mm^3–150Mm^3.
- For completeness, the next best performing site(s) were also taken through to the fine screening stage for further appraisal.
- At the larger reservoir capacity options (125Mm^3 and 150Mm^3), SESRO was the only available site option. Two potential alternative options were considered at a 100Mm^3 reservoir capacity.

4.3 The work undertaken for WRMP19 confirmed the recommendation that the SESRO site was the preferred solution for a major strategic regional option with a storage volume > 125 Mm^3. Consequently, no further review has been undertaken for the SRO for the submission to Gate 1. However, the 2017 Reservoir Feasibility Report has been reviewed and updated by Thames Water as part of their preparatory work for WRMP24. Ahead of Gate 2, when the Final NPS on Water Resources is published by Defra, we will review the previous site selection work and consultation against the new requirements of this legislation, to ensure compliance and robustness.

Configuration and Operation of SESRO

4.4 The SESRO concept consists of the following main elements:

Element	Relevant details
Abstraction from the River Thames and Jetting into the Reservoir	Water would be abstracted from the River Thames to the south of Abingdon and conveyed to the reservoir site via a large diameter conveyance tunnel. A pumping station, constructed at the toe of the embankment, would pump the inlet water under the embankment and into the reservoir via a jetting system to assist mixing.
Storage of water within a Fully Bunded Reservoir.	For all options the storage reservoir is formed from clay sourced from a borrow pit in the reservoir basin. Careful design of the embankments has ensured that there is no need to import or export large quantities of clay from the site. Due to the existing topography the embankment heights vary from between 15m and 25m above natural ground level. Additionally, as is typical for this type of dam construction, sand and gravel will form

[5] Arup, "Reservoir Site Selection Study Report", September 2006 and Mott MacDonald, "Thames Water WRMP19 Resource Options: Reservoir feasibility report, July 2017.

Element	Relevant details
	internal filters and drainage to intercept seepage. On the inner face of the embankment 'riprap' would be placed as erosion protection from waves. The materials required for these aspects will need to be imported. A temporary railway siding is proposed (for freight train deliveries), to reduce the number of HGVs.
Water quality management	While there will be natural circulation of water within the reservoir, there is a risk that poor mixing could result in water quality deterioration and algae growth. The jetting of water into the reservoir (described above) will enhance the natural circulation of reservoir water and aid mixing. Additionally, air diffusers on the reservoir bed are included to further assist mixing.
Release from the Reservoir and Discharge into the River Thames	Water can be released from the reservoir at one of three separate outlet towers. This provides flexibility when deciding where within the reservoir water can be released to the River Thames, depending on the quality at any given time. Water is transferred by gravity back to the River Thames, via energy recovery turbines.
Emergency Drawdown of the Reservoir	Guidance from the EA and DEFRA[6] advises that reservoir design should enable rapid emergency drawdown. For SESRO, 1m depth of drawdown per day is recommended. This drawdown would discharge to an Auxiliary Drawdown Channel (ADC), hence conveyed to the River Thames. There is an opportunity for the final 3.3km section of the Wilts and Berks Canal restoration to be designed in a way that would allow it to be used dual-purpose, for both recreational navigation and also as the ADC.

Design Development since WRMP19

4.5 The design of the major components of SESRO has not significantly changed since WRMP19. Work carried out for Gate 1 has focused on studies to reduce uncertainty related to three main aspects – flood risk review, rail access and movement strategy. The key findings from the assessments are provided in Table 3 below.

Option costs and carbon footprint

4.6 The NPV, AIC and carbon footprints of the different options are documented in Section 10.

4.7 The Risk Register, that was developed during WRMP14 and updated for WRMP19, has been revisited for Gate 1 to estimate risk values for the most critical risks. The risk approach that has been used is in line with the Cost Consistency Methodology Technical Note[7]. Both the costed risk value and the cost optimism bias[8] have been incorporated into the SESRO cost submissions to WRSE, consistent with other options and SROs.

[6] Guide to drawdown capacity for reservoir safety and emergency planning, DEFRA Doc ref: SC130001, 2017
[7] Cost Consistency Methodology, Technical Note and Methodology, Mott MacDonald
[8] The HM Treasury's Green Book (HM Treasury (2018), The Green Book – Central Government Guidance on Appraisal and Evaluation) defines optimism bias as the "tendency for appraisers to be over-optimistic about key project parameters".

Table 3 Summary of key findings from flood risk, rail access and movement strategy work packages for Gate 1

Study	Key Findings
Flood Risk	• Flood risk modelling has been undertaken using an existing model of the River Ock catchment provided by the EA. The model was reviewed, run for the baseline scenario without the reservoir and then updated to include the reservoir. Previous flood risk modelling undertaken for the SESRO project was based on a 1D hydraulic model, the Gate 1 review has used a more accurate 1D-2D model. • The update of the hydraulic model (from 1D to a 1D-2D) has demonstrated that the construction of SESRO results in a slight reduction in flood risk to Abingdon rather than the previously identified increase in flood risk. This is because an increased accuracy in the modelling technique and the fact that rain falling on the reservoir surface is effectively removed from the River Ock catchment. • However, replacement flood storage has been retained in line with Environment Agency guidance for development. The area required for level-for-level replacement floodplain storage (RFS) has been revisited based on the updated flood risk model. The assessment has increased confidence that there is sufficient space on the west side of SESRO for relatively shallow excavation to provide sufficient RFS. However, further development of the design will be required in consultation with geomorphologists and ecologists to confirm this conclusion. • There is potential for the access road from the north to be used as a flood embankment either as part of an Abingdon Flood Alleviation Scheme (FAS) or a wider Thames Valley Flood Strategy. This has been investigated within the current flood model and will be further explored in consultation with the EA during the next stage of design development taking into consideration the EA's wider aspiration for flood alleviation for the Thames catchment.
Rail Access	• The review of potential rail network capacity constraints, which included liaison with Network Rail, identified that there are possible train paths to the SESRO site and has improved confidence in the feasibility of using freight trains to deliver construction materials to the site. The current analysis (based on WRMP09 quantity estimates) indicates that a maximum of two trains per day are required to deliver materials, therefore, existing freight train paths could be considered. If new paths are required (i.e. further design work indicates that more than two trains are required during certain periods of the construction), of the 10 available paths identified 4 are between 06:00 and 21:00 and 6 are between 21:00 and 06:00. • The review highlighted that the Great Western Main Line transitions from a four-track railway to a two-track railway several kilometres to the west of the rail siding identified in previous WRMPs. Extension of the four-track railway to the railway siding would have benefits for maintaining rail capacity during construction but would increase the scheme cost. A potential alternative site for the railway siding has been identified to reduce the length of four-track railway extension required. These potential locations will assessed further for Gate 2.
Visitor Access	• The existing public transport routes / cycle routes / public rights of way around the site have been mapped to inform future access planning. • A high-level estimate of the number of visitors that SESRO could attract has been conducted. This has used information on similar sites and an assessment of the population living within different drive-time catchment areas to the site. • The alignment of the Access Road has been revised to create further separation between the junction and existing road interchanges, following engagement with Oxfordshire County Council (OCC). Junction modelling has been undertaken (making use of the visitor number estimation) to inform the required junction design needed to reduce impact on the existing road network. • The alignment of a required road diversion across the site has been revised following consultation with OCC. The western junction of this realigned road has been moved south, to be closer to the potential future Wantage and Grove train station to help facilitate non-road access.

4.8 The variable operating cost associated with operating SESRO relates to the pumping required to fill the reservoir. These will vary from year to year depending on the need to refill the reservoir and the availability of water. The annual energy required for pumping will be partially offset by energy recovery turbines; based on previous studies, it has been assumed that 33% of the pumping energy can be recovered during release.

4.9 The asset life classes for water resource planning as outlined in the WRSE guidance[9] have been applied. These vary between 10 years for instrumentation, control and automation, 100 years for pipelines and tunnels, with the largest being 250 years for the main embankment works.

4.10 Estimates of the embodied and operational carbon footprint of each option have been derived. These are summarised in Section 10.

Cost Benchmarking

4.11 The capex costs for a selection of the options have been benchmarked against independent cost intelligence. Over 70% of the principal items associated with the scheme have been benchmarked. The capex costs for the options were found to be within 5% of the average benchmark costs, and hence deemed acceptable and reasonable for this stage of the project.

Water resource benefits

4.12 The DO benefit for SESRO options has been calculated using the 'Tier 1' approach outlined in WRSE's published method statement[10].

4.13 Current water resource guidelines and practices focus on the calculation of DO at a 'system' level, as opposed to individual source level, recognising that sources may act in a conjunctive way. In particular, the EA's Water Resources Planning Guideline supplementary note states that '1 in 500' deployable output should be defined using 'system response'. The DO assessment for SESRO options follows this principle, and as such is not assessed as a standalone source, but as part of a wider water resource system. DO is initially calculated for London without SESRO (known as baseline DO), and then again with SESRO. The DO benefit ascribed to the SESRO option is then the difference between the two DO values that have been found[11]. A summary of the outputs of this modelling work is provided in Table 4 below.

[9] WRSE Options Appraisal – Guidance on option identification, screening and development' (Mott MacDonald, 2020

[10] WRSE, July 2020, "Method Statement: Calculation of deployable output." Consultation version

[11] A difference in the calculation methodology followed since WRMP19 is the DO benefit of SESRO has been found for 'one-zone' (London) only. The methods previously used to determine the DO benefit for SWOX potentially double-counts benefits associated with effluent returns. SESRO, as a regional resource, would not be used as a 'one-zone' resource. However, significant uncertainty exists around how SESRO would be operated and so a simple approach is used, to give a relatively conservative value for the DO benefit.

Table 4 DO summary (1 in 500 year drought, Dry Year Annual Average)

Option variant	1 in 500 year, DYAA (Ml/d)
150Mm^3	293
125Mm^3	244
100Mm^3	195
75Mm^3	155
30 + 100Mm^3	68 / 186
80 + 42Mm^3	163 / 75

Data provided to WRSE

4.14 The cost, carbon, lead-time, deployable output and dependency data for all options have been submitted into the WRSE options database. In addition, the options have been assessed by WRSE to determine environmental metrics associated with each component. These metrics have been aligned to the findings and data within this Gate 1 report, to ensure consistency.

4.15 Overall, the data provided to WRSE enables each of the shortlisted options to be considered against all other options, to enable the selection of the WRSE Best Value Plan

5. Environmental and drinking water quality considerations

5.1 Environmental assessment has been undertaken in accordance with the methodology in the ACWG and WRMP environmental assessment guidance.

Strategic Environmental Assessment

5.2 The SEA Objectives for SESRO were derived from those provided by the relevant ACWG guidance[12]. Many of the effects identified by the SEA level options assessment, both beneficial and adverse, are the same for all reservoir options. The key moderate or major residual impacts (after mitigation), both positive and negative, are summarised in Table 5.

[12] Mott MacDonald, 2020, "All Companies Working Group, Strategic Environmental Assessment: Core Objective Identification"

Table 5 Summary of moderate or major residual environmental impacts for all SESRO options

Objective	Phase	Assessment	Rationale
Biodiversity	Construction	Moderate adverse	Impacts on habitats and species within reservoir footprint and across nearby county wildlife sites. While retention and enhancement of priority habitats within the option boundary are prioritised, it has been identified that Priority Habitat and woodland within the footprint of the reservoir will be permanently lost, including the deciduous woodland Priority Habitat features of the CWS.
Biodiversity	Operation	Moderate adverse	Significant potential impact on water bodies within the R.Ock catchment with regard to loss of main watercourse and many contributing ditches and flow changes (see WFD assessment below). As a result, the scheme has the potential to cause a deterioration in WFD status for these particular waterbodies.
Population and Human Health	Construction	Moderate adverse	Loss of residential and commercial properties, transport infrastructure and energy and community facilities within reservoir footprint.
Soil	Construction	Moderate adverse	The reservoir options fall predominantly within Grade 3 and 4 agricultural land, however it does also cover a small area of Grade 2 land. All reservoir options would lead to the permanent loss of agricultural land, including that which is considered Best and Most Versatile (BMV) and short-term loss of top soil.
Air	Construction	Moderate adverse	There are two AQMA within 2km. Construction is likely to have minor and temporary impacts on air quality as a result. There are also no Noise Action Planning Important Areas within the reservoir boundary however these are present immediately adjacent from both road and rail sources. Construction traffic associated with the reservoir is likely to compound noise issues at noise sensitive locations.
Cultural Heritage	Construction	Moderate adverse	Listed buildings and scheduled monuments in close proximity to each of the reservoir options and the reservoir boundaries are also immediately adjacent to a listed building. There is therefore potential for the setting of these historic assets to be affected during the construction phase. There is a high likelihood of encountering previously undiscovered archaeological assets as a result of construction activities.
Landscape	Construction	Moderate adverse	The construction of the reservoir would result in landscape and visual impacts, mitigation measures will be implemented to avoid, reduce and minimise loss or disturbance.
Biodiversity	Operation	Major Beneficial	Delivered through a commitment to Biodiversity Net Gain and the provision of habitat creation, including grassland and aquatic habitat of a higher nature conservation value than those lost.
Population and Human Health	Operation	Major Beneficial	Visitor facilities for water and land based recreation and amenity, education facilities would contribute to improved health and wellbeing from recreation, access to new greenspace, as well as opportunities for community cohesion. Will provide significant contribution to securing resilient water supplies for the health and wellbeing of customers.
Water	Operation	Moderate Beneficial	Will help contribute to increased resilience of Public Water Supply (PWS) and natural systems to droughts and help reduce abstractions in more vulnerable areas and during times of low flow, further increasing the resilience of water supply.
Climate Factors	Operation	Moderate Beneficial	Each of the options will increase resilience of the environment by having capacity to release water into river during low flow and drought conditions and may indirectly help reduce abstraction in more vulnerable areas that would be exacerbated by drought conditions. All of the options have a relatively high embodied carbon as it is a very large infrastructure scheme requiring significant earth movements and construction of large structures. However, the operational carbon is relatively low for the size of the scheme. The reservoir stores water for use in dry years and therefore pumping into the reservoir (with consequent power / carbon use) is an intermittent activity. Aeration / mixing equipment in the reservoir would be used more regularly to maintain water quality, but the operational carbon footprint overall, taking account of the energy recovery on discharge, is relatively small.
Landscape	Operation	Moderate Beneficial	Landscape-led design and mitigation strategy ensure embedded mitigation, good environmental design integration, and an environmentally sustainable development that will contribute to an overall improvement in the landscape surrounding the reservoir. The design and mitigation strategy will aim to connect the reservoir design into the landscape, protecting the landscape character and identifying opportunities for landscape improvements and enhancements, whilst taking into account the views and visual amenity of key receptors.
Material assets	Operation	Moderate Beneficial	Operationally, the reservoir presents a significant asset in terms of recreation, water resource, attracting development and increasing tourism potential in the local and wider area.

5.3 The SEA (nor the associated HRA) does not include an in-combination assessment, as the combination and timing of options is uncertain at this stage. The types of in-combination impacts that will require consideration include those between different SROs (e.g. sharing resources or creating cumulative impacts in the same catchment) or between the SRO and local development plans (which may cause cumulative construction impacts or unforseen operational issues). An in-combination assessment will be completed for the WRSE plan. We will review and develop the findings in our revised environmental assessments for Gate 2.

Habitats Regulations Assessment

5.4 The Gate 1 HRA comprises Stage 1 Screening in accordance with the ACWG guidance[13], excluding the effects of mitigation. A draft version of technical analysis has been shared with Natural England (NE) prior to the Gate 1 submission.

5.5 All options are within 10 km of three European (SAC) sites[14]. There are no SACs designated for more mobile species (bats) within 30 km of the Scheme. None of the options has a Likely Significant Effect (LSE) on any of these SACs, with the exception of Cothill Fen SAC, which was screened in due to a potential risk from saline groundwater intrusion. An Appropriate Assessment was carried out for impacts on this site, which has demonstrated that there is no pathway for adverse effects due to the nature of the local topography, hydrology, geology and hydrogeology. Given this, in-combination effects can also be ruled out. Therefore, the project will not have an adverse effect on the integrity of the Cothill Fen SAC.

5.6 Once an option has been selected and the HRA updated to reflect scheme development, we will review the need for an in-combination assessment and if necessary, consider other SROs, plans and projects in relation to the Scheme. This reassessment will be undertaken in consultation with NE ahead of Gate 2.

Water Framework Directive Assessment

5.7 In total ten WFD surface water bodies, in both the Ock and Thames catchments, have the potential to be impacted by the construction and operation of all reservoir options. Other WFD water bodies can be screened out at this stage. All options have the potential to conflict with the objectives of WFD to varying degrees.

5.8 The WFD water bodies within the River Ock catchment and the River Thames (Evenlode to Thame) are all screened in for further assessment. Of particular note, the impacts on two water bodies in the R.Ock catchment were given a high impact score prior to mitigation.

[13] Mott MacDonald, 2020, "ACWG, WRMP environmental assessment guidance and applicability with SROs"
[14] Cothill Fen SAC, Hackpen Hill SAC and Little Wittenham SAC

- Waterbody (a): Due to physical habitat loss of tributaries and ditches. Even after mitigation, the high impact score is retained and there is a risk of deterioration in the status of both watercourses within this waterbody. Detailed discussions with the Environment Agency have not been possible at this stage and the means of mitigating the impact on this water body has not yet been defined. Further work is planned ahead of Gate 2 to explore both the impacts of the scheme, the potential mitigation available and the resultant position of the Environment Agency on the proposals.
- Waterbody (b): Linked to the re-distribution, and change of flow volumes from the diverted watercourses, which could have a detrimental impact on this water body. These impacts could be mitigated through changes to the scheme design.

5.9 In summary, the WFD assessment has concluded that there is a potential risk of WFD non-compliance[15] for these two water bodies, regardless of the option, and there is the potential for a derogation to be required under Article 4.7 of the WFD in respect of both. All other WFD water bodies have been deemed as compliant.

5.10 We will engage early and in detail with the EA and other stakeholders in relation to such a derogation whilst continuing with optioneering, and will seek as far as possible to avoid any requirement for an Article 4.7 derogation. Detailed mitigation and compensation proposals will be discussed and developed in liaison with the EA ahead of Gate 2. In addition, to improve the comparable impacts of the different options, a more detailed impact assessment will be undertaken as part of Gate 2.

Invasive Non-Native Species (INNS) Risk Assessment

5.11 For all options, the reservoir site itself would be considered a 'medium risk'. However, the full removal of all recreational activities from the site would reduce this to 'low' risk[16]. Further work is needed for Gate 2 to balance the risk of INNS transfer and the potential cost of biosecurity measures with the large socio-economic benefits that can be gained from allowing recreation at the reservoir.

5.12 All of the raw water transfer aspects were considered a 'medium' risk to the reservoir itself and the River Thames. This is due to unmitigated movements of water into and out of the reservoir during refill and release. Suitable mitigation will be explored ahead of Gate 2.

Biodiversity Net Gain (BNG) Assessment

5.13 An initial assessment of BNG has been undertaken for all options, using the WRSE methodology[17]. The WRSE Assessment is based upon the terrestrial

[15] at risk of failing WFD objective 1 which is 'to prevent deterioration of any WFD element of any water body – in line with Regulation 13(2)a and 13(5)a.'

[16] Recreational activities, especially those in the aquatic environment, present an elevated risk to the transfer of INNS

[17] Mott MacDonald, June 2020, "WRSE Regional Plan Environmental Assessment Methodology Guidance"

footprint only and excluded watercourses. However, watercourses are expected to be lost as a result of the reservoir scheme. Therefore, an additional BNG assessment for watercourses was carried out.

5.14 A net increase in terrestrial biodiversity units of over 10% could be achieved for all options[18]. Habitat creation opportunities have been identified, but as design progresses refinements could include rewilding to create added value.

5.15 Each option results in a net loss in watercourse biodiversity units (rivers and ditches). Watercourse biodiversity units will need to be gained within the site boundaries or mitigation sought in impacted water bodies or within the wider catchment to deliver net gain. This will be considered as the design and configuration of the watercourse diversions around the site are developed.

Natural Capital Assessment (NCA)

5.16 The main conclusions of the SESRO Gate 1 NCA were:

- All options demonstrate an overall positive change in natural capital value, although there will be lag after construction to realise this gain. This is largely due to the significant increase in recreation value at the site.
- The 75 Mm^3 and 100 Mm^3 options exhibited the largest net positive change, due to the combination of changes in specific ecosystem service values, in particular their lower losses in food production (due to smaller footprint).

Assessment of opportunities for net zero carbon contributions

5.17 As detailed in Section 10, SESRO has a high embodied carbon footprint. The analysis undertaken indicates that earth moving accounts for over half of the construction carbon. These impacts can be mitigated through offsetting and implementation of low carbon construction techniques. In contrast, positively, the operational carbon is relatively low.

5.18 Opportunities to reduce carbon and support net zero carbon objectives include:

- Use of low carbon construction plant and lower carbon intensity construction materials. Pursuing change in this area is likely to have the most significant impact on the carbon footprint of the scheme.
- Further consider potential for local low carbon initiatives such as recycling construction materials or provision of on-site EV charging.
- Where possible, engage the supply chain to start to remove barriers to lower carbon alternative options ahead of construction phase.

[18] At the time of writing the draft Water Resources Planning Guideline supplementary guidance sets out an expectation that plans, and therefore logically projects such as SESRO, deliver BNG and environmental gain and use a natural capital approach of assessment. Thames Water has committed to a 10% improvement in BNG for new projects like SESRO. While no target level of net gain is set within current law, it is of note that the Environment Bill would, if enacted, result in a net gain target of 10%.

Comparison between options and summary conclusions

5.19 There are moderate adverse effects from the construction of the scheme that will require further investigation as part of Gate 2. There are no significant differences in the strategic environmental effects between the options.

5.20 None of the options would have an LSE on designated European sites.

5.21 All of the options have the potential to conflict with the objectives of WFD to varying degrees. The larger schemes have the greatest compliance risk, particularly on certain waterbodies in the Ock catchment.

5.22 A net increase in terrestrial biodiversity units of over 10% could be achieved for any of the options. Habitat creation opportunities have been identified, but as design progresses refinements could include rewilding to create added value.

5.23 All options demonstrate an overall positive change in natural capital value compared to the baseline. The 75 Mm^3 and 100 Mm^3 options exhibited the largest net positive change.

5.24 The highest embodied carbon footprints are for the largest options, with the single-phase options being better overall than the dual-phase options.

Initial drinking water quality risk assessment (WQRA)

5.25 The WQRA process has been applied in accordance with the methodology developed by the ACWG Water Quality Risk Framework Report[19]. This initial RA is based upon existing water quality monitoring data; insufficient reliable data exists from the SRO procured monitoring programme. Targeted monitoring is ongoing and that data will be used to update the WQRA for Gate 2.

5.26 The key limiting hazards identified for SESRO include Escherichia coli and other pathogens, iron and manganese associated with the resuspension of dissolved metals from the reservoir, pesticides pumped into the reservoir, taste due to biological activity in the reservoir (algae and macrophytes) and other algal products including toxins. These key hazards are identified that determine the principle actions required to control the risks.

5.27 Control measures have been identified, to apply in the catchment or at the intake (raw water transfer or to a treatment works). These include controls on reservoir management, treatment of raw water, INNS, abstraction timing and wider monitoring or catchment activity. The detailed application of such control measures will be considered for Gate 2.

5.28 Ahead of Gate 2, there will be a need to integrate the WQRA with those for the raw water transfer, treatment and distribution for companies receiving the raw water and with the WQRA for any other associated SROs (e.g. the STT). This will be done once the regional WRSE modelling has identified the likely combinations and sequencing between options.

[19] Jacobs, ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 |

6. Initial outline of procurement and operational strategy

Procurement strategies considered

6.1 This strategy considers a range of potential procurement options for the scheme, including all varieties of the Direct Procurement for Customers (DPC) model. Due to the current early stage of scheme development, the strategy does not provide a definitive recommendation for a single procurement option, but does summarise and justify a preferred 'direction-of-travel' to take forward to Gate 2 for further development.

6.2 A range of possible procurement models for delivery and operation were considered and 'workshopped'. For each, we have mapped the risk allocation between parties, and compared this with the key commercial risks identified.

6.3 To assess the suitability of the different procurement models, we have used the criteria set out by Ofwat for the assessment of DPC suitability and adapted this for the other models considered. To provide some insight into the value-for-money of different models, we have used a high-level commercial risk and pricing assessment. The results are shown in Table 6. At this early stage, the leading options are a late / very late DPC model or a collaboration JV.

Scheme Ownership

6.4 In summary, with the exception of IP models, 'ultimate accountability' resides with TW and AFW under all models considered. 'Day-to-day control' could reside with different parties under different options within most models, but further clarity on the preferred operational regime is needed to determine the specific implications of this for the SESRO scheme. The 'day-to-day control' aspect of ownership needs further discussion with Ofwat as the scheme develops to determine the preferred approach.

Developing the procurement strategy

6.5 Key next steps to progress the procurement strategy towards Gate 2 include:

- Further development of the operational regime and implications for the preferred procurement strategy, including how often the reservoir is likely to be used for supply, requirements for turnover of storage water, and how challenging environmental constraints on filling will become over time as weather patterns change.
- More comprehensive, detailed commercial risk appraisal of the key technical, delivery and operational risks of the scheme, their mitigations, and whether they are best managed by TW, AFW or the supply chain.
- Further investigation of the value-for-money analysis of different procurement models, particularly focusing on supply chain operational capability. This should include scenario-testing (e.g. different drought conditions, scenarios where other SROs are delayed or don't deliver as expected or significant delays during construction).

- Market engagement with design, construction, equipment, operations, and finance providers will commence after Gate 2 once scheme 'go-ahead' is more certain. However, light-touch, targeted early engagement around specific commercial aspects may be useful before Gate 2.

Table 6 Assessment of Procurement Models

Procurement Models	Assessment of Procurement Models for SESRO	Rating
Typical current models	SESRO is a £multi-billion Totex investment across a 25-year lifecycle. It is likely that this would be a significant investment for one water company to carry on their respective balance sheet. It is foreseeable that the function of the reservoir may also introduce some challenge in developing the inter-company regulatory, operational, and commercial arrangements to enable the reservoir to operate as a resource for resilience for multiple companies across the South East of England.	
Early DPC	The workshop process agreed that there would need to be significant early involvement from water companies in the early stages of developing this project. This would be significant for gaining appropriate consents, overcoming early stakeholder objections, land access, environmental impacts, potential for public enquiry, early design feasibility, and managing public perceptions. The early DPC model would require planning risk to be transferred to the CAP, which would not deliver value-for-money as significant planning work has already been undertaken.	
Late/Very Late DPC	These models avoid the need to transfer planning risk to the CAP, which is the key disadvantage of the early DPC model. Previous value-for-money undertaken by Thames Water indicates that the DPC model could offer good value-for-money. Note that this analysis needs to be reviewed to ensure that it fully considers the complexity of operating a multi-party reservoir; however, at this stage the late/very late DPC models are considered likely to be well-suited to the SESRO scheme.	
Split DPC	Similar to the 'Early' DPC model, the split DPC model would require planning risk to be transferred to the CAP, which would not deliver value-for-money as significant planning work has already been undertaken.	
Collaboration JV	Collaboration between water companies through the creation of a Special Purpose Vehicle could 'compartmentalise' scheme commercial risk investment risk and offer some financial protection. It will also enable capability of both water companies to be cooperatively applied, and the flexibility to involve the supply chain where appropriate, through the project life-cycle to overcome the early planning risks through to construction.	
IP Model	This would require a licenced service provider which, through the size of the scheme, would need regulatory endorsement. At this stage, there is no existing legal framework for the SESRO scheme to have its own licence, therefore this model is not considered feasible.	

Anticipated operational utilisation

6.6 The anticipated utilisation of SESRO under different operational scenarios is discussed in Table 7 below.

Table 7 Discussion of expected operational utilisation for different scenarios

Condition	Expected operation
Normal years	For much of the time, SESRO would remain full, with abstractions and discharges made to meet sweetening flow requirements only. As such, at the beginning of a dry period, there is an expectation that SESRO would be full.

Condition	Expected operation
Moderately dry year or increased demand or reduced supply (e.g. sustainability reductions at existing groundwater sources)	Releases would be made from SESRO to support flows in the Thames such that greater abstractions could be made in the Lower Thames to keep reservoirs in the Lower Thames fuller for longer. These releases would likely be from 1-6 months, beginning in around April-June, and ending in around October-December (depending on antecedent conditions and when rain arrives). When this moderately dry period ended, abstractions would then be made to fill the reservoir once again.
Extremely dry period (first summer)	Likely to begin with a dry winter (at the end of a first dry winter SESRO would be full) and drawdown likely beginning in March/April, continuing through the year. Releases may continue through a dry winter if required, perhaps ceasing for a period, as winter flows in the River Thames are often high enough for significant abstraction to take place, even during drought periods.
Extremely dry period (second summer)	Should a dry period continue, releases would then continue through a second summer period. The currently assumed SESRO release rate allows for around 16 months of consecutive releases to be made, and so SESRO would likely be empty (or nearly empty) by the end of a 24 month severely dry period.
Non-drought periods or emergency outage support	The SESRO solution is not explicitly designed to operate during times of non-drought peak demand, for example during incidents or as part of formalised emergency response. However, if the resource was available when required then it could be deployed at relatively short-notice (4 days travel time to London is assumed) to assist with short-term outage or peak demand periods in London. If connections are developed to other resource zones, then water availability to assist with short-term outage would be more readily deployable.
Planned outage support and unplanned maintenance resilience	Additionally, SESRO would also enable support to wider maintenance planning particularly around existing storage reservoirs. The storage volumes available in SESRO, during periods of normal demand, should be high and therefore could be used to support supplies in London during planned (or unplanned) maintenance of the existing Lower Thames Reservoirs. This would enable one of the existing reservoirs to be drawn down and taken out of supply for a planned outage of up to 18 months should such planned maintenance be scheduled. However, the reduction in storage during planned outage could undermine the drought resilience of SESRO and this risk trade-off will be explored as part of the operational strategy ahead of Gate 2. Additionally, as TW's existing reservoir stock continues to age, inevitably the likelihood of unplanned maintenance activity becomes greater. The additional storage in the Thames system will provide additional supply resilience to help manage this unplanned future maintenance risk.

6.7 Given that WRZs which will rely on SESRO are as yet uncertain, and dependent on the outcome of the WRSE investment optimisation process, the current scenario assumes primary use for London. Should there be other WRZs which make use of SESRO, the operation above may include additional releases made to support abstractions in other zones, and a reduced release to London. The optimisation of this operation under different severities of drought and climate change conditions will continue to be investigated during subsequent project phases and reported at RAPID Gate 2.

7. Planning considerations

7.1 All of the SESRO options qualify as Nationally Significant infrastructure Projects (NSIP) and are therefore to be consented through a Development Consent Order (DCO) under the Planning Act 2008 (PA2008).

7.2 In summary the DCO provides a route designed for the delivery of large-scale national infrastructure projects, the ability to include a range of consents, rights and powers within a single DCO (including land acquisition), more programme certainty and a decision framework focused on national policy and need. However, it does come with a more onerous and lengthy pre-application process and a lack of post-submission flexibility.

Key planning steps and risks

7.3 The key consenting risks and suggested mitigation for SESRO are summarised in the table below.

Table 8 Key consenting risks

Risk	Mitigation
Demonstrating the 'need' case for the project	Ensure compliance with the NPS; WRSE/WRMP24 adoption; Ensure emerging NPS policy continues to establish the need.
Unable to secure desired consents within the DCO	Identify the list of secondary consents required and able to be included in a DCO at an early stage (Gate 2 consideration). Begin to communicate these to stakeholders (especially regulators) early
Inadequate EIA	Identify project requirements, description and flexibility as early as possible to enable effective EIA scope.
Inadequate pre-application consultation	Ensure compliance with the PA2008 and regulations. Production of a high quality Consultation Report
Post-consent approvals / conditions	Embed flexibility in the scope of the EIA and DCO. ECI can add significant value in framing the scope of the DCO.
Appeals and Judicial review	Ensure all information is well evidenced, justified and reasoned, being built on a robust need case that has been had stakeholder engagement.
Land acquisition	Produce a robust compulsory acquisition strategy; Ensure purchase of all property can be justified as being essential for the project.

7.4 The key planning tasks to be completed ahead of RAPID Gate 2 include review of WRSE options appraisal, best value planning methodologies and previous site selection studies for SESRO and ensure compliance with NPS requirements, producing a Planning consent strategy (which includes defining the project for DCO and EIA purposes) and developing strategies for critical aspects such statutory DCO consultation requirements and public engagement through a Statement of Community Consultation and the definition of an aligned approach for land acquisition.

Programme and relationship with RAPID, WRSE and WRMP24

7.5 The current consent programme for SESRO assumes a 5 – 6 year programme for development and planning deliverables.

7.6 It is appropriate for the widerDCO consultation and engagement strategy (including formal statutory consultation under the PA2008 process) to occur following the publication of the draft WRMP24 (quarter 4 2022), which aligns with post Gate 2 of the RAPID Gated process.

8. Customer and stakeholder engagement

Customer engagement completed ahead of Gate 1

8.1 We participated in a research programme coordinated by WRSE, involving nine water companies, to examine customers' understanding of water resources and the need for regional solutions. This coordinated approach ensured feedback was comparable across regions and solutions and was cost efficient.

Summary of Customers' Feedback

8.2 The research provided evidence on customers' understanding of the need for regional water resource solutions and the level of support for sharing water resources. The key findings from this research were:

- Customers are positive to collaboration on long term planning for water;
- Customers place a high priority on environmental protection;
- There is "in principle" support for sharing resources, although companies need to get their "own house in order" prior to sharing resources;
- Reservoirs are the most preferred of new supply options due to familiarity, and a view that reservoirs are a 'natural' way to provide large volumes of water. They are also an asset for the local community with wildlife and amenity benefits alongside their functional purpose. The main concerns focused on cost, lead time, disruption during construction, land take and the impact on local communities.

Stakeholder Engagement

8.3 A new reservoir in Oxfordshire has been considered for more than two decades and most recently the reservoir has been promoted in AFW's and TW's WRMP19s. Over this lengthy period there has been extensive engagement with national and regional stakeholders, and local communities, and as such we have a good understanding of both concerns and potential opportunities, and this has been the foundation of our work programme and engagement plan with stakeholders to Gate 1.

8.4 Our engagement plan has two parts: firstly, activity to inform the development of the SE regional plan to ensure stakeholders understand how SESRO, and other SROs, fit within the strategic planning framework; and secondly, SESRO specific discussions.

8.5 WRSE has an on-going engagement and consultation programme to support the development of the South East regional plan and South East company's WRMP24s. In 2020, the focus of the programme was on the building blocks of the plan (e.g. planning policies and technical methods) and in 2021 the engagement has broadened to focus on feasible solutions and the approach to determine the best value plan. Consultation on the draft plan is scheduled early in 2022.

8.6 To guide SESRO specific discussions to Gate 1, the focus has been on legal, regulatory, and strategic issues which could prevent the scheme progressing or substantially change the design of the scheme. An overview of the engagement undertaken is presented in .

8.7 Table 9.

Table 9 Overview of engagement on SESRO to Gate 1

1	Scope of interest	Activity to date
Environment Agency (EA)	Water quality and environmental monitoring and assessment including the requirements of, and compliance with, the WFD.	NAU monthly progress meetings to facilitate collaborative working and ensure timely discussions on key technical studies (water quality and ecological monitoring, hydrological assessments, and flood risk review).
Natural England (NE)	Legal and regulatory requirements with respect to the natural environment	
DWI	Compliance with drinking water quality legislation and ensuring water quality risks are properly assessed and evaluated.	Meetings held to discuss the WQRA methodology, the monitoring programme, and the potential risks to drinking water quality and supply issues. Discussion on monitoring for Gate 2 including consideration of emerging contaminants and algae.
Historic England (HE)	Protection of the historic environment.	Initial discussions on the scope, method, and timing of work on issues of cultural heritage and archaeology. This has also been in collaboration with the OCC County Archaeologist.
RAPID	Responsibility for overseeing the work to examine the SROs and for administering the Gated process	Active engagement to update and introduce general options analysis and more detailed discussions on approach to customer and stakeholder engagement.
CCG / CCW	Protecting customer interests, ensuring plans and schemes are developed with customer engagement and input.	WRSE Regional CCG meet regularly to input into WRSE customer engagement (including SRO engagement)
Oxfordshire County Council and Vale of White Horse District Council	Strategic planning including the assessment of need, as well as early engagement on design including transport, landscape and archaeology impacts and wider economic, environmental, and social opportunities.	Biannual meetings to provide an update on the overall programme of work, supported by topic specific meetings to aid coordinated and collaborative planning. Topics covered include strategic transport planning, flood risk, and archaeology.

1	Scope of interest	Activity to date
Network Rail	Rail network capacity and infrastructure requirements	Discussion on the use of the rail network, covering capacity and infrastructure, to enable the transit of materials to and from the site during the construction period
Wilts and Berks Canal Trust (WBCT)	Potential impact on the future of the canal's restoration and routing.	Re-engagement to share the relative programmes of work for SESRO and WBCT and discuss opportunities for collaborative working and outcomes.
Wider stakeholder community	There is wide interest from a range of perspectives. Affinity Water and Thames Water host a quarterly Water Resources Forum to provide information and opportunity to input to the development of the regional water resources plan and WRMP24s. Specifically, with respect to solutions, a series of workshops were held in May and June 2021 including sharing work to date on SESRO.	

Stakeholder and customer engagement proposed to Gate 2

8.8 At this point, the evidence base we have from our customer research can primarily inform on: (a) customer understanding of the need for large scale regional water resource solutions; and (b) the level of support – in principle – for sharing water resources and the SRO proposals as they stand. Further research is planned with customers to address the main issues and concerns. It will include the following topics:

How we communicate the **efficient use of resources** for customers. Companies will need to demonstrate and communicate current and future levels of leakage and water use within their own and recipient companies' areas.	**Service levels** - customers in donor companies want reassurance that the long-term viability of sharing water does not come at the expense of deteriorated service. We need to look at how we communicate the wider strategic movement of water.
Water quality. Assurances are needed about safety and reliability of raw water storage and of transferred water and whether their supply will change.	**Scheme design, construction, and operation**. Customers want more information on the reservoir design including costs and operational strategy as well as environmental impact and opportunities.

Targeted Stakeholder Engagement

8.9 On-going engagement is planned through WRSE and WRMP24, including the selection and prioritisation of solutions. There will be public consultation on the regional plan in January 2022. This provides an integrated approach between the WRSE consultation, subsequent WRMPs and leads into scheme specific consultation on the SRO that may follow.

8.10 Continued engagement will occur with regulators and strategic stakeholders to ensure legal, regulatory, and strategic issues are identified and fully addressed.

8.11 Recognising the potential for wide regional and local social, economic, and environmental benefits, beyond providing a resilient and sustainable water resource, we will also develop a plan to enable active participation in the co-creation of the design of the reservoir with regional and local stakeholders, for implementation after Gate 2.

9. Key risks and mitigation measures

Risk Register

9.1 The risk register for the programme consists of two specific elements:

- The overarching **Programme Risk Register**, as reported to RAPID through the quarterly reporting process. This provides a register of programme level risks to the overall delivery of the scheme or to the achievement of the strategic outcomes.
- The detailed **Costed Risk Register**, which provides the breakdown of key construction phase risks that may have a material impact on the costs of the scheme. This element forms a key component of the overall scheme costs, as provided into the WRSE regional WR modelling process[20].

9.2 Initial discussions have been held with the Environment Agency NAU with regard to how environmental risks are best identified and managed after Gate 1 in a collaborative manner with the environmental regulators. The aspiration of the SRO is to ensure that all pertinent environmental risks are discussed and agreed with environmental regulators and captured within the programme risk register, thereby enabling regular proactive communication of the progress of technical work to address and avoid such risks to be shared with the regulators. We plan to establish a regular forum, to ensure a close and productive working relationship between the SRO and environmental regulators.

Key risks and associated mitigation

9.3 The key risks may be derived from the existing risk registers and are summarised (Table 10 below) to provide an overview of the mitigation strategy for each element. The categorisation follows that used in the programme risk register, as shared previously with RAPID during the quarterly reporting process.

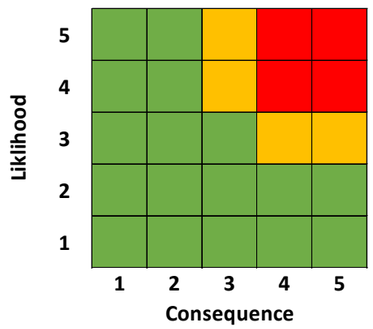
Table 10 Key risk themes and proposed mitigation

Risk Theme	Details	Pre-Mitigation			Proposed Mitigation	Post-Mitigation		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Programme	• Delays to WRSE regional plan programme or lack of integration between regional plans, which results in delays to subsequent WRMP24 and / or SRO promotion.	4	4	High	The regional and company planning risks will be mitigated through continued close liaison with the regional coordination group (RCG), regional modelling teams at WRSE and with the WRMP teams within both partner companies, to ensure that the SRO options are represented appropriately within both regional and company specific water resource management plans and presented for comment within the resulting public consultations during 2022.	3	4	Medium
	• Delays to the publication of the Final WRMP24 for either partner company, due to the need for a formalised public hearing or enquiry process, resulting in delay to the subsequent formal DCO process required for scheme promotion.	4	4	High		3	4	Medium
	• Failure to secure a direction from the Secretary of State to confirm that any associated transfer schemes which use the SESRO raw water are NSIPs, resulting in the need to seek consent for the scheme under the TCPA. This could cause complexity in the SESRO NSIP and the definition of the 'project'.	3	5	Medium	The NSIP direction risk will be mitigated through early definition of the planning strategy for the T2AT and the T2ST (and any other schemes that might rely upon SESRO), ahead of Gate 2, and, if required, seeking legal advice on this issue.	2	5	Low
Stakeholder	At this stage in the development of the project, with so many options being considered, the key stakeholder risks are considered to lie with potential scheme delays due to opposition to the choice of scheme at a regional level and through more local community challenge due to local concerns and constraints.	4	5	High	These risks will be managed primarily through the close alignment with the WRSE modelling and consultation, as noted above. However, to address the potential risk of more local concerns, we plan to initiate a local collaborative partnership to help explain the scheme to local residents and ensure that local issues are understood and incorporated into the final form and design of the scheme, where possible. We expect the format of this partnership forum to be developed ahead of Gate 2, but not initiated until early 2023 (i.e. between Gates 2 and 3), once the partner companies' WRMPs have been through public consultation.	3	5	Medium
Environmental	We have identified a number of key environmental areas that could cause a risk to the successful delivery of the SESRO scheme. At this stage, although our assessment suggests that all such issues should be mitigatable through design and							

[20] As we continue to explore these risks after Gate 1, we would expect to see more risk pass from the estimated Optimism Bias into costed risk or base capex, as risks are defined and mitigation developed.

Risk Theme	Details	Pre-Mitigation			Proposed Mitigation	Post-Mitigation		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
	construction good practice, we believe that the following issues remain and require further investigation ahead of Gate 2:							
	• Delays in obtaining (or failure to secure) abstraction consents from the EA, noting that there may be a risk that the existing Lower Thames Operating Agreement (LTOA) requires refinement and / or the inclusion of the T2AT abstraction within that protocol.	5	5	High	We plan to mitigate this through targeted hydrological investigations, in close liaison with the EA, ahead of Gate 2, to establish in principle whether the existing abstraction control arrangements remain valid and appropriate or whether the LTOA requires amendments.	3	4	Medium
	• Potential risk of WFD non-compliance for waterbodies within the R.Ock catchment and potential for a derogation to be required under Article 4.7 of the WFD.	4	5	High	We will engage early and in detail with the EA and other stakeholders in relation to such a derogation whilst continuing with optioneering, and will seek as far as possible to avoid any requirement for an Article 4.7 derogation. Detailed mitigation and compensation proposals will be discussed and developed in liaison with the EA ahead of Gate 2.	3	4	Medium
	• Uncertainty in the environmental impacts of the scheme, particularly on aquatic and terrestrial biodiversity, landscape, air quality and noise and heritage / archaeology.	5	4	High	We plan to mitigate the second risk through planned desk-based analysis of the key environmental impacts identified by our Gate 1 assessment, with desk-based archaeological assessment to be agreed with OCC and Historic England, an initial landscape and visual impact assessment, desk based assessment of air quality and noise and further work on the impacts of the scheme on important terrestrial and aquatic ecological receptors.	3	4	Medium
	• Uncertainty regarding the use of the scheme for recreation and amenity and of the associated local and regional benefits that this may bring.	4	4	High	We will mitigate the third risk, through the continued development of the quantified benefits assessment for the scheme and via a targeted conservation, access and recreation strategy. These documents will inform the design of the scheme as we work towards Gate 2 and help provide a framework for the more local stakeholder engagement planned after Gate 2.	3	4	Medium
Planning	As discussed in Section 7, there are a number of risks associated with the consenting of the SESRO scheme as an NSIP. We will not repeat that analysis here and our Gate 2 work is targeted towards reducing the impact of these areas of uncertainty. However, it is worth noting one significant residual risk associated with the current planning strategy: • There is currently a lack of a National WR Policy Statement, which may undermine statement of need for the SRO referring back to WRMP24.	2	5	Medium	There is not a great deal that can be done to mitigate this risk, noting that both partner companies have previously made representation on the draft NPS, except to remain in close liaison with Defra through our various professional advisors. We currently assume that a Final NPS will be published ahead of Gate 2.	2	5	Medium

* Assessment of risk in accordance with a standard 5 x 5 matrix of likelihood and consequence, as illustrated below:



10. Option cost/benefits comparison

Solution delivery date

10.1 As noted in Section 3, depending on the option chosen, the scheme can be commissioned between April 2036 and December 2037.

Summary of economic costs for SESRO

10.2 Capex, Opex and Optimism bias have been derived following the guidance given in the ACWG cost consistency method[21]. The capital cost estimates have primarily been based on refinement of those developed for previous WRMP submissions. The WRMP09 cost estimate was developed as a 'bottom-up' contractor's estimate, and this same cost estimate has been reviewed, refined and utilised for Gate 1.

10.3 Optimism Bias was calculated alongside the costed Risk Analysis, as detailed in the ACWG Cost Consistency Methodology, resulting in a scaled back Optimism Bias figure. Opex costs were generated for each element, including labour, power, chemicals and an allowance for operational maintenance.

10.4 Construction capex and opex costs have been used to generate the NPV values for the elements using the Treasury Green book with a declining schedule of discount rates and an 80-year period. The estimated NPV and AIC for each of the options is shown in Table 11 below.

Table 11 Net Present Value and Average Incremental Cost for each of the options

Option name	Units	150Mm3	125Mm3	100Mm3	75Mm3
Option benefit – additional resources or demand saved	Ml/d	293	244	195	155
Total planning period option benefit (NPV)	Ml	1,766,284	1,470,899	1,219,484	969,333
Total planning period indicative capital cost of option (NPV)	£000	1,330,226	1,247,403	1,180,991	1,097,979
Total planning period indicative operating cost of option (NPV)	£000	91,256	82,919	77,474	69,009
Total planning period indicative option cost (NPV)	£000	1,421,482	1,330,321	1,258,466	1,166,988
Average Incremental Cost (AIC) (max. utilisation)	p/m³	80.5	90.4	103.2	120.4
Average Incremental Cost (AIC) (25% utilisation)	p/m³	79.8	89.7	102.4	119.6

[21] ACWG (2020), Cost Consistency Methodology, 412624 | CC-400 | C

Option name	Units	30+ 100Mm3, Ph1	80 + 42Mm3, Ph1	30+ 100Mm3, Ph2	80 + 42Mm3, Ph2
Option benefit – additional resources or demand saved	Ml/d	68	163	254	238
Total planning period option benefit (NPV)	Ml	425,256	1,019,364	991,940	1,255,757
Total planning period indicative capital cost of option (NPV)	£000	995,485	1,166,933	1,256,848	1,344,269
Total planning period indicative operating cost of option (NPV)	£000	55,896	78,206	81,463	93,401
Total planning period indicative option cost (NPV)	£000	1,051,381	1,245,139	1,338,312	1,437,670
Average Incremental Cost (AIC) (max. utilisation)	p/m³	247.2	122.1	134.9	114.5
Average Incremental Cost (AIC) (25% utilisation)	p/m³	246.5	121.4	134.0	113.6

Note: maximum utilisation is assumed for these calculations: 1 in 500 year deployable output for 365 days / year, to enable comparison between options. 25% utilisation is assumed for alternative AIC. Required utilisation to be confirmed through WRSE modelling.

10.5 The phased options are the least cost-effective due to the nature of the construction approach, although phasing does enable a more gradual investment and additional water resource to address future uncertainty, but ultimately at a much higher economic cost. Based upon this assessment, the best value option for customers is the SESRO 150 Mm³ variant. However, whether this scheme is optimal for the south-east will be determined by the application of the WRSE Best Value Planning framework.

10.6 Costs for the work associated with future RAPID gateways are in Section 14.

Carbon Costs

10.7 The breakdown of the carbon footprint for the different options is summarised in Table 12 below. We have not converted the carbon footprint data into a monetary value for Gate 1, as this analysis (of both carbon and power requirements) will be done by WRSE as part of their investment modelling.

Table 12 Summary of carbon footprint for each option

Option variant	Embodied Carbon (tCO_2e)	Fixed (annual) Operational Carbon (tCO_2e)*	Variable Operational Carbon (tCO_2e / Ml) *
150Mm³	352,081	913.09	0.013
125Mm³	329,148	725.51	0.014
100Mm³	305,205	595.20	0.015
75Mm³	281,972	494.20	0.015
30Mm³ P1	250,871	200.14	0.014

Option variant	Embodied Carbon (tCO_2e)	Fixed (annual) Operational Carbon (tCO_2e)*	Variable Operational Carbon (tCO_2e / Ml) *
100Mm^3 P2	151,774	641.36	0.019
80Mm^3 P1	301,151	523.53	0.015
42 Mm^3 P2	102,159	315.12	0.027

* assuming 'normal' Grid, based upon Total UK Grid average (Carbon Accounting Workbook v14) - 0.000277 tCO2e / kWh

10.8 The 150 Mm^3 option has the largest embodied carbon footprint of the single-phase options, but still lower than both dual-phase options. However, the operational carbon is relatively low for the yield of the scheme. The reservoir stores water for use in dry years and therefore pumping into the reservoir (with consequent power / carbon use) is an intermittent activity and the operational carbon footprint overall, taking account of the energy recovery on discharge, is relatively small.

Water Resource benefits

10.9 The water resource benefits of the different options have been previously documented in Section 4 and shown in Table 4. The evaluation completed indicates that the different options can supply between 68 Ml/d and 293 Ml/d as deployable output during a 1 in 500 year drought event. As noted in Section 2 and reported in the T2AT SRO Gate 1 submission, there is expected to be a material conjunctive use benefit when operating SESRO in conjunction with the T2AT.

Environmental Benefits

10.10 Despite the environmental impacts during construction, a carefully planned mitigation and enhancement strategy ensures that SESRO provides excellent opportunity for environmental (and particularly terrestrial biodiversity) benefits.

10.11 Additionally, a wide array of opportunities to develop beneficial synergies with other parties / sectors have been identified. These will inform the development of a strategy to engage and develop a collaborative partnership for the promotion of the SESRO scheme, for the mutual benefit of these stakeholder groups. A further phase of the wider benefits study is planned ahead of Gate 2 to review and quantify the most significant benefits identified.

10.12 As noted in Section 5, there are, however, trade-offs with the benefits package for the reservoir that will need to be made. For example, the INNS risk assessment shows clearly that use of the reservoir for recreation does increase the risk of INNS transfer. These will be considered as the recreation and access strategy is developed for the scheme ahead of Gate 2.

Resilience Analysis

10.13 Analysis of the resilience benefits of each option has been assessed by the WRSE regional modelling team, using their resilience framework[22]. SESRO scores very well for the 'Reliability' and 'Adaptability', providing resilient and beneficial new water supply assets, but less well for the 'Evolvability' metrics, as infrastructure at this scale is not easily modularised and it has a very long 'lead-in' time. There is no significant difference in resilience between the different options.

11. Impacts on current plan

11.1 In WRMP19 SESRO was triggered in both TW and AFW's WRMPs by 2038, primarily as source for a two-phase transfer of raw water to AFW and to maintain longer-term supply resilience for both companies.

11.2 TW's WRMP19 included plans for four future scenarios (challenging, expected, optimistic and aspirational). SESRO is selected in the first three scenarios, but not in the very low forecast aspirational plan. For the challenging and expected future SESRO is required by 2038. For the optimistic future, SESRO was deferred until the mid 2040s. Four alternative futures were also modelled in AFW's plan. SESRO in combination with the T2AT was selected in all futures, although the timing of the need did vary significantly between them.

11.3 Additionally, as stated in "Future Water Resource Requirements for South East England", WRSE, February 2021[23], WRSE expect that the amount of water needed to supply customers is going to increase from the position predicted in WRMP19. Key drivers of future uncertainty include:

- The EA's National Framework[24] advocates greater reductions in existing abstractions to achieve more ambitious environmental 'destinations'
- The National Infrastructure Strategy[25] requires Water Companies to plan for a much more extreme 1 in 500 year drought resilience
- There remains a high degree of uncertainty in predictions of future growth, climate change impacts and customer demands for water.

11.4 The development of a new transfer from SESRO to SWS, as noted in Section 2, is a new option to share resources from SESRO. This assists with the regional sharing of resources to meet increased water demands and future uncertainties identified by WRSE. Modelling work ongoing by WRSE will confirm whether this transfer will be selected in the regional Best Value Plan. A key positive aspect of this additional option is that it allows for additional flexibility in the sharing of raw water storage with SWS or SEW. During periods when flows in the River

[22] WRSE, August 2020, "resilience-framework-response-to-feedback-03-august-2020_final.pdf (wrse.org.uk)"
[23] https://wrse.uk.engagementhq.com/future-water-requirements-for-south-east-england
[24] Environment Agency, 2020 "Meeting our Future Water Needs: A National Framework for Water Resources"
[25] HM Treasury, November 2020, "National Infrastructure Strategy")

Thames are sufficiently high and London doesn't need or can't make use of water from SESRO, then SWS or SEW could alternatively make use of SESRO should demands be high enough.

11.5 SESRO remains as a key part of the management of this future uncertainty. Ongoing development of the WRSE regional plan during Gate 2, which now includes a number of additional options, will provide an understanding of the need for all of the Strategic Resource Options.

12. Board statement and assurance

12.1 This report meets the assessment criteria defined by RAPID, in accordance with the PR19 Final Determination. The options for the SESRO scheme are presented with robust evidence and a complete set of technical assessments to support all assertions made. The analysis is consistent with available policy and technical guidance, including that produced by the All Company Working Group (ACWG) and any deviations are justified. Uncertainties are explained, explored and quantified, where possible, enabling expected impacts to be discussed along with appropriate mitigation to manage such uncertainties.

Assurance approach

12.2 The assurance framework used for this submission has been developed jointly by TW and AFW. This approach provides an effective programme of assurance which considers areas that we know are of prime importance to our customers and regulators; or may have a significant financial value. Areas of higher risk receive three line assurance while other areas, where the risk is lower, may be targeted with first and second line only.

12.3 Jacobs were appointed as our external assurers. Our approach was augmented by experience that the companies gained through the PR19 assurance process and the sharing of best practice.

Items to highlight

12.4 Jacobs' Assurance Report confirms that, overall, at the completion of their assurance work, they consider:

- The Gate 1 submission is consistent and aligned to the regulatory requirements for Gate 1 as set out in Ofwat's final determination and subsequent additional feedback.
- For the information within their scope, the information contained within the Gate 1 submission has been derived using methodologies, assumptions, and input data suitable for Gate 1 and is therefore reliable
- The assurance scope is appropriate for the submission.
- Their opinions and feedback have been appropriately considered
- Progress on the solution to date is commensurate with the Final Determination timeline of being 'construction ready' for AMP8

- For the information within their scope, that the work carried out to date is of sufficient scope, detail and quality which would be expected of a large infrastructure scheme of this nature at this stage.
- The expenditure that has been incurred in generating the Gate 1 submission is efficient and relevant to the development of the submission

12.5 We constantly look to improve our assurance approach and will conduct a "lessons learnt" exercise before we finalise our assurance approach for Gate 2.

Board Statement(s)

12.6 A copy of the Board Statement(s) is provided within the covering letter to this submission.

13. Solution or partner changes

13.1 There are no changes to solution partner and no solution substitutions for SESRO at RAPID Gate 1. The option(s) considered at WRMP19 remain valid.

13.2 This position may change ahead of Gate 2, pending completion of the WRSE regional plan, should the storage from SESRO be better shared with other (additional) partner companies. The project does not rule out the possibility of new partners in the future should the strategic need for SESRO change from the position outlined in WRMP19.

14. Efficient spend of gate allowance

Breakdown of Gate 1 costs

14.1 The costs up to the Gate 1 submission are presented relative to Ofwat's Final Determination allowance. Due to the timing of the authoring and assurance of this report, the total costs are reported as the sum of actual costs for work actually completed (to end April 2021) plus estimated forecast costs for remaining work to Gate 1 (5th July 2021). The assessment of the spend is included in the assurance activity for Gate 1 (see Section 12).

14.2 For accurate comparison with the Final Determination allowance, as requested by RAPID, actual costs are deflated back to a 2017/18 cost base using Thames Water's Internal Business Plan (IBP) deflationary factors, based upon the CPIH (November 2019 dataset) index (see Table 13 below).

Table 13 Deflationary factors used for actual cost calculations

AMP7	Deflation Factors *
Year 1 (2020/21)	0.9469
Year 2 (2021/22)	0.9283

* from actual costs back to 2017/18 cost base

14.3 The cost allowances to produce the Gate 1 submission were provided in Ofwat's Final Determination documentation[26]. Overall, as shown in Table 14, the forecast spend to Gate 1 represents a saving of just over £10.4M against the final determination allowanceTable 14. The reasons for this efficient delivery of the Gate 1 submission are explained in subsequent sections. All required outputs for the Gate 1 submission have been delivered.

14.4 The total forecast costs may be further broken down, to show the proportion of spend across each of the main technical workstreams. The breakdown of the total forecast cost is shown in Table 15 below.

Table 14 Gate 1 forecast total cost for each partner company

Company	Forecast Total Cost to RAPID Gate 1 (£M, 2021 prices)	Forecast Total Cost to RAPID Gate 1 (£M, 2017/18 prices)	Ofwat FD Allowance for Gate 1 (£M, 2017/18 prices)	Saving (£M)
Thames Water	£1.23	£1.16	£8.11	£6.95
Affinity Water	£0.62	£0.58	£4.06	£3.48
TOTAL	£1.85	£1.75	£12.17	£10.42

14.5 We have undertaken initial qualitative benchmarking of the proportion of total cost assigned to each workstream across other SROs. This analysis provides an initial understanding of outliers and identifies that, for most workstreams, the percentage splits are well aligned to other SROs. The following areas show a difference from the average of more than 10%:

- **Regulator Costs (EA and NE).** The assignment of costs that has been agreed between the EA and the ACWG, is based upon the proportion of the total Ofwat cost allowance to each SRO, hence higher for SESRO.
- **Engineering Analysis and Design**. As noted in Section 4, in comparison to other SROs, significant options appraisal and site selection work was not required. Hence costs are significantly lower for this aspect than for similar sized but less well developed or newer schemes. This has helped contribute to the overall efficiency of the SESRO Gate 1 spend.

Table 15 Cost breakdown, by technical workstream

	Total Cost (17/18 prices)		% spend
Program Mgt. and Governance	£	178,134	10.2%
Assurance	£	63,183	3.6%
Commercial and legal support	£	107,849	6.2%
Stakeholder engagement	£	22,292	1.3%
Engineering analysis and design	£	277,991	15.9%
Environmental studies	£	431,780	24.7%
Drinking Water quality studies	£	23,866	1.4%
Planning and land studies	£	48,143	2.8%
Water Resource modelling	£	183,462	10.5%
Regulator costs (EA and NE)	£	408,956	23.4%
Sub-total	**£**	**1,745,655**	**100%**

[26] PR19-final-determinations-Strategic-regional-water-resource-solutions-appendix.pdf (ofwat.gov.uk)

14.6 No workstream has a total forecast cost greater than £500k, although one does approach this total (see Table 15, environmental studies). In accordance with the latest guidance from RAPID, we do not therefore provide any further breakdown.

Efficiency of Gate 1 costs

14.7 Overall, as noted in the previous sections, the programme has delivered the Gate 1 submission for an efficiency saving of just over £10.4M (approximately 86%). This efficiency is developed across 7 key principles, which are discussed in Table 16 below.

Table 16 Cost efficiency overview

Area	Application	Efficiency achieved	Contribution
A	The work that we have completed was aligned to RAPID's requirements.	Costs applied only to work packages and scope that is directly required to deliver the Gate 1 submission or to avoid programme risks for Gate 2. This results in a very targeted scope of work. Additionally, the Gate 1 allowance is very high relative to the level of technical information and insight already available. Extensive and robust previous investigations could be relied on for Gate 1 submission and to support the WRSE regional modelling and hence costs were significantly lower for this aspect of the work that might have been the case for less well developed or newer schemes. This has helped significantly to contribute to the overall efficiency of the SESRO Gate 1 spend.	Very high
B	Standard methodologies for key areas (e.g. environmental assessment)	Shared methodology and application reduces technical work effort (standard templates, outputs etc); no need to assure bespoke methodologies across all SROs, driving consistency with other SROs for Gate 1 submission.	Low
C	Use of technical assessments undertaken for WRSE	Standard methodology applied by WRSE to all constrained options (environmental and resilience) helps drive consistency; use of WRSE data and assessment outputs helps reduce technical work effort and time required to assess options for Gate 1	Medium
D	Implementation of common procurement principles	Standardised rules for the procurement of services on behalf of multiple solution partners to provide best value for money; Prioritised hierarchy of standard procurement approaches to drive competition and efficiency into external procurement; Allows governance over the procurement of technical services and drives accountable efficiency into the process.	Low

Area	Application	Efficiency achieved	Contribution
E	Adoption of competitive procurement and qualitative benchmarking	91% of the value of the key external support services has been procured using competitive approaches, with the majority going via framework mini-bid processes. Where direct award was used, qualitative benchmarking using professional judgement against similar previous work packages ensures efficiency. Framework mini-tender approaches have delivered estimated savings of 36 - 70% across four of the largest work packages (engineering, environmental, water quality and planning strategy)	Medium – High
F	Procurement of aligned work-packages across multiple SROs	Several work packages procured on behalf of multiple SROs, to drive efficiency into both procurement and delivery (fewer contracts to let and manage and fewer consultancy interfaces). Examples include environmental and water quality surveys, procured across multiple SROs and Programme Management, Planning and land strategy and external assurance procured centrally for SESRO and T2AT.	High
G	Application of rigorous project management controls	All external work packages were delivered at or below the agreed contract value, including approved changes; robust control helps prevent 'scope creep' and cost escalation.	Low

Gate 2 proposed costs

14.8 Overall, the SRO forecast cost to Gate 2 is £8.3M (2017/18 price base), showing a 55% forecast efficiency against the FD allowance. These cost estimates are derived through a detailed work breakdown structure of the work required for the next stages of the project, up to Gate 2, and the assignment of costs to each work package based upon professional judgement. Forecast cost for future Gates will be provided at Gate 2. However, at Gate 1, there is nothing to indicate that the spend for later gates will be significantly different to the FD allowance.

14.9 Gate 2 spend is also forecast to deliver a significant saving compared to the FD allowance. Additionally, to drive further efficiency into delivery, we plan to procure more of the technical support services on behalf of multiple SROs at the same time. However, we have also defined an extensive programme of environmental survey and assessment, coupled with further engineering concept design, to help refine the scheme. Hence, we forecast a closing of the gap between our incurred costs and the Ofwat FD allowance for Gate 2.

15. Proposed Gate 2 activities and outcomes

Breakdown of Gate 2 activities and outcomes

15.1 Our Gate 2 activities are identified to meet the requirements of the RAPID gated process, recognising that they will be done in parallel to the WRSE planning process and the partner companies Water Resource Management Plans.

15.2 The outcome of the WRSE best value planning process should be available in draft in the second half of 2021 and as a final version in mid 2022[27]. We will continue to develop our understanding around the feasibility and uncertainty of all options, as they are all based around the same overall site albeit with different footprints, but the focus of the studies shall be the largest, 150 Mm^3, (currently preferred) option pending any change found within the WRSE regional planning.

15.3 The key workstreams and activities proposed for Gate 2 are shown in Table 17 below, aligned to the outcomes required by Ofwat's Final Determination[28]. .

Table 17 Gate 2 Workstreams, activities and outcomes

Workstream	Key activities
Environmental Assessment	Hydrological and geomorphological assessment; River and reservoir modelling; update G1 assessments ; Conservation, access and recreation strategy; Desk-based assessment around key environmental risks; Further benefits assessment and monetisation; Initiate permitting and licensing investigations
Environmental Monitoring	Aquatic ecological and water quality surveys (including algae); River surveys, access allowing
Technical and Engineering Assessment	Develop initial integrated Master Plan for site integrated with other SROs; Develop the engineering concept design; Update scheme costing, risk and mitigation; Engage Early Contractor Involvement, if possible
Water Resources Modelling and Analysis	Continued modelling of option(s), to optimise the scheme and to better understand vulnerability to different 'futures' and combined operation with AFW; Continued interface into the WRSE regional modelling process
Commercial Assessment	Further development of the operational regime for the scheme; More comprehensive risk appraisal; Assessment of the commercial models available.
Legal Support	Ongoing legal advice, as required
Planning Assessment	Audit of WRSE options appraisal process and previous SESRO site selection analysis; Produce overarching planning strategy for scheme promotion

[27] WRSE Regional Plan v2b (draft), programmed to be issued for Public Consultation in January 2022.
[28] PR19-final-determinations-Strategic-regional-water-resource-solutions-appendix.pdf (ofwat.gov.uk)

Workstream	Key activities
Land Assessment	Collation of Property Information - ownership, value estimation, type – for all options; ID utilities constraints (power requisition and off-site routes).
Stakeholder engagement, third party activities	Update to WRSE customer preference studies; Ongoing regular, technical engagement with regulators and affected LPAs and CCs; Engagement with other key parties; Interface into WRSE and WRMP24 engagement and Consultation.
Programme mgt. governance, reporting and assurance	Programme management and governance; External assurance; Authoring, checking and reviewing of Gate 2 submission; Regulation review of proposals

Gate 2 penalty assessment criteria

15.4 No changes to the penalty assessment structure are proposed for Gate 2.

Assessment of solution delay impacts

15.5 The project is currently running to programme and on-track to deliver the scheme by the required dates. At this stage we do not anticipate any solution delay impacts for the delivery of Gate 2. However, there are a number of critical assumptions and dependencies which might impact upon the successful commissioning of the scheme by 2038. These will be explored further for Gate 2.

16. Conclusions and recommendations

Conclusions

16.1 The different options for SESRO are all feasible. They have been reviewed and provided as costed options to the WRSE regional best value planning process.

16.2 The different sized options deliver a deployable output of between 68 Ml/d (30 Mm^3, Phase 1 of 2) and 293 Ml/d (150 Mm^3, single phase) for London, which can potentially be shared regionally. No DO benefit has been found from explicitly combining the SESRO and STT options, but there is expected to be a material conjunctive use benefit when operating SESRO with the T2AT.

16.3 As expected, the highest NPV for a single phase option is for the largest (150 Mm^3) but this option also delivers water at the lowest unit cost, with an AIC of £0.805 / Ml. The phased options are the least cost-effective.

16.4 There are some moderate adverse environmental impacts from SESRO, which need to be addressed through scheme design and mitigation, including significant effects on compliance under the WFD, and there is the potential for a derogation to be required under Article 4.7 of the WFD in respect of two waterbodies. None of the impacts identified in the Gate 1 studies are considered to be unresolvable during the subsequent design of the scheme, but further detailed study is required.

16.5 SESRO also provides an excellent opportunity for biodiversity net gain and positive contributions to NC value. A wide array of other opportunities to develop other beneficial synergies between SESRO and other local and regional parties have been identified.

16.6 SESRO does have a relatively high embodied carbon footprint which will require mitigation both through utilisation of low carbon construction methods in addition to off-setting opportunities. The operational carbon, taking account of the opportunity for energy recovery on discharge, is relatively small.

16.7 The earliest available delivery date is 2036 (75 Mm^3 option). The largest option is considered deliverable by the WRMP19 required date of 2038.

16.8 The initial assessment of alternative procurement models concludes that the two leading options would be a late / very late DPC model or else a Joint Venture Collaboration between the partner companies.

16.9 The SESRO options all qualify as NSIPs and are therefore would need to be consented through DCO under the Planning Act 2008 (PA2008).

16.10 The programme is on track to deliver the future RAPID gateways as originally planned.

Recommendations

16.11 It is recommended that the scheme continue to Gate 2, for the further assessment of the alternative options and scheme configurations.