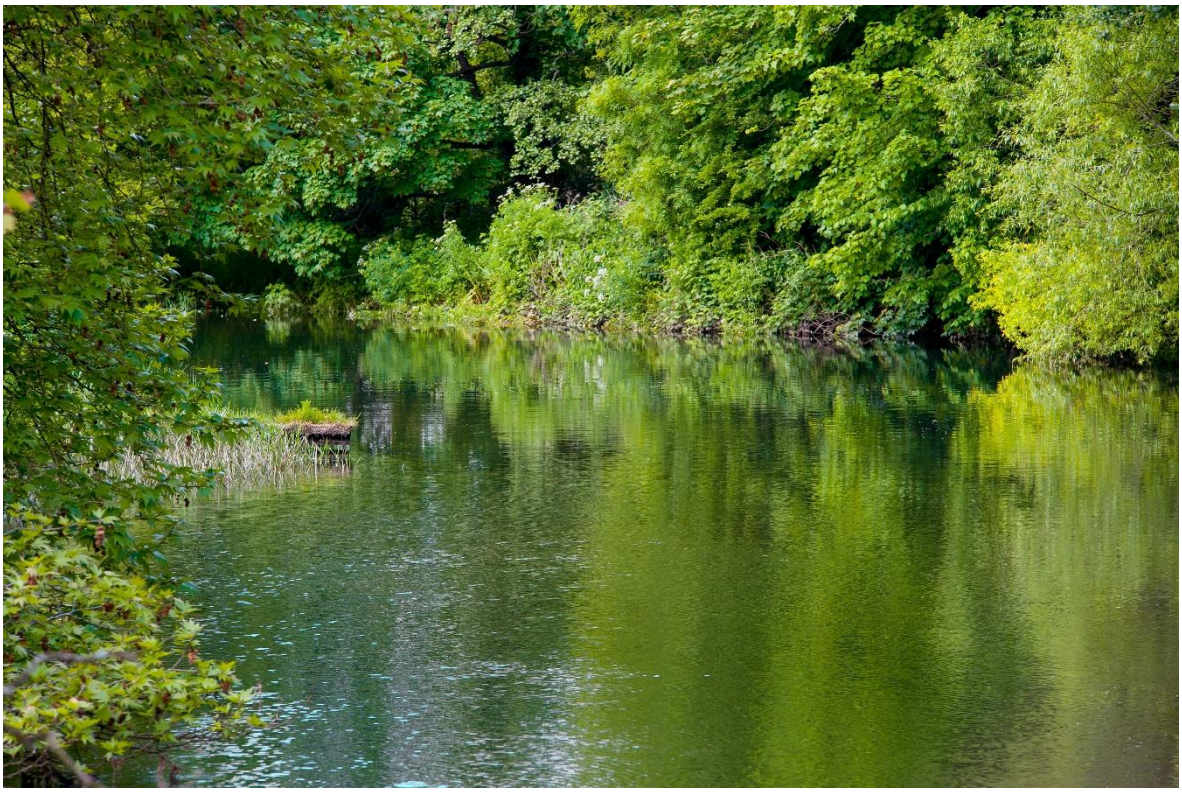
Strategic Regional Water Resource Solutions: Annex A1 Options Appraisal Screening Report

Standard Gate Two Submission for Thames to Southern Transfer (T2ST)

Date: November 2022



Notice

Position Statement

- *This document has been produced as the part of the process set out by RAPID for the development of the Strategic Resource Options (SROs). This is a regulatory gated process allowing there to be control and appropriate scrutiny on the activities that are undertaken by the water companies to investigate and develop efficient solutions on behalf of customers to meet future drought resilience challenges.*
- *This report forms part of suite of documents that make up the 'Gate 2 submission.' That submission details all the work undertaken by Thames Water and Southern Water in the ongoing development of the proposed SROs. The intention of this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress and future funding requirements.*
- *Should a scheme be selected and confirmed in the Thames Water and Southern Water final Water Resources Management Plans, in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised, and in most cases an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.*
- *Community and stakeholder engagement is crucial to the development of the SROs. Some 'high level' activity has been undertaken to date. Much more detailed community engagement and formal consultation is required on all the schemes at the appropriate point. Before applying for permission Thames Water and Southern Water will need to demonstrate that they have presented information about the proposals to the community, gathered feedback and considered the views of stakeholders. We will have regard to that feedback and, where possible, make changes to the designs as a result.*
- *The SROs are at a very early stage of development, despite some options having been considered for several years. The details set out in the Gate 2 documents are still at a formative stage and consideration should be given to that when reviewing the proposals. They are for the purposes of allocating further funding not seeking permission.*

Disclaimer

This document has been written in line with the requirements of the RAPID Gate 2 Guidance and to comply with the regulatory process pursuant to Thames Water's and Southern Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, Thames Water and Southern Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

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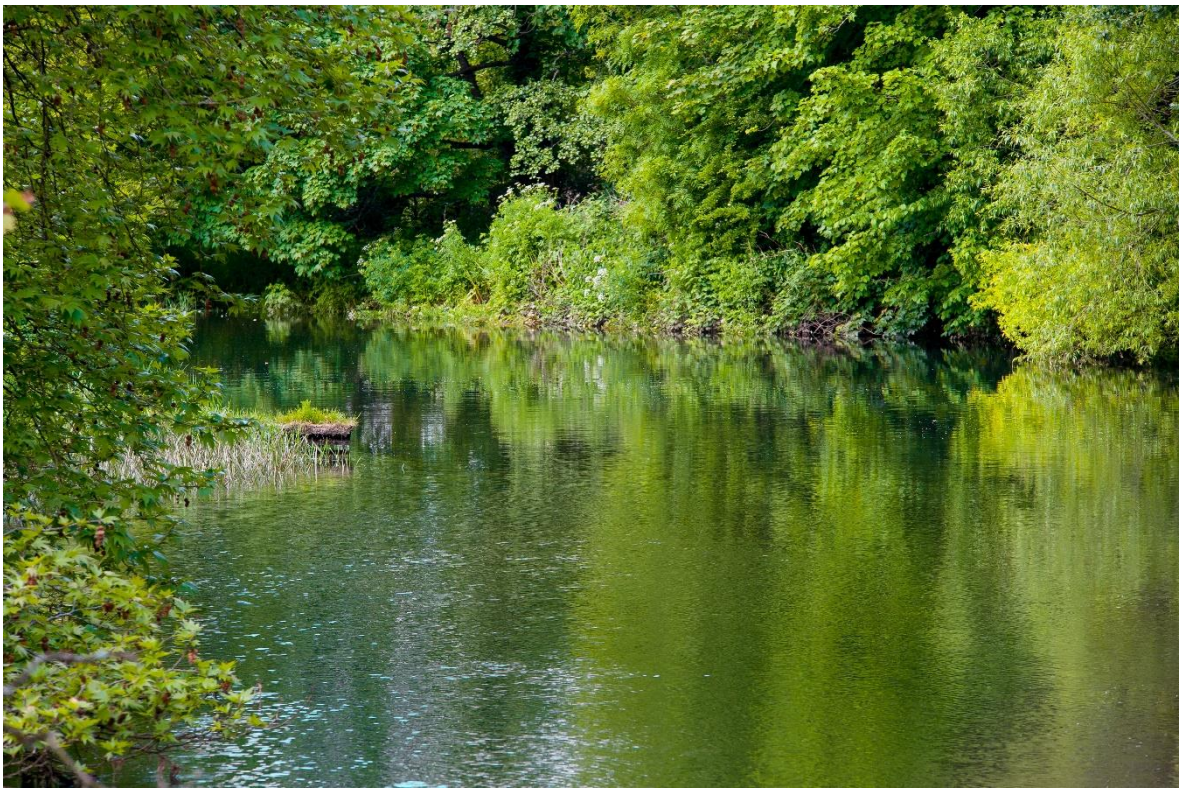

THAMES TO SOUTHERN TRANSFER (T2ST)

Annex A1 Options Appraisal Screening Report

Atkins Ref: T2ST-G2-REP-01 (Annex A1)

November 2022

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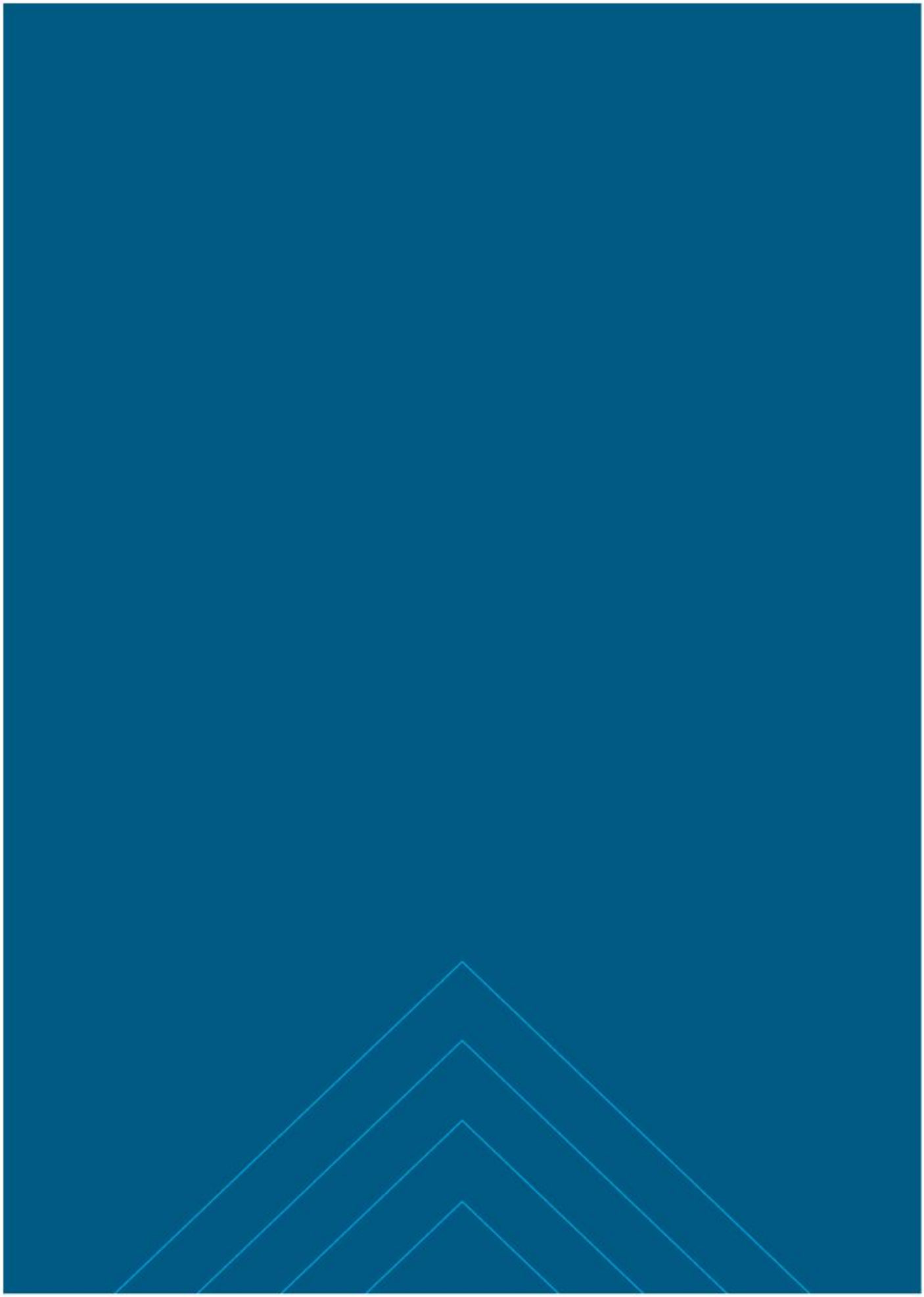


1. Introduction

The Thames to Southern Transfer (T2ST) Gate 1 Report, submitted to RAPID in July 2021, identified 6No. feasible options to carry forward for more detailed assessment in Gate 2. Following commencement of T2ST Gate 2 work in August 2021, further options appraisal work has been undertaken to address key questions concerning the viability and operation of the Gate 1 options. This approach has enabled an informed decision to be made on the preferred options to take forward into the Gate 2 concept design stage commencing in January 2022.

Details of the options appraisal process, conclusions and recommendations are documented within this report. The option appraisal has included 3No. option workshops (held on 8/9/21, 13/10/21 and 10/11/21) attended by representatives from the T2ST technical team, Thames Water and Southern Water. Third party assurance of the options appraisal report has also been undertaken to ensure that the 'decision making' process for selection of the preferred T2ST options for Gate 2 is robust before commencement of concept design.

2. Screening Methodology

The screening methodology for the T2ST Gate 2 options appraisal has followed the same screening approach as used for the Thames to Affinity (T2AT) SRO, to provide consistency across the SRO options. This screening approach has been applied to the 6No. T2ST options identified at Gate 1, to determine preferred options to take forward to concept design for Gate 2. A description of each of the 6No. Gate 1 options is provided under Section 3.0 of this report.

The screening criteria have been updated to be consistent with the WRMP24 process to ensure that a common, robust process has been used to screen all options. The updates have been completed based on the latest WRPG requirements and options appraisal work undertaken for WRSE.

The screening process is a multi-stage approach, with initial screening followed by a secondary screening stage to progressively determine a list of constrained options to take forward into the conceptual design stage for the T2ST SRO. The screening process is illustrated in Figure 2-1.

The initial stage of the option screening removes all the options from the list that are not technically, or environmentally feasible, on a pass/fail basis. Table 2-1 sets out the initial assessment criteria where options are assessed against a pass/fail definition.

The secondary screening stage uses a RAG system (red/amber/green) to present the findings of the assessment and to demonstrate how the options perform against the assessment criteria. The secondary screening criteria are set out in Table 2-2. The assessment criteria ensures consistency with the Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and Water Framework Directive (WFD), that underpin the environmental assessment of options consistent with the approach taken for WRMP24.

The outputs of the screening process as applied to the 6No. Gate 1 options is provided in Appendix A.

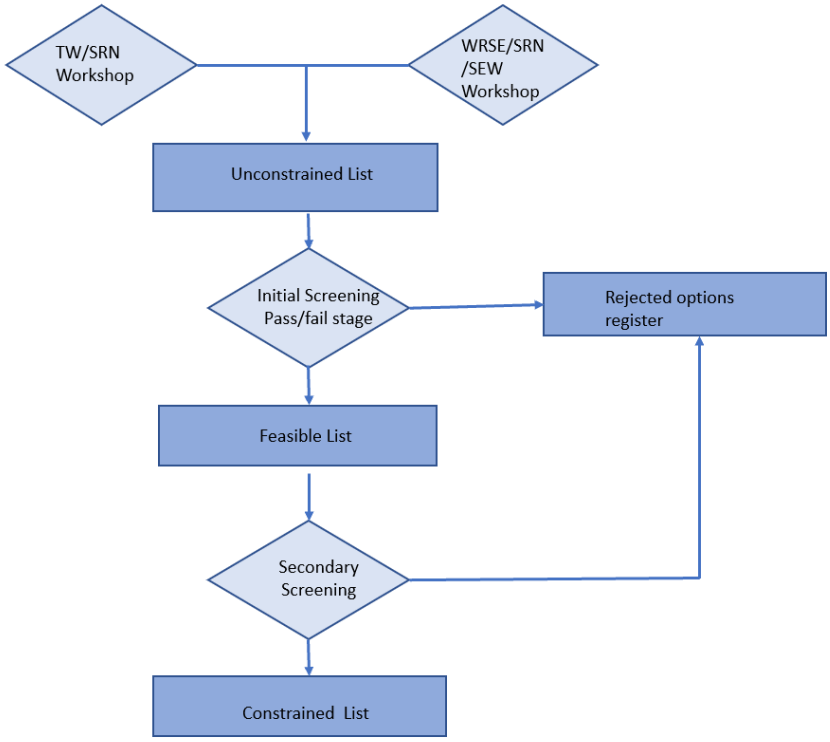


Figure 2-1 - Initial Screening Criteria

Table 2-1 - Initial Screening Criteria

Ref	Criteria	Description for Fail	Evidence for audit
1	Delivery underway	Option already delivered/delivery is underway, and option under delivery cannot be scaled up in any way	Reference to show delivery underway. (Business plan reference, confirmation by [Name, role, date], etc). Explanation as to why not scalable
2	Duplication	Option is duplicated with another on the unconstrained list	Duplicate option reference, name, type and capacity. Reference to which named option is removed/which kept in
3	Comparative rejection	There are multiple mutually exclusive options and it is clear, even at this early stage, and without any further investigation being needed that a significantly better value option variant is available. Assessment for transfers to include a comparison of length of transfer 'as the crow flies'	Preferred feasible option reference and clear evidence for why another option is significantly better value in terms of appraisal metrics (cost, yield, resilience, etc)
4	Superseded	Option has been superseded by another to make it no longer relevant.	Superseded feasible option reference and clear evidence for why this option is no longer valid
5	Low flow availability	Option would require abstraction beyond current licensed limits at times of low flow AND relevant CAMS specifies water not available for licensing OR relevant source subject to sustainability reductions which would make any further increase in abstraction unviable	Abstraction licence volume v proposed volume. CAMS document and water body name. WINEP status (for sustainability reductions)
6	CAMS resource reliability	Option would require abstraction beyond current licensed limits when flows are above a certain threshold AND CAMS resource reliability at the required threshold insufficient for the option to be feasible	Reference to abstraction licence volumes. CAMS document and water body name
7	3rd party water availability	Third party constraints make the option completely unviable AND there is no scope to develop a shared option which would overcome the third-party constraints	Specify the constraints and why they are insurmountable, e.g. CAMS resource reliability, low flow availability, water required locally, etc. Cost unlikely to be a legitimate reason
8	SEA Criteria	Option has a direct or likely impact, (Footprint or associated impact are within 100m) on: - Special Area of conservation - Sites of specific scientific Interest - Special protected areas - Ramsar Sites - Scheduled Monuments AND impact(s) cannot be mitigated sufficiently to make the option viable	ArcGIS ATLAS tool outputs/maps: reference to SEA criteria and why mitigation not possible

Table 2-2 - Secondary Screening Criteria

Ref	Criteria	Question for screening	Evidence for audit	Pass/ fail or RAG	Green	Amber	Red
A5	A5: Operational complexity (H)	Would the option increase the complexity of operation of the abstraction, treatment or distribution infrastructure?	Explanation for the expected change in complexity	RAG	No increase in complexity	Some increase in complexity	Significant increase in complexity
E1	E1: Modularity and scalability	Can the option be implemented on a modular or scalable basis?	Clear explanation for why/why not scalable	RAG	Option has potential for flexibility in capacity	Option capacity is largely fixed	Option capacity is fully fixed
R1	R1: Uncertainty of option's supply/demand benefit (H)	What is the uncertainty in deployable output of the option?	Explanation for cause of the uncertainty and why it cannot be resolved	RAG	<50% uncertainty	50% to 100% uncertainty	>100% uncertainty
R3	R3: Vulnerability of infrastructure to asset failure other hazards (H)	Is the option particularly vulnerable to asset failures during shock events?	Clear explanation for expected impact	RAG	Option no more vulnerable to asset failures than average for the WRZ	Option more vulnerable to asset failures than average for the WRZ	Option highly vulnerable to asset failures
R5	R5: Catchment & raw water quality risks (H)	Would the option be likely to increase WRZ outage associated with transient catchment water quality events?	Clear explanation for expected impact	RAG	Transient catchment water quality risks no higher than average for the WRZ	Option may increase WRZ outage associated with catchment raw water quality risks	Option likely to significantly increase WRZ outage from catchment raw water quality risks
S2	Regulatory approval (H)	Are there significant risks associated with regulatory approval of the option?	Regulatory correspondence or reference to regulatory guidance	RAG	No risks identified	Regulators have suggested licensing or approval may not be possible	Regulators have suggested licensing or approval unlikely to be granted
S3	Customer preference (H)	What is the customer preference for this option type	Reference to customer surveys, specifying survey details (numbers surveyed, dates, results, etc)	RAG	Customers indicated a preference for this option type and will be straightforward to promote	Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve	Customers indicated other option types were preferred and the option will be difficult to promote.

Ref	Criteria	Question for screening	Evidence for audit	Pass/ fail or RAG	Green	Amber	Red
						acceptability of option	
S4	Stakeholder Promotability (H)	Are there risks associated with non-regulatory stakeholder support for the option?	Evidence to show stakeholders oppose this option type and that it would be difficult to mitigate that opposition	RAG	No reason to expect significant local opposition to this option	Evidence to suggest stakeholders may actively oppose the option	Stakeholders likely to significantly oppose this option
S5	Planning (H*)	Is the option at risk of being blocked by unalterable planning constraints?	Reference to planning guidance/law	RAG	No high-profile planning constraints	Planning constraints that can be over come	Planning constraints that are high profile and unlikely to be overcome. E.g. Heathrow third runway or HS2
WR MP3	Excessive Cost and carbon (H*)	Are the option cost and carbon emissions likely to be excessively high?	Quantitative assessment of option characteristics (e.g. length of route and pumping head)	RAG	Quantitative assessment clearly indicates least cost option for addressing need, or would clearly be part of least cost programme for addressing anticipated needs	Due to estimating uncertainties option has potential to become least cost, or potential to be part of the least cost programme for addressing anticipated needs	Quantitative assessment clearly indicates substantially more costly than other options for addressing need
WR MP5	Option status with respect to environmental designation, including SEA and HRA considerations (H*)	Does the option have a direct or likely impact (Footprint or associated impact are within 100m) on: Special Areas of conservation; Sites of Special Scientific Interest; Special Protected Areas; Ramsar Sites; Scheduled Monuments; National Nature Reserve; Registered Parks and gardens; current or historic landfills; Grade 1 Agricultural Land; Flood Zone 3; Ancient Woodland; Marine conservation zones; Local Nature Reserves, Areas of	Route optimiser tool outputs and maps	RAG	No designations within 100m of proposed option footprint	Pipeline/transfer route located within statutory sites; mitigation may be required but option still feasible	Significant overlap with designated site boundaries makes option unlikely to be feasible

Ref	Criteria	Question for screening	Evidence for audit	Pass/ fail or RAG	Green	Amber	Red
		Outstanding Natural Beauty; Listed Buildings					
WR MP6	Option status with respect to overall SEA screening (sustainability) (H*)	Consideration of full SEA screening results and identification of key issues	Route optimiser tool outputs and maps	RAG	No significant risks identified	Some concerns owing to SEA screening	Significant risks identified under the SEA
WR MP7	Natural Capital (H)	Is the proposed scheme likely to impact Natural Capital Stocks	TBC	RAG	The Option is likely to cause an overall gain in Natural Capital Stocks	The Option is likely to cause an overall loss in Natural Capital Stocks	The Option is likely to cause an unacceptable loss of Natural Capital
WR MP8	Water framework directive assessment and/or urban wastewater directive (H)	Is the option likely to impact upon WFD no-deterioration objectives?	TBC	RAG	No likely impacts on WFD no-deterioration objectives	Risk of deterioration but mitigation possible or not enough information available currently	Likely impacts on WFD no-deterioration objectives
WR MP9	European designated sites (H)	Does the option have an impact or likely impact on European designated sites	Route optimiser tool outputs and maps	RAG	No European designated sites within 500m	One or more European designated sites within 500m or Not enough information available currently	Direct land take or likely impacts on a European designated site
SR O1	Construction complexity (H*)	Detailed review of construction requirements: are there adverse ground conditions / large number of major crossings? How will these conditions affect the construction timeline?	Route of transfer pipeline, using route optimiser tool.	RAG	No major crossings required or contaminated land risks identified. Construction complexity is anticipated to have no significant impacts on construction programme and cost	1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	> 10 major crossings required or significant contaminated land risks identified. Construction complexity is anticipated to have major impacts on construction programme and cost.
SR O2	Impact from construction (H*)	Non-traffic impact of construction on local residents - the impact of dust and noise. Will construction activities result in the loss of	Shape file of the construction site and 100m radius around the site to determine impact on residential dwellings, and	RAG	Less than 100 residential properties likely to be affected during construction by	Between 100 and 299 residential properties likely to be affected by construction by	More than 300 residential properties likely to be affected during construction by

Ref	Criteria	Question for screening	Evidence for audit	Pass/ fail or RAG	Green	Amber	Red
		residential dwellings? Will construction traffic affect local roads /built up areas?	construction shape outline to determine loss of dwellings		noise and dust. No residential dwellings located within the site. Route largely not through built up areas and / or likely to have limited impacts on local traffic. No constraint posed	noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome	noise and dust. More than 10 residential dwellings located within the site. Route predominantly through built up areas and / or likely to have substantial impacts on local traffic. These impacts cannot be mitigated
SR O3	Opportunities (H*)	Are there any opportunities for biodiversity improvement and chalk stream enhancement?	Footprint of options and its proximity to possible opportunities	RAG	Site with a watercourse and surrounding woodlands. Scheme is directed at chalk stream enhancement. Scheme will provide recreational benefit.	Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit.	Not applicable
SR O4	Environmental considerations	Can any of the flags that were identified at the secondary stage be mitigated?	List of considerations where mitigation can be undertaken and the level of mitigation required	RAG	No flags identified no mitigation required	Mitigation required but not at a high cost	Significant mitigation required at a high cost

Note that secondary screening criteria WRMP1 (Provision of a DO benefit), and WRMP2 (Provision of surplus into a WRZ) are not applicable for SRO screening and so are not listed here. ‘H’ in the table indicates an assessment criterion that is important and ‘H*’ are those assessment criteria that are important and a differentiator.

It should be noted that a Red RAG rating for environmental considerations does not preclude an option from being taken forward to the next stage of design, but this will require commitment to apply mitigation, such as by using trenchless dig techniques. The aim of the secondary screening was not to automatically exclude opportunities on the basis of identifying 'red' constraints, but to identify those opportunities that would be affected by a higher proportion of constraints or risks to delivery if they were to be considered further.

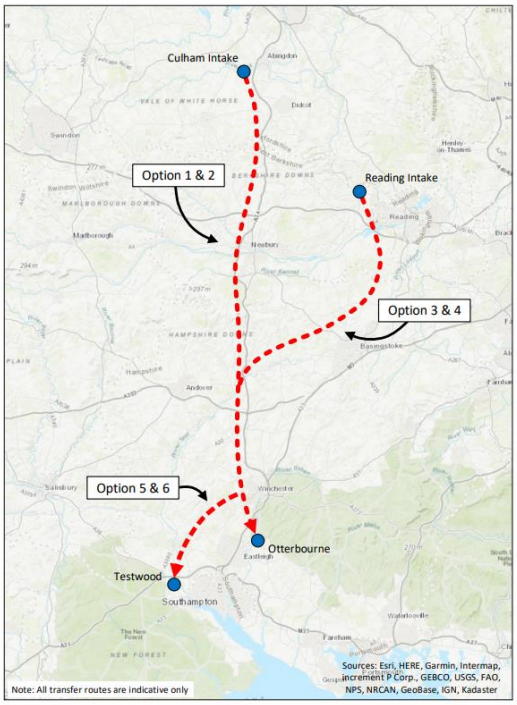
3. Overview of Gate 1 Options

The 6No. T2ST Gate 1 options comprise 2No. potable options and 4No. raw water options as summarised in Table 3-1.

Table 3-1 - Gate 1 Options

Option 1	Culham to Otterbourne	Potable water transfer
Option 2	Culham to Otterbourne	Raw water transfer
Option 3	Reading to Otterbourne	Raw water transfer
Option 4	Reading to Otterbourne	Potable water transfer
Option 5	Culham to Testwood	Raw water transfer
Option 6	Reading to Testwood	Raw water transfer

Figure 3-1 - Key Plan showing Gate 1 Options



For Gate 1 capacities of 50, 80, and 120Ml/d were assessed for each of the 6No. options, between the abstraction point at Culham/Reading and delivery location at Otterbourne/Testwood in Hampshire. In addition, a T2ST capacity of 200Ml/d was also assessed for each option for inclusion within the WRSE regional modelling.

10Ml/d capacity spur connections from the T2ST main were also included within the Gate 1 options to the Kingsclere and Andover water resource zones in Hampshire, as agreed with Southern Water to meet projected long term resource deficits in these areas.

3.1. T2ST Abstraction locations

For Gate 1, two alternative abstraction locations for T2ST were identified and assessed as follows;

i) At the proposed site of the South East Strategic Reservoir Option (SESRO) on land to the west of Drayton; and

ii) A new River Thames abstraction to the west of Reading.

Both abstraction locations for T2ST would require prior completion of either SESRO or the Severn to Thames Transfer (STT) to provide a reliable water source for transfer to Hampshire.

Other potential T2ST abstraction locations from the River Thames upstream of Culham, between Culham and Reading or downstream of Reading have been ruled out on grounds of additional infrastructure, planning risk, cost, embedded and operational carbon and environmental and social impacts. Further detail on the abstraction locations is provided in Section 8.

At the proposed SESRO site to the west of Drayton, water for T2ST would be drawn by gravity from the reservoir outlet. New above ground infrastructure for T2ST at the SESRO site (comprising water treatment, water storage and high lift pumping station) would be located on open farmland to the northeast of the reservoir embankment on land proposed as the construction compound for the new reservoir. The T2ST abstraction location at the SESRO site, would avoid any requirement for new abstraction works on the banks of the River Thames, as water would be drawn from the new reservoir, not directly from the river.

In the event that STT proceeds without SESRO, it is expected that the T2ST infrastructure would be sited in the same location with a cross connection to the buried STT pipeline that is planned to cross the north of the SESRO site, prior to discharge to the Thames at Culham.

3.2. T2ST transfer destinations (Otterbourne or Testwood)

The T2ST Gate 1 options allow for the delivery of water to either Otterbourne (potable or raw water) or Testwood (raw water only).

At Otterbourne due to the limited space available for future development at the existing water treatment works site, (and scale of the T2ST transfer volumes) it was assumed for Gate 1 that a new satellite Otterbourne site, (located to the north of Otterbourne and south of Winchester) would be required to provide space for the necessary treatment/storage infrastructure to receive water from T2ST.

The Testwood raw water options were included within the Gate 1 options on the basis that potential storage capacity at Testwood Lakes could reduce the required capacity of the transfer. For Gate 1 no detailed assessment was made on the viability of storage at Testwood which is a key question in the decision between the Otterbourne and Testwood options, as discussed below in Section 5.

3.3. T2ST spur connections

For Gate 1 the following spur connections for the T2ST options were included through agreement with Southern Water and Thames Water.

- Southern Water; Kingsclere and Andover water resource zones (10Ml/d to each zone assumed for Gate 1);
- South East Water; Northgate and/or Whitedown near Basingstoke (10-20Ml/d); and
- Thames Water; Kennet Valley water resource zone (40Ml/d depending on potential sustainability reduction of the West Berkshire Groundwater scheme).

Note that the requirements and capacity of the T2ST spur connections have been further developed during Gate 2, as detailed within Section 6 of this report and the T2ST concept design report (doc ref: T2ST-G2-REP-07 (Annex A3).

4. T2ST Potable or Raw Water Transfers

As described under Section 3, the 6No. Gate 1 options comprise 2No. potable water options and 4No. raw water options. The choice to be made between potable or a raw water transfer is one of the fundamental questions that needs to be addressed in order to progress to selection of a preferred T2ST option to take forward in Gate 2.

The key issues relating to this decision between a potable or raw water transfer include: INNS transfer risk, water quality, infrastructure requirements, capex and opex, carbon costs and environmental and social impacts. Each of these issues is discussed below in relation to the T2ST options.

4.1. INNS transfer risk

The risk of invasive non-native species (INNS) including invertebrates and macrophytes being transferred between the Thames and Hampshire regions is of significant concern, particularly given the internationally recognised importance of the chalk stream environment in Hampshire including the River Test, River Itchen and chalk stream tributaries.

The Gate 1 INNS surveys carried out by Ricardo have shown a wide range of INNS species within the River Thames at the abstraction point to SESRO at Culham, and at other downstream locations along the river. At the proposed SESRO location, notable INNS species include signal crayfish, asian clam, zebra mussel, demon shrimp, acute bladder snail, trumpet ramshorn and Jenkin's spire shell snail. Further INNS surveys are continuing to inform the INNS assessments for the Thames Water SROs during Gate 2.

For the potable water options to Otterbourne, the abstracted water from SESRO or the River Thames to the west of Reading would be fully treated at source to drinking water quality standards, including coagulation and flocculation, dissolved air flotation (DAF), rapid gravity filtration (RGF), granular activated carbon (GAC), ozonation, and UV and chlorination disinfection. Hence all risk of INNS transfer along the T2ST pipeline between Thames and Southern would be removed at the point of abstraction for the potable water options.

In Gate 1, Natural England (NE) and the Environment Agency (EA) expressed concerns over potential raw water transfers as part of the Gate 1 consultation process and indicated a clear preference towards potable water transfers, due to INNS risk. Hence for the raw water options, robust pre-treatment of raw water would be required at the point of abstraction before water is pumped to Hampshire to reduce INNS risk at source. INNS transfer could result from leakage (or pipe bursts) from the pipeline at stream or river crossings, draining down sections of the T2ST main at washouts for repairs or maintenance purposes, or from transferring untreated raw water into the existing lakes at Testwood.

The required level of pre-treatment for the T2ST raw water options is expected to include screening, coagulation and flocculation, clarification, filtration and sludge processing. In addition, bio dosing to target species such as the zebra mussel that could potentially pass through the filtration process would also be required. Alternatively, chemical dosing (chlorine or chloride dioxide) could be used, but this approach would introduce associated disinfection by-products, which would require removal at the receiving water treatment works. Effectively the introduction of pre-treatment measures for the raw water options would results in splitting the water treatment into two treatments sites, with initial stages of treatment at the abstraction location up to and including rapid gravity filtration and sludge processing, and final stages of treatment located at the ends of the transfer pipelines including ozonation, GAC, UV and chlorination. Construction and operation of separate water treatment sites for the raw water options would increase capex and opex of the raw water options compared to the potable water options where all treatment processes would be located at the same location.

4.2. Water quality

4.2.1. Potable water transfers

It is expected that in normal year operation, T2ST will not be required to meet demand in Hampshire and that the transfer will be operated at a minimum sweetening flow only to maintain water quality within the transfer system. The transfer is only expected to be required at peak flow at times of extreme drought.

Conditioning flows would also be required to prevent build-up of sediment within the treated water mains, typically by operating the transfer scheme at full flow capacity for 1-2 hours per week.

The sweetening flow received by Southern Water will need to be blended with local sources within the receiving service reservoirs, and abstraction from local resources in Hampshire reduced accordingly. Given the length of the T2ST transfer the operational cost of the T2ST water will be higher than that of local Southern Water sources and hence the sweetening flow will need to be turned down to a minimum level, to maintain the operational readiness of the treatment process and quality of water within the T2ST transmission main and on-line storage tanks.

At Gate 1 a minimum sweetening flow of 30% peak flow capacity was assumed, which is a typical turn down flow rate for water treatment. Analysis of the transfer system storage capacity carried out at Gate 1 including pipeline and storage tank volumes showed that typical travel times for the T2ST potable options from the water treatment works to the receiving Southern Water network would be around 2-3 days at times of peak flow. At times of normal operation and sweetening flows of 30%, travel times increased to 9-10 days based on the Gate 1 assumptions which would require booster chlorination at intermediate break pressure tanks to maintain water quality.

Further analysis of sweetening flows and water storage requirements for Gate 2 is set out within the Concept Design Report (Annex A3).

4.2.2. Raw water transfers

For the raw water options new treatment plant would be located at the ends of the main transfer pipeline and at the ends of each spur connection to treat the water to drinking water standards prior to distribution. Pre-treatment works would also be required at the abstraction location to mitigate INNS risk.

As for the potable options a sweetening flow through the transfer system would be required to maintain the operational readiness of the treatment works located at the end of the raw water transfer pipelines. At Gate 1 a sweetening flow of 30% peak flow was assumed for both the raw water and potable options.

Based on the Gate 1 assumptions under peak flow conditions the travel time between Culham and Otterbourne would be around 2-3 days, and 9-10 days at minimum flow - the same travel times as for the potable water options. For the raw water options aeration plant would be required at intermediate storage tanks along the pipeline transfer system to maintain dissolved oxygen levels and remove the risk of stagnation. As for the potable options the treated sweetening flow through the receiving water treatment works would need to be distributed into supply by Southern Water.

Conditioning flows would also be required for the raw water options to prevent build-up of sediment within the transfer mains, typically by operating the transfer scheme at full flow capacity for 1-2 hours per week.

4.3. Infrastructure requirements

The required pumping station locations and power ratings, break pressure/storage tanks, pipeline route and size, and major pipe crossings of roads, railways and rivers, would be the same for both the potable and raw water options. A summary of infrastructure requirements for each of the 6No. options at Gate 1 assuming the 80Ml/d capacity scheme is provided in Appendix B. The infrastructure items for the 50 and 120Ml/d capacity options are the same as the 80Ml/d case (i.e. the same pipeline routes and pumping sites etc) with variations only in element sizing and have not been included in Appendix B to avoid repetition.

The main difference in infrastructure requirements between potable and raw water options is the requirements for water treatment. For the potable options a single new water treatment works would be required at the abstraction location at SESRO or from the River Thames to the west of Reading. Water would be fully treated and then pumped through the T2ST transmission main to Hampshire and through any required potable water spur connections, including Kingsclere and Andover.

For the raw water options new treatment works would be required in Hampshire at Otterbourne or Testwood and at the end of each spur main to provide treatment prior to distribution into supply. For example, for Option 2 (Culham to Otterbourne raw), three new treatment sites would be required at Otterbourne, Kingsclere, and Andover, compared to a single treatment site for the potable Culham to Otterbourne transfer option (Option 1). Treatment sites would also be required for the SEW raw water spur mains. (Note: for the proposed spur to Kennet Valley it has been assumed for Gate 1 that raw water from T2ST would be treated at the existing Fobney WTW).

In addition to multiple downstream treatment sites for the raw water options, pre-treatment measures would also be required at the abstraction locations to reduce the INNS transfer risk as set out in Section 4.1.

The provision of multiple new treatment sites and pre-treatment works, results in the raw water options having higher capex than potable water schemes, as presented in the Gate 1 costings. A summary of the Gate 1 capex for each option (at 80Ml/d) is provided in Table 4-1, which shows total capex for Option 1 (Culham to Otterbourne, potable) at £462.7m, compared to £540.5m for Option 2 (Culham to Otterbourne, raw), a difference of £77.8m (excluding optimism bias).

Comparative opex and carbon costs for the raw water options are shown in Table 4-2, which again show lower values for the potable options compared to raw water options. It is also noted that the Gate 1 costs the options at 50 and 120Ml/d, are relative to the 80Ml/d case with the same variation in costs between the 6No. options. The 50Ml/d and 120Ml/d costs are available within the gate 1 report but are not repeated here to avoid repetition.

Table 4-1 - Gate 1 Capex costs for 80Ml/d capacity

Option	Capacity (Ml/d)	Capex (£m)	Costed Risk (£m)	Optimism Bias (£m)	Total (£m)
1 – Culham to Otterbourne Potable	80	462.7	33.2	177.8	673.6
2 – Culham to Otterbourne Raw	80	540.5	39.3	207.8	787.6
3 – Reading to Otterbourne Raw	80	484.2	35.6	186.4	706.2
4 – Reading to Otterbourne Potable	80	399.6	29.0	153.6	582.1
5 – Culham to Testwood Raw	80	599.7	43.5	230.6	873.7
6 – Reading to Testwood Raw	80	543.4	39.8	209.1	792.3

Table 4-2 - Gate 1 Opex and Carbon costs for 80Ml/d capacity

Option	Capacity (Ml/d)	Fixed Operational Annual Costs (£m/annum)	Variable Operational Annual Costs (£/Ml)	Total Operational Annual Costs (£/Ml)	Embedded Carbon (tCO2e)	Operational Carbon (kgCO2e/Ml)
1 – Culham to Otterbourne Potable	80	1.59	289	344	110,876	18.11
2 – Culham to Otterbourne Raw	80	2.21	287	363	129,573	18.11
3 – Reading to Otterbourne Raw	80	2.10	261	333	118,095	16.99
4 – Reading to Otterbourne Potable	80	1.46	262	311	98,282	15.95
5 – Culham to Testwood Raw	80	2.32	287	367	144,444	18.11
6 – Reading to Testwood Raw	80	2.22	261	336	132,966	16.99

It is also noted that if spur connections are required to SEW then additional treatment sites would be required at the ends of these spurs, thus further reducing the cost effectiveness of the raw water options (not included in the Gate 1 costs). Given the increase in the number of treatment sites and associated land take area, it follows that the raw water options would also have a higher embedded carbon value and environmental and social impact compared to the potable water options.

For the Kingsclere and Andover spur connections it was noted at the first options appraisal workshop on 8th September 2021 that there could be a possibility of constructing a single treatment works close to the T2ST pipeline with treated water pipelines to Kingsclere and Andover. This solution would reduce the number of treatment sites for the raw water options but would still require multiple treatment sites and would also likely result in additional pipeline lengths for the spur connections.

Opex costs for raw water transfers would be marginally higher than potable options due to the increase in the number of treatment sites. Pumping costs for raw water options would also be marginally higher than potable water options due to process losses at the receiving treatment works, i.e the sweetening flows for the raw water options would be marginally higher than for potable options.

The Gate 1 costs shown within Table 4-1 and Table 4-2 are at 80Ml/d capacity. As expected, the Gate 1 costs at 50 and 120Ml/d show the same relative differences between the 6No. options, with lower capex and opex for the potable options compared to the raw water options but for clarity are not included within this report.

4.4. Environmental and Social impacts

The main environmental and social issues differentiating between raw and potable solutions are;

(i) The risk of invasive non-native species (INNS);

(ii) Land requirement for infrastructure (affecting designated sites) and impacts from construction activities; and

(iii) Impacts from material requirements, including embedded and operational carbon.

The land requirement for raw water transfers is greater than potable water transfers due to the need for multiple new treatment sites and pre-treatment works. In addition to the land use impacts, the additional construction activities for the raw water options are also likely to impact the amenity of local communities.

The installation and operation of additional infrastructure for raw water transfers compared to potable water options also results in an additional need for materials and higher embedded and operational carbon emissions. This is an additional impact beyond the impact of the potable transfer options.

4.5. Planning consent risks

Given the increased number of treatment sites for the raw water options and land take requirements, there is the potential that planning consent risks would be higher than for the potable water options. This would be assessed in detail if raw water options are taken forward.

5. Otterbourne or Testwood

The existing 6No. Gate 1 options include delivery of T2ST water to either Otterbourne WTW to the south of Winchester or to Testwood WTW to the northwest of Southampton.

5.1. Otterbourne

Given existing space constraints within the existing Otterbourne WTW works boundary, it was assumed for Gate 1 that a new satellite site to the north of the existing Otterbourne site would be required for the T2ST options. The site identified in Gate 1 would be located on open farmland approximately 3km north of the existing Otterbourne site, to provide space for construction of the required T2ST infrastructure (water treatment and/or storage tanks depending on whether potable or raw options are selected).

A key advantage of the Otterbourne location over Testwood is that the transfer distance from Culham or Reading is approximately 15km shorter than the Testwood options. Hence the capex estimates for the Otterbourne options within the Gate 1 report are significantly lower than the Testwood options due to the reduction in transfer distance (See Table 4-1 above).

There is unlikely to be any opportunity for utilising the existing treatment works at Otterbourne to treat T2ST water for the raw water transfer option as the works is planned to be at full capacity from other sources during a 1:500 year drought. In addition, the existing works has been designed to treat water abstracted from the River Itchen and chalk aquifer, not water from the River Thames, and hence could not be used to treat T2ST water without refurbishment of the existing treatment process. Hence for Gate 1 it was assumed that a new WTW for T2ST water would be required to the north of Otterbourne for the raw water options.

For the potable options to Otterbourne, T2ST could connect into existing service reservoirs within the Otterbourne area. T2ST could also potentially utilise capacity provided by the planned WRMP19 Otterbourne to Andover link main. Further work in Gate 2 will be undertaken to investigate these opportunities should the Otterbourne potable water options proceed and once further information on the required capacity of T2ST is known from the WRSE regional plan.

5.2. Testwood

5.2.1. Testwood Lakes

The Testwood lakes complex is a Southern Water owned asset located directly to the northwest of Testwood WTW. The current utilisation of the lakes is as follows:

Little Testwood Lake is an operational bankside storage reservoir linked via the lakes pumping station to Testwood WTW. Water is abstracted from the intake on the River Test and then either pumped to Little Testwood Lake (for turbidity reasons) and then to Testwood WTW, or it is pumped directly to the works where it is treated to produce potable water and pumped into the distribution system. Little Testwood Lake has a storage capacity of approximately 250Ml. It has been stocked as a course fishery, and fishing by two local clubs began in June 2002. A car park and toilet facilities have been provided for the fishing clubs.

Testwood Lake – is a body of groundwater (flooded gravel workings) developed as a nature conservation and recreational resource. The lake has an estimated capacity of 500Ml. Southern Water was granted planning permission to develop Testwood Lake as a reservoir in 1994, but in 2000 Ofwat declined to make allowance in price limits for this option development. As Southern Water had already extracted the majority of the gravel, it proposed an interim restoration scheme to realise the amenity, recreational and nature conservation value of the site. This was granted planning permission by New Forest District Council (NFDC) in 2003, subject to a Legal Agreement that allowed Southern Water until August 2010 to implement its original reservoir permission.

Land surrounding the lake has been developed as an amenity area with a network of footpaths and includes a public car park. The lakes pumping station that serves Little Testwood Lake has been built with capacity for Testwood Lake as well, but the final connections into the lake, including inlet and discharge structures, are not in place.

Meadow Lake - originally proposed as a third reservoir on the Testwood Lakes site but has not been developed. This part of the site has been developed as a shallow nature conservation 'mere' and has no water storage capacity.

Testwood Centre – is an Interpretation Centre, run by Hampshire and Isle of Wight Wildlife Trust (HWT). The Centre is used by schools, community groups, conservation volunteers and visitors. The Centre has its own car park.

5.2.2. Potential Use of Current Lakes for T2ST Storage

During Gate 1 the Testwood raw water options were included on the basis that potential enhanced storage capacity at Testwood Lakes could be utilised by T2ST prior to water treatment. If storage volumes were of a sufficient scale, then this buffer storage could reduce the required peak capacity of the transfer system from the River Thames. Southern Water had previously excluded the Testwood Lakes as a storage option within WRMP19.

As mentioned above, Little Testwood Lake has a volume of 250Ml and is used as an operational bankside storage reservoir, where water can be drawn from the lake into Testwood WTW as an alternative to direct river abstraction during periods of high turbidity/or pollution events within the River Test. The larger Testwood Lake has an estimated volume of approximately 500Ml but has no operational use as a water supply reservoir.

Given that both lakes are unlined and in hydraulic connectivity with the underlying river gravels there is no opportunity for utilising the current lake capacity for T2ST. In most years the lakes will be full and hence will have no spare capacity to store any new water from T2ST; and storing raw water from the River Thames within an unlined lake would not be acceptable to NAU for environmental reasons.

The only possible option would be to raise the embankments around the Testwood Lake and Little Testwood Lake, as the original Southern Water Reservoir planning application in 1991. However as described above the Testwood Lakes site was restored for amenity, recreational and nature conservation use in 2002 when an allowance in price limits for the original reservoir scheme was declined by Ofwat in 2000. The legal agreement with the planning authority that allowed Southern Water permission to develop the reservoir site by 2010 has since lapsed. The site, whilst owned by Southern Water, is now managed as an amenity and conservation site by the Hampshire and Isle of Wight Wildlife Trust and bringing any proposals forward now to increase the storage volume of the lakes would be challenging. The site is well used by the local community for recreation and educational visits. The Wildlife Trust claims that the site is now the most significant wading bird breeding site in the Test Valley.

Developing either lake for additional water storage would require draining the lake and translocation of fish stocks; deepening the lakes by extracting sands and clays from the lake bed to win material for the embankment construction and to provide additional storage volume; lining permeable areas of the lake bed either with a geomembrane or placement of clay lining; removal of existing mature trees around the edge of the lakes; and construction of new embankments around the lake perimeter to a height of around 6m above existing ground level.

Hence construction works would result in the temporary loss of existing ecology within the existing footprint of the lakes and embankment areas, which is within the amenity and conservation area managed by the Wildlife Trust.

In addition to the sensitivity of the lakes regarding amenity and ecology, raising of the lakes would have significant flood risk challenges. Both lakes are within Flood Risk Zone 3 (>1% risk of flooding). Planning policy indicates that the development would fall under Essential Infrastructure, and is therefore permitted in FZ3 but subject to providing compensatory floodplain storage and passing the Exception Test. This would require providing level for level compensation storage which given the location of the site bounded to the south by the Solent and Southampton Water Ramsar and Special Protection Area (SPA) and the M27 to the north, would be difficult to achieve. The scheme would also need to pass the Exception Test for development within FZ3, i.e. 1) demonstrate that the site will provide wider sustainability benefits to the community that outweigh flood risk, and 2) demonstrate that it will be safe for its lifetime without increasing flood risk elsewhere, and where possible reduce flood risk overall.

5.2.3. Broadlands Lake

Another potential storage option at Testwood would be the raising of Broadlands Lake, which is located to the north of Testwood Lake, immediately south of the M27 (a Southern Water WRMP19 option). Broadlands Lake

is a privately owned carp fishery and is recognised as one of the most popular fishing lakes in the Hampshire area. The lake is surrounded by mature trees around the edge of the lake and includes two wooded islands. The lake is understood to be fed from a carrier of the River Test.

As for Testwood Lake there is no existing spare capacity within the lake that could be used for T2ST water, and the lake is also unlined and hence storage of water from the River Thames would not be acceptable to NAU for environmental reasons. Potentially the lake could be compulsorily acquired by Southern Water and raised to provide storage capacity for T2ST. However, similar issues to those of raising Testwood Lake would apply, in terms of loss of existing ecology to drain, excavate, line and raise the lake, loss of current amenity value as a community valued fishing lake, and location of the existing lake within Flood Zone 3. Hence the scheme would need to provide level for level compensatory floodplain storage and pass the Exception Test.

5.3. Environmental and Social impacts

Due to the presence of the Solent & Southampton Water Ramsar site and SPA near the Testwood site and the Testwood site being located within Flood Zone 3, Otterbourne would be a preferred receptor site with regards to biodiversity and water impacts, although mitigation at Otterbourne would need to be included to reduce impacts associated with the potential landscape, historic environment and population and human health impact during construction. The transfer length for the Otterbourne options would also be approximately 15km shorter than delivering water to Testwood and hence the Otterbourne options would have reduced environmental & social impact and reduced embedded carbon impacts compared to the Testwood options.

5.4. Planning consent risks

Given the concerns stated above regarding the sensitivity of the site as an amenity and conservation area and the location of the lakes within Flood Zone 3, it is likely that any raising scheme for Testwood Lakes or Broadlands Lake to provide storage capacity for T2ST would be challenging to consent, particularly as other options are available other than delivering T2ST water to the Testwood site.

6. T2ST Spur connections

The scale and timing of spur connections from T2ST main to Andover, Kingsclere, and potentially to SEW and Thames Water Kennet Valley, will have an impact on the capacity and timing of the T2ST scheme. The Gate 2 position of each of these spur connections is provided below. Further details are provided within the Gate 2 Concept Design Report (Annex A3).

6.1. Andover

The Gate 1 options assumed a 10Ml/d capacity spur connection to the Andover water resource zone to meet potential long term demand for both potable and raw water options. For the raw water options a new water treatment works was assumed at Gate 1, located to the south of Andover on open farmland to the east of the River Anton. The potable water options assumed a connection to an existing service reservoir to the south-east of Andover on Micheldever Road.

Through consultation and agreement with Southern Water the capacity of the Andover spur main has now been sized at 45Ml/d for Gate 2 for all T2ST options. In drought conditions 20Ml/d from T2ST would supply the town of Andover, with the remaining 25Ml/d pumped through the planned Southern Water AMP8 Andover to Crabwood pipeline.

6.2. Kingsclere

The Gate 1 options assumed a 10Ml/d capacity spur connection to the Kingsclere water resource zone to meet potential long term demand for both potable and raw water options. For the raw water options, a new water treatment works was assumed at Gate 1 to be located adjacent to the Kingsclere service reservoir to the south of Kingsclere on open farmland. The potable water options assumed a connection to the Kingsclere service reservoir and an extension to the tank capacity.

For Gate 2 the capacity of the Kingsclere spur has been reduced from 10Ml/d to 5Ml/d with a connection into the Beacon Hill service reservoir for all options.

6.3. SEW (Northgate)

South East Water (SEW) and WRSE have developed an option for a spur connection from the T2ST transfer main to supply Northgate WSR to the south of Basingstoke, at 10Ml/d and 20Ml/d capacity. SEW have advised that the T2ST spurs to Northgate and Whitedown have not been included to date in the WRSE modelling. These spurs would not be selected as the Company's supply demand balance to 2075 is met by proposed demand management measures and bulk supplies from Affinity Water.

Whilst this option has been identified and modelled by WRSE the offtake has not been selected by the WRSE Regional plan. Hence no consideration of this spur has been included as part of the T2ST concept design for Gate 2. As for the Kennet Valley connection, the need for a T2ST connection to SEW will be reviewed as latest WRSE modelling outputs become available.

6.4. TW (Kennet Valley)

TW have also identified a potential spur connection from the T2ST pipeline to provide support to the Kennet Valley water resource zone, at Newbury (10Ml/d) and Reading (40Ml/d). These options have been included in the latest WRSE modelling. The potential need for a spur connection to Kennet Valley will be kept under review post-Gate 2 as the WRSE Regional Plan is finalised.

6.5. Environmental and Social impacts

The environmental and social impacts of the T2ST spur mains will depend on the pipe length and location in relation to designated sites and other sensitive receptors. Further work on the spur alignments to minimise impacts will be undertaken once the preferred Gate 2 options have been identified.

6.6. Planning consent risks

Planning consent risks associated with the spur mains will be assessed and where possible minimised through careful routing of the spur mains once the preferred Gate 2 options are identified.

7. Abstraction location, Culham or Reading

7.1. Potential abstraction locations

Two abstraction locations for the T2ST options were identified during Gate 1 as follows:

1) **Abstraction directly from SESRO/STT on land to the west of Drayton.**
T2ST infrastructure comprising treatment works, storage tanks and pumping station located on land used as the construction compound for the proposed reservoir to the northeast of the reservoir embankment. In the event that Severn to Thames Transfer (STT) proceeds instead of SESRO, it is expected that T2ST infrastructure would be located on the same site with a buried pipeline connection to the STT pipeline which is planned to pass to the north of SESRO prior to discharge to the River Thames at Culham.

2) **A new river abstraction from the River Thames located to the west of Reading**.
T2ST infrastructure to include a new riverside pumping station located on the south bank of the River Thames, together with treatment works, storage tanks and pumping station.

An assessment of potential alternative abstraction sites undertaken by the T2ST technical team as part of the Gate 2 options appraisal has concluded that there are no viable abstraction sites for the T2ST SRO scheme, other than the 2No. Gate 1 abstraction locations stated above.

7.1.1. Alternative abstraction locations north of Culham

Abstraction locations from the River Thames upstream of the identified Gate 1 abstraction at Culham have been shown to be unviable and can be ruled out at this stage, without the need for any further investigation. The main reasoning for this conclusion is that any abstraction from the River Thames north of Culham would be upstream of the proposed abstraction and discharge point for SESRO/STT. Hence any new abstraction from the river upstream of Culham could not be supported by flow releases from SESRO or STT and hence no water source for T2ST would be available.

In the event that STT proceeds without SESRO it is apparent that the optimum location for a cross connection from the STT pipeline would be at the SESRO site west of Drayton. There would be no advantage in moving the T2ST connection to STT further west/north along the STT pipeline as this would increase the length of the T2ST transfer and associated costs, consenting risks and environmental impacts. Likewise, there would be no advantage in moving the T2ST connection to the east of the A34, between the A34 and the River Thames, as this would also increase the T2ST transfer length and require a further crossing of the A34.

On this basis, alternative abstraction locations from the River Thames to the north of Culham for T2ST have been ruled out.

7.1.2. Alternative abstraction locations between Culham and the Gate 1 location to the west of Reading

Abstraction locations to the east of the A34 between Culham and Dorchester would increase the T2ST transfer length, compared to the Gate 1 SESRO/STT abstraction location to the west of Drayton and would also introduce the need for a further major infrastructure crossings (A34) and potentially a crossing of the mainline railway between Oxford and Didcot, leading to additional costs and engineering risks and complexities, compared to the Gate 1 SESRO/STT abstraction location to the west of Drayton.

Abstraction locations from the River Thames between Dorchester and the Gate 1 abstraction location to the west of Reading, lie within the North Wessex Downs AONB, as for the Gate 1 Reading abstraction location. Alternative abstraction locations within this river reach would involve a greater length of pipeline construction within the AONB compared to the Gate 1 abstraction to the west of Reading. Hence these locations would not lead to any consenting benefits over the identified Gate 1 location.

On this basis, any alternative abstraction locations between Culham and the Gate 1 abstraction location to the west of Reading have been ruled out at the Gate 2 options appraisal stage.

7.1.3. Alternative abstraction locations downstream of the Gate 1 location to the west of Reading

Locations downstream of the identified Gate 1 location to the west of Reading, once outside of the AONB, would present consenting benefits over the Gate 1 location, however the land becomes heavily developed into Reading and available locations for abstraction and treatment and/or pumping locations are not available until the east of Reading. Locations beyond Reading would involve significant additional pipeline lengths and engineering complexities with routeing through the urban area or around Reading, and associated social impacts, although these would reduce the length of pipeline through the AONB.

On this basis alternative abstraction locations downstream of the Gate 1 abstraction location to the west of Reading have been ruled out.

7.2. Comparison of consenting advantages and disadvantages

Having ruled out any alternative locations (Section 7.1) a high level comparison of the consenting advantages and disadvantages of the two abstraction locations has been undertaken, as part of the option appraisal process. This review focused on:

- Planning and environmental designations relevant to the abstraction location itself; and
- Planning and environmental designations relevant to the pipeline transfers from those locations to Otterbourne.

The results of the high level review are presented in Table 7-1, from which the following findings are made:

- Based solely on abstraction locations, there would be a preference for the SESRO/STT abstraction location west of Drayton over the location to the west of Reading in consenting terms, as the SESRO/STT location is located outside of the AONB and development there avoids AONB impacts from the abstraction, pumping station and treatment plant;
- There could be the potential to reduce the impacts on the AONB to the west of Reading if it was possible to relocate the treatment plant approx. 5km downstream of the abstraction, such that it would be outside of the AONB. However, the intake, screens and pumping station would remain a consenting risk, being within the AONB; and
- Based solely on the transfer pipelines, there would be a preference for the transfer from the west of Reading over the transfer from the SESRO/STT location, as this option has a significantly shorter length of pipeline within the AONB (approx. 11-13km compared to 40km); and
- There could be the potential to further reduce the length of pipeline in the AONB for the west of Reading abstraction, depending on detailed work on routeing of spur connections currently indicated to be within the AONB. There would appear to be less potential to reduce the length of pipeline within the AONB from SESRO/STT, without significantly increasing the overall pipeline length.

On the basis of this, it was concluded at the end of the options appraisal stage in December 2022 that there was insufficient differentiation between the two options to down select one of the abstraction locations based on consenting risk; and that it would be preferable in consenting terms, for sites for both the SESRO/STT and west of Reading abstraction locations and associated pipeline route options to be taken forward for more detailed assessment in the Gate 2 route and site selection process.

The results of the high level consenting review are outlined below, based on the Gate 1 Options at 80Ml/d capacity. Note estimated site sizes are indicative and do not include temporary construction working areas.

Table 7-1 - Results of the High Level Review

Abstraction location / Pipeline transfer	Planning and environmental designation or constraint	Comments on potential consenting risk
<u>SESRO/STT abstraction location:</u> Estimated 5ha site for • Water treatment plant; • Treated water storage tank; and • High lift pumping station	• Outside AONB - within countryside; • Could avoid nature conservation designations; • Could be located outside of floodplain; • Relatively isolated from local communities / sensitive land uses; and • Would be in proximity to SESRO or STT infrastructure.	• There are no in principle planning constraints or designations that might prevent major new water resources infrastructure being consented in this general location, subject to details of the scale and design of the scheme, its impacts, mitigation and enhancement measures; and • Development should avoid floodplain and designated natural and built environment features or mitigate impacts on them.
<u>SESRO/STT Pipeline transfer infrastructure (and associated spurs):</u> • Buried pipeline (900mm diameter for main pipe and 400mm for spurs); and • Above ground infrastructure (AGI) –	• Gate 1 route has approx. 32km of the main pipeline route within the AONB, plus a further 11km of spur connection pipelines; • AGI largely located outside of AONB, although one break pressure tank (BPT) lies within it; and • Pipeline passes through a largely rural environment with numerous	• Over 40km of buried pipeline within the AONB brings consenting risk relating to the draft NPS for Water Resources (dNPS), as 'exceptional circumstances' will need to be demonstrated to secure consent; • This will require detailed assessment of alternative options that avoid the AONB (dNPS refers to the "scope for and cost of developing outside the designated landscape, or meeting the need in some other way"), and/or reduce the length of pipeline within it (and/or reduce impacts on the AONB); • There would only be limited potential to reduce the length of buried

Abstraction location / Pipeline transfer	Planning and environmental designation or constraint	Comments on potential consenting risk
various locations - estimated site sizes range from 0.25ha to 1.5ha.	environmental designations that will need to be avoided through detailed route and site selection work.	pipeline within AONB through route selection, without significantly increasing pipeline length. This applies to both the main pipeline and spurs; and • There could be potential to bury the BPT, but with greater construction cost and impact.
<u>West of Reading abstraction location:</u> Estimated 0.1ha site on river bank for intake, screens, low lift pumps and control building. Estimated 5ha site for • High lift pumping station; • Treated water storage tank; and • Water treatment plant.	• Gate 1 locations within AONB; • Northernmost sites within floodplain; • Open undeveloped land; • Thames Path runs along river bank; and • Environmental designations (including SSSI) affecting individual sites in area.	• Locating intake, screens, pumping station and water treatment works within the AONB brings consenting risk relating to the draft NPS for Water Resources (dNPS), as 'exceptional circumstances' will need to be demonstrated to secure consent; • This will require detailed assessment of alternative options that avoid the AONB (dNPS refers to the "scope for and cost of developing outside the designated landscape, or meeting the need in some other way"), and/or reduce the amount of infrastructure within it (and/or reduce impacts on the AONB); and • There may (subject to detailed assessment) be the potential to locate some of the infrastructure outside of the AONB (e.g. moving the treatment works 5km down the pipeline). This would reduce impacts on the AONB. There might also be the potential to bury some infrastructure, however intake structure and screens would remain highly visible on the river bank.
<u>West of Reading Pipeline transfer infrastructure (and associated spurs):</u>	• Gate 1 route has approx. 5-6km of the main pipeline route within the AONB, plus a further 6-7km of spur connection	• Between 11-13km of buried pipeline within the AONB brings consenting risk relating to the draft NPS for Water Resources (dNPS), as 'exceptional circumstances' will need to be demonstrated to secure

Abstraction location / Pipeline transfer	Planning and environmental designation or constraint	Comments on potential consenting risk
• Buried pipeline (900mm diameter for main pipe and 400mm for spurs); and • AGI – various locations - estimated site sizes range from 0.25ha to 1.5ha.	pipelines; • AGI located outside of AONB; and Pipeline passes through a largely rural environment with numerous environmental designations that will need to be avoided through detailed route and site selection work.	consent; • This will require detailed assessment of alternative routeing options that avoid the AONB (dNPS refers to the "scope for and cost of developing outside the designated landscape, or meeting the need in some other way"), and/or reduce the length of pipeline within it (and/or reduce impacts on the AONB); and • There may be potential to reduce the length of buried spur pipelines within AONB through route selection.

8. Conclusions and Recommendations

Following completion of the Gate 2 T2ST Options Appraisal, the conclusions and recommendations from this process are as follows:

8.1. Conclusions

1. Potable water options are preferred to raw water options, on the basis that potable options would only require one treatment site, compared to multiple treatment sites for the raw water options. Potable options have therefore less land take requirements and less associated social and environmental impact than raw water options. Raw water options to either Testwood or Otterbourne would also require pre-treatment works at the abstraction locations to reduce INNS transfer risk. The requirements for multiple treatment sites and pre-treatment measures result in raw water options having higher capex and opex compared to potable options;
2. Whilst there are lower consenting risks associated with the SESRO/STT abstraction location compared to the west of Reading location (principally related to the AONB), the position is complicated by the fact that a transfer pipeline from SESRO/STT involves significantly greater lengths of pipeline construction in the AONB than a transfer from the west of Reading. As a result, it is not yet possible to conclude that one location is preferable to the other in consenting terms. This can be investigated in more detail through the planned route and site selection work, and engagement with stakeholders as part of that process; and
3. Based on the conclusions above it is concluded that the potable water options (1 and 4) are preferred options to take forward into concept design, as documented within the options screening results in Appendix A. Only Options 1 and 4 pass through the secondary screening stage.

8.2. Recommendations

Further work for completion during the Gate 2 concept design stage is recommended as follows:

1. It is recommended that the 4No. raw water options to Otterbourne and Testwood (Options 2,3, 5 and 6) are ruled out at this stage and not progressed beyond the Gate 2 options appraisal stage. Work should progress on the 2No. potable water options, Culham to Otterbourne (Option 1) and Reading to Otterbourne (Option 4).
2. Based on consenting risks, both SESRO/STT and west of Reading abstraction locations and pipeline transfer options relating to them to Otterbourne (Options 1 and 4) should be taken forward for more detailed route and site selection work.
3. Engagement with stakeholders (AONB Management Unit, National Assessment Unit (NAU) and the Local Planning Authorities) should be undertaken during the route and site selection work to test and review the AONB consenting risk relating to the options.
4. Further work is required to consider the connectivity of T2ST to the Southern Water network in Hampshire for Options 1 and 4. This includes connections to existing service reservoirs within the Otterbourne area and potential T2ST utilisation of the proposed Otterbourne to Andover link main. This work will be informed by the required T2ST capacity required by the WRSE Regional plan.
5. Further consultation with Thames Water and Southern Water concerning requirements for the spur connections to Andover, Kingsclere, and Kennet Valley, as information from the WRSE regional plan becomes available. Also consult with South East Water to confirm no requirement for the Basingstoke spur.
6. Further consultation with Thames Water's WRMP24 team regarding the SESRO/STT SWOX transfer, as information from the WRSE regional plan becomes available.

7. Further consultation with the SESRO and STT SRO teams regarding interface of the T2ST abstraction works at the SESRO/STT site.

Appendices

Appendix A. Option screening results

A.1. T2ST Gate 2 Options Appraisal Screening Spreadsheet

A.1.1. Unconstrained Gate 1 Options

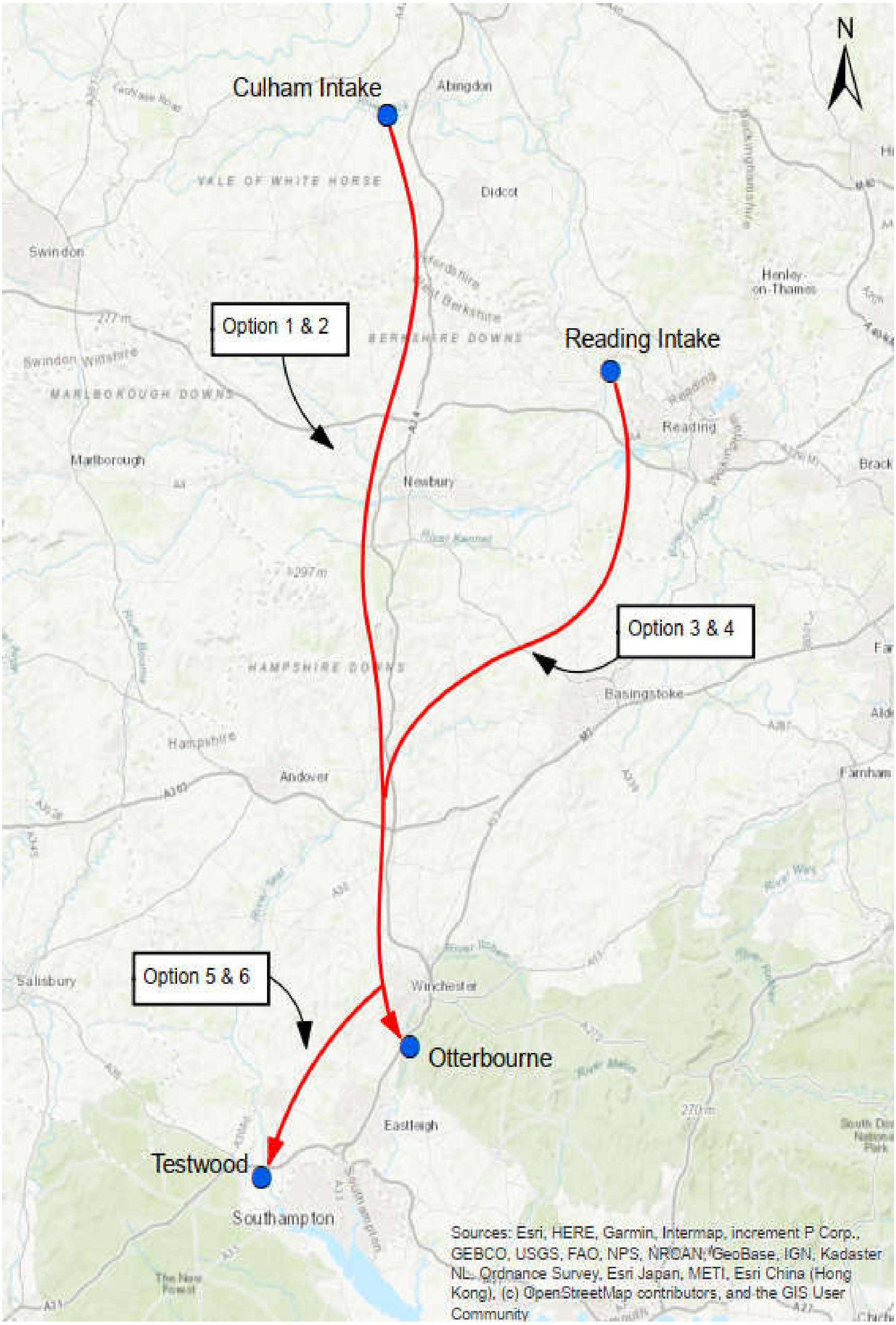
Thames to Southern Transfer T2ST SRO
Unconstrained Options List (Gate 1 Options)

Option Ref:	Option Name	Option Description
1	Potable water transfer from Culham to Otterbourne WTW	Transfer of potable water from the SESRO/STT site west of Culham to Otterbourne. Water provided from either SESRO or the Severn to Thames Transfer (STT). Water treatment at SESRO/STT site and transfer to SRN Otterbourne supply area. This option also includes potable water offtakes to the SRN Andover and Kingsclere water resource zones. Potable water spur connections to SEW (Whitedown or Northgate), and Kennet Valley may also be required.
2	Raw water transfer from Culham to Otterbourne WTW	Transfer of raw water from the SESRO/STT site west of Culham to Otterbourne. Water provided from either the Severn to Thames Transfer (STT) or SESRO. Raw water transfer to SRN Otterbourne supply area with water treatment located at end of transfer pipeline and spur connections. This option includes raw water offtakes to the SRN Andover and Kingsclere water resource zones. Raw water spur connections to SEW (Whitedown or Northgate), and Kennet Valley may also be required.
3	Raw water transfer from the River Thames west of Reading to Otterbourne WTW	Transfer of raw water from the River Thames, west of Reading to Otterbourne. Water provided from either the Severn to Thames Transfer (STT) or SESRO. Raw water transfer to SRN Otterbourne supply area with water treatment located at end of transfer pipeline and spur connections. This option also includes raw water offtakes to the SWS Andover and Kingsclere water resource zones. Raw water Spur connections to SEW (Whitedown or Northgate), and Kennet Valley may also be required.
4	Potable water transfer from the River Thames west of Reading to Otterbourne WTW	Transfer of potable water abstracted from the River Thames west of Reading to Otterbourne. Water provided from either SESRO or the Severn to Thames Transfer (STT). Water treatment west of Reading and transfer to SRN Otterbourne supply area. This option also includes potable water offtakes to the SRN Andover and Kingsclere water resource zones. Potable water spur connections to SEW (Whitedown or Northgate), and Kennet Valley may also be required.
5	Raw water transfer from Culham to Testwood.	Transfer of raw water from the SESRO/STT site west of Culham to SRN Testwood WTW. Water provided from either the Severn to Thames Transfer (STT) or SESRO, and raw water transfer to SRN Testwood WTW. Water treatment located at end of transfer pipeline. This option also includes raw water offtakes to the SWS Andover and Kingsclere water supply zones. Raw water spur connections to SEW (Whitedown or Northgate), and Kennet Valley may also be required.
6	Raw water transfer from the River Thames west of Reading to Testwood.	Transfer of raw water from the River Thames west of Reading to SRN Testwood WTW. Water provided from either the Severn to Thames Transfer (STT) or SESRO, and raw water transfer to SRN Testwood WTW. Water treatment located at end of transfer pipeline. This option also includes raw water offtakes to the SWS Andover and Kingsclere water supply zones. Raw water spur connections to SEW (Whitedown or Northgate), and Kennet Valley may also be required.

A.1.2. Initial Screening

Option Description	Thames to Southern Transfer T2ST SRO: Initial Screening Stage (Pass/Fail)							
	1. Delivery underway Description for Fail: Option already delivered/delivery is underway, and option under delivery cannot be scaled up in any way. Evidence for Audit: Reference to show delivery underway. (Business plan reference, confirmation by [Name, role, date], etc). Explanation as to why not scalable.	**2. Duplication** Description for Fail: Option is duplicated with another on the unconstrained list. Evidence for Audit: Duplicate option reference, name, type and capacity. Reference to which named option is removed/which kept in.	**3. Comparative rejection** Description for Fail: There are multiple mutually exclusive options and it is clear, even at this early stage, and without any further investigation being needed that a significantly better value option variant is available. Assessment for transfers to include a comparison of length of transfer 'as the crow flies'. Evidence for Audit: Preferred feasible option reference and clear evidence for why another option is significantly better value in terms of appraisal metrics (cost, yield, resilience, etc)	**4. Superseded** Description for Fail: Option has been superseded by another to make it no longer relevant. Evidence for Audit: Superseded feasible option reference and clear evidence for why this option is no longer valid	**5. Low flow availability** Description for Fail: Option would require abstraction beyond current licensed limits at times of low flow AND relevant CAMS specifies water not available for licensing OR relevant source subject to sustainability reductions which would make any further increase in abstraction unviable. Evidence for Audit: Abstraction licence volume v proposed volume. CAMS document and water body name. WINEP status (for sustainability reductions).	**6. CAMS resource reliability** Description for Fail: Option would require abstraction beyond current licensed limits when flows are above a certain threshold AND CAMS resource reliability at the required threshold insufficient for the option to be feasible. Evidence for Audit:Reference to abstraction licence volumes. CAMS document and water body name.	**7. 3rd party water availability** Description of Fail: Third party constraints make the option completely unviable AND there is no scope to develop a shared option which would overcome the third-party constraints. Evidence for Audit: Specify the constraints and why they are insurmountable, e.g. CAMS resource reliability, low flow availability, water required locally, etc. Cost unlikely to be a legitimate reason.	**8. SEA Criteria** Description of Fail: Option has a direct or likely impact, (Footprint or associated impact are within 100m) on: - Special Area of conservation - Sites of specific scientific Interest - Special protected areas - Ramsar Sites - Scheduled Monuments AND impact(s) cannot be mitigated sufficiently to make the option viable. Evidence for Audit: ArcGIS ATLAS tool outputs/maps: reference to SEA criteria and why mitigation not possible.
Option 1: Potable water transfer from Culham to Otterbourne WTW	**PASS** T2ST is a long term resilience scheme for the SE Region that will not be constructed until post 2040 following Severn Trent Transfer or SESRO	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. All T2ST options will require support from either SESRO or STT, to maintain sweetening flows and bulk water supplies to Southern Water.	**PASS** Pipeline routes and new pumping station and water treatment assets will be located to avoid impacts on designated sites wherever possible. Where designated sites cannot be avoided and are crossed by the pipeline, environmental impacts will be mitigated sufficiently using trenchless construction.
Option 2: Raw water transfer from Culham to Otterbourne WTW	**PASS** T2ST is a long term resilience scheme for the SE Region that will not be constructed until post 2040 following Severn Trent Transfer or SESRO	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. All T2ST options will require support from either SESRO or STT, to maintain sweetening flows and bulk water supplies to Southern Water.	**PASS** Pipeline routes and new pumping station and water treatment assets will be located to avoid impacts on designated sites wherever possible. Where designated sites cannot be avoided and are crossed by the pipeline, environmental impacts will be mitigated sufficiently using trenchless construction.
Option 3: Raw water transfer from Reading to Otterbourne WTW	**PASS** T2ST is a long term resilience scheme for the SE Region that will not be constructed until post 2040 following Severn Trent Transfer or SESRO	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. All T2ST options will require support from either SESRO or STT, to maintain sweetening flows and bulk water supplies to Southern Water.	**PASS** Pipeline routes and new pumping station and water treatment assets will be located to avoid impacts on designated sites wherever possible. Where designated sites cannot be avoided and are crossed by the pipeline, environmental impacts will be mitigated sufficiently using trenchless construction.
Option 4: Potable water transfer from Reading to Otterbourne WTW	**PASS** T2ST is a long term resilience scheme for the SE Region that will not be constructed until post 2040 following Severn Trent Transfer or SESRO	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. All T2ST options will require support from either SESRO or STT, to maintain sweetening flows and bulk water supplies to Southern Water.	**PASS** Pipeline routes and new pumping station and water treatment assets will be located to avoid impacts on designated sites wherever possible. Where designated sites cannot be avoided and are crossed by the pipeline, environmental impacts will be mitigated sufficiently using trenchless construction.
Option 5: Raw water transfer from Culham to Testwood WTW	**PASS** T2ST is a long term resilience scheme for the SE Region that will not be constructed until post 2040 following Severn Trent Transfer or SESRO	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. All T2ST options will require support from either SESRO or STT, to maintain sweetening flows and bulk water supplies to Southern Water.	**PASS** Pipeline routes and new pumping station and water treatment assets will be located to avoid impacts on designated sites wherever possible. Where designated sites cannot be avoided and are crossed by the pipeline, environmental impacts will be mitigated sufficiently using trenchless construction.
Option 6: Raw water transfer from Reading to Testwood WTW	**PASS** T2ST is a long term resilience scheme for the SE Region that will not be constructed until post 2040 following Severn Trent Transfer or SESRO	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** T2ST would provide a strategic link from STT or SESRO to SWS Hampshire zone to provide long term resilience to the region. No other option variants are available.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. Water transfer capacities will be maintained within licensed abstraction limits for STT/SESRO.	**PASS** Water availability for the T2ST is dependent on the Severn Thames transfer and/or SESRO. All T2ST options will require support from either SESRO or STT, to maintain sweetening flows and bulk water supplies to Southern Water.	**PASS** Pipeline routes and new pumping station and water treatment assets will be located to avoid impacts on designated sites wherever possible. Where designated sites cannot be avoided and are crossed by the pipeline, environmental impacts will be mitigated sufficiently using trenchless construction.

A.1.3. Option Map


Culham Intake
Reading Intake
Option 1 & 2
Option 3 & 4
Option 5 & 6
Otterbourne
Testwood
N
Abingdon
Didcot
Swindon
Henley-on-Thames
Reading
Newbury
Basingstoke
Andover
Marlborough
Salisbury
Winchester
Eastleigh
Southampton
Fareham
VALE OF WHITE HORSE
MARLBOROUGH DOWNS
HAMPSHIRE DOWNS
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

A.1.4. Secondary Screening

Option Description	Pass/Fail?	Thames to Southern Transfer T2ST SRO: Secondary Screening Stage (RAG)																		
		A5: Operational complexity Question for Screening: Would the option increase the complexity of operation of the abstraction, treatment or distribution infrastructure? Evidence for Audit: Explanation for the expected change in complexity.	**E1: Modularity and scalability** Question for Screening: Can the option be implemented on a modular or scalable basis? Evidence for Audit: Clear explanation for why/why not scalable	**R1: Uncertainty of option's supply/demand benefit** Question for Screening: What is the uncertainty in deployable output of the option? Evidence for Audit: Explanation for cause of the uncertainty and why it cannot be resolved	**R3: Vulnerability of infrastructure to asset failure other hazards** Question for Screening: Is the option particularly vulnerable to asset failures during shock events? Evidence for Audit: Clear explanation for expected impact	**R5: Catchment & raw water quality risks** Question for Screening: Would the option be likely to increase WRZ outage associated with transient catchment water quality events? Evidence for Audit: Clear explanation for expected impact	**S2: Regulatory approval** Question for Screening: Are there significant risks associated with regulatory approval of the option? Evidence for Audit: Regulatory correspondence or reference to regulatory guidance	**S3: Customer preference** Question for Screening: What is the customer preference for this option type Evidence for Audit: Reference to customer surveys, specifying survey details (numbers surveyed, dates, results, etc	**S4: Stakeholder Promotability** Question for Screening: Are there risks associated with non regulatory stakeholder support for the option? Evidence for Audit: Evidence to show stakeholders oppose this option type and that it would be difficult to mitigate that opposition.	**S5: Planning** Question for Screening: Is the option at risk of being blocked by unalterable planning constraints? Evidence for Audit: Reference to planning guidance/law	**WRMP3: Excessive Cost and Carbon** Question for Screening: Are the option cost and carbon emissions likely to be excessively high Evidence for Audit: Quantitative assessment of option characteristics (e.g. length of route and pumping head	**WRMP5: Option status with respect to environmental designation, including SEA and HRA considerations** Question for Screening: Does the option have a direct or likely impact (Footprint or associated impact are within 100m) on: Special Areas of conservation; Sites of Special Scientific Interest; Special Protected Areas; Ramsar Sites; Scheduled Monuments; National Nature Reserve; Registered Parks and gardens; current or historic landfills; Grade 1 Agricultural Land; Flood Zone 3; Ancient Woodland; Marine conservation zones. Evidence for Audit: Route optimiser tool outputs and map	**WRMP6: Option status with respect to overall SEA screening (sustainability)** Question for Screening: Consideration of full SEA screening results and identification of key issues Evidence for Audit: Route optimiser tool outputs and maps.	**WRMP7: Natural Capital** Question for Screening: Is the proposed scheme likely to impact Natural Capital Stocks	**WRMP8: Water framework directive assessment and/or urban waste water directive** Question for Screening: Is the option likely to impact upon WFD no deterioration objectives?	**WRMP9: European Designated Sites** Question for Screening: Does the option have an impact or likely impact on European designated sites? Evidence for Audit: Route optimiser tool outputs and maps	**SRO1: Construction Complexity** Question for Screening: Detailed review of construction requirements: are there adverse ground conditions / large number of major crossings? How will these conditions affect the construction timeline. Evidence for Audit: Route of transfer pipeline, using route optimiser tool	**SR02: Impact from construction** Question for Screening: Non-traffic impact of construction on local residents - the impact of dust and noise. Will construction activities result in the loss of residential dwellings? Will construction traffic affect local roads /built up areas? Evidence for Audit: Shape file of the construction site and 100km radius around the site to determine impact on residential dwellings, and construction shape outline to determine loss of dwelling	**SR03: Opportunities** Question for Screening: Are there any opportunities for biodiversity improvement and chalk stream enhancement? Evidence for Audit: Footprint of options and its proximity to possible opportunities	**SR04: Environmental considerations** **Question for Screening:** Can any of the flags that were identified at the secondary stage be mitigated? **Evidence for Audit:** List of considerations where mitigation can be undertaken and the level of mitigation required
Option 1: Potable water transfer from Culham to Otterbourne WTW	**PASS:** No significant grounds to rule out at this stage. Take option through to Constrained list	**AMBER:** Some increase in complexity Agreement will be required between Thames Water and SWS concerning the quantity and timing of the bulk transfer, and procurement and operation of the project. Agreement will also be required with SEW if an offtake to Basingstoke is required.	**GREEN:** Option has potential for flexibility in capacity The option is scalable. Transfer volumes of 50, 80, and 120Ml/d were assessed for Gate 1. The maximum transfer rate will be adjusted as required to meet EA environmental ambition targets for the region.	**AMBER**: 50% to 100% uncertainty Water availability for the T2ST is dependent on deployable output of the Severn Thames Transfer and or SESRO. Uncertainty will be reduced following ongoing WRSE DO modelling.	**GREEN**: Option no more vulnerable to asset failures than average for the WRZ Standard industry design for bulk transfer and water treatment	**GREEN:** Transient catchment water quality risks no higher than average for the WRZ Water treatment process will be designed to mitigate any risks of transient water quality	**GREEN:** No risks identified SRO scheme approved for investigation by RAPID	**AMBER**: Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve acceptability of option. Further customer consultation will be undertaken by companies during WRMP24 on future water resource strategy for the region.	**AMBER:** Evidence to suggest stakeholders may actively oppose the option There are known pressure groups oppose SESRO.	**AMBER:** Planning constraints that can be overcome.	**AMBER:** Due to estimating uncertainties option has potential to become least cost, or potential to be part of the least cost programme for addressing anticipated needs	**AMBER:** Pipeline/transfer route requires crossing the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations. Mitigation may be required, but option still feasible.	**AMBER**: Some concerns owing to SEA screening	**AMBER:** The Option is unlikely to cause an overall gain in Natural Capital Stocks, but they are unlikely to result in an unacceptable loss of Natural Capital Stocks. Option will include environmental mitigation to provide biodiversity net gain where possible.	**AMBER**: Option requires river crossings and as such there is a risk of deterioration but mitigation is possible. Option crosses the Winterbourne Stream multiple times near the village of Winterbourne, and crosses the River Enbourne multiple times to the south of Newbury. The transfer route should be modified in these locations in order to reduce the impact on these waterbodies. Option will not include transfer of water along natural watercourses.	**RED:** Options requires crossing the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations. Best practice construction methods will be used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be expected to be	**AMBER**: 1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	**AMBER:** Between 100 and 299 residential properties likely to be affected by construction by noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome. Pipeline route predominantly through rural countryside.	**AMBER:** Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit. The pipeline will cross a number of chalk streams including the River Lambourne, River Kennet and River Test. There are likely to be opportunities during design and construction for local habitat enhancement at these locations to provide net biodiversity gain.	**RED:** Requires works within the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations. The potential impacts on these designated areas result in a Red RAG rating for European Designated Sites. Best practice construction methods will used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or

Option Description	Pass/Fail?	Thames to Southern Transfer T2ST SRO: Secondary Screening Stage (RAG)																			
																	sited outside of the designated boundary.				buildings would be expected to be sited outside of the designated boundary.
Option 2: Raw water transfer from Culham to Otterbourne WTW	**FAIL:** Raw water options have greater number of treatment sites compared to potable options, hence greater environmental impact and higher costs. Screen out at this stage.	**AMBER:** Some increase in complexity Agreement will be required between Thames Water and SWS concerning the quantity and timing of the bulk transfer, and procurement and operation of the project. Agreement will also be required with SEW if an offtake to Basingstoke is required.	**GREEN:** Option has potential for flexibility in capacity The option is scalable. Transfer volumes of 50, 80, and 120Ml/d were assessed for Gate 1. The maximum transfer rate will be adjusted as required to meet EA environmental ambition targets for the region.	**AMBER**: 50% to 100% uncertainty Water availability for the T2ST is dependent on deployable output of the Severn Thames Transfer and or SESRO. Uncertainty will be reduced following ongoing WRSE DO modelling.	**GREEN**: Option no more vulnerable to asset failures than average for the WRZ Standard industry design for bulk transfer and water treatment	**GREEN:** Transient catchment water quality risks no higher than average for the WRZ Water treatment process will be designed to mitigate any risks of transient water quality	**GREEN:** No risks identified SRO scheme approved for investigation by RAPID	**AMBER**: Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve acceptability of option. Further customer consultation will be undertaken by companies during WRMP24 on future water resource strategy for the region.	**AMBER:** Evidence to suggest stakeholders may actively oppose the option There are known pressure groups oppose SESRO.	**AMBER:** Planning constraints that can be overcome.	**RED:** Raw water options have greater land take compared to potable options due to multiple treatment sites, hence higher costs and carbon.	**AMBER:** Pipeline/transfer route requires crossing the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations. Mitigation may be required, but option still feasible.	**AMBER**: Some concerns owing to SEA screening	**AMBER:** The Option is unlikely to cause an overall gain in Natural Capital Stocks, but they are unlikely to result in an unacceptable loss of Natural Capital Stocks. Option will include environmental mitigation to provide biodiversity net gain where possible.	**AMBER**: Option requires river crossings and as such there is a risk of deterioration but mitigation is possible. Option crosses the Winterbourne Stream multiple times near the village of Winterbourne, and crosses the River Enbourne multiple times to the south of Newbury. The transfer route should be modified in these locations in order to reduce the impact on these waterbodies. Option will not include transfer of water along natural watercourses.	**RED:** Options requires crossing the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations Best practice construction methods will be used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be expected to be sited outside of the designated boundary.	**AMBER**: 1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	**AMBER:** Between 100 and 299 residential properties likely to be affected by construction by noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome. Pipeline route predominantly through rural countryside.	**AMBER:** Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit. The pipeline will cross a number of chalk streams including the River Lambourne, River Kennet and River Test. There are likely to be opportunities during design and construction for local habitat enhancement at these locations to provide net biodiversity gain.	**RED:** Requires works within the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations. The potential impacts on these designated areas result in a Red RAG rating for European Designated Sites. Best practice construction methods will used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be expected to be sited outside of the designated boundary.
Option 3: Raw water transfer from Reading to Otterbourne WTW	**FAIL:** Raw water options have greater number of treatment sites compared to potable options, hence greater environmental impact and higher costs. Screen out at this stage.	**AMBER:** Some increase in complexity Agreement will be required between Thames Water and SWS concerning the quantity and timing of the bulk transfer, and procurement and operation of the project. Agreement will also be required with SEW if an offtake to Basingstoke is required.	**GREEN:** Option has potential for flexibility in capacity The option is scalable. Transfer volumes of 50, 80, and 120Ml/d were assessed for Gate 1. The maximum transfer rate will be adjusted as required to meet EA environmental ambition targets for the region.	**AMBER**: 50% to 100% uncertainty Water availability for the T2ST is dependent on deployable output of the Severn Thames Transfer and or SESRO. Uncertainty will be reduced following ongoing WRSE DO modelling.	**GREEN**: Option no more vulnerable to asset failures than average for the WRZ Standard industry design for bulk transfer and water treatment	**GREEN:** Transient catchment water quality risks no higher than average for the WRZ Water treatment process will be designed to mitigate any risks of transient water quality	**GREEN:** No risks identified SRO scheme approved for investigation by RAPID	**AMBER**: Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve acceptability of option. Further customer consultation will be undertaken by companies during WRMP24 on future water resource strategy for the region.	**AMBER:** Evidence to suggest stakeholders may actively oppose the option There are known pressure groups oppose SESRO.	**AMBER:** Planning constraints that can be overcome.	**RED:** Raw water options have greater land take compared to potable options due to multiple treatment sites, hence higher costs and carbon.	**AMBER:** Pipeline/transfer route does not directly impact on any European Designated Sites, but such sites are present within 100m of the proposed route	**AMBER**: Some concerns owing to SEA screening	**AMBER:** The Option is unlikely to cause an overall gain in Natural Capital Stocks, but they are unlikely to result in an unacceptable loss of Natural Capital Stocks. Option will include environmental mitigation to provide biodiversity net gain where possible.	**AMBER**: Option requires river crossings and as such there is a risk of deterioration but mitigation is possible. Option will not include transfer of water along natural watercourses.	**AMBER:** Does not directly impact on any European Designated Sites.	**AMBER**: 1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	**AMBER:** Between 100 and 299 residential properties likely to be affected by construction by noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome. Pipeline route predominantly through rural countryside.	**AMBER:** Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit. The pipeline will cross a number of chalk streams including the River Test. There are likely to be opportunities during design and construction for local habitat enhancement at these	**AMBER:** Does not directly impact on any European Designated Sites Mitigation required but not at a high cost

Option Description	Pass/Fail?	Thames to Southern Transfer T2ST SRO: Secondary Screening Stage (RAG)																		
																			locations to provide net biodiversity gain.	
Option 4: Potable water transfer from Reading to Otterbourne WTW	**PASS:** No significant grounds to rule out at this stage. Take option through to Constrained list	**AMBER:** Some increase in complexity Agreement will be required between Thames Water and SWS concerning the quantity and timing of the bulk transfer, and procurement and operation of the project. Agreement will also be required with SEW if an offtake to Basingstoke is required.	**GREEN:** Option has potential for flexibility in capacity The option is scalable. Transfer volumes of 50, 80, and 120Ml/d were assessed for Gate 1. The maximum transfer rate will be adjusted as required to meet EA environmental ambition targets for the region.	**AMBER**: 50% to 100% uncertainty Water availability for the T2ST is dependent on deployable output of the Severn Thames Transfer and or SESRO. Uncertainty will be reduced following ongoing WRSE DO modelling.	**GREEN**: Option no more vulnerable to asset failures than average for the WRZ Standard industry design for bulk transfer and water treatment	**GREEN:** Transient catchment water quality risks no higher than average for the WRZ Water treatment process will be designed to mitigate any risks of transient water quality	**GREEN:** No risks identified SRO scheme approved for investigation by RAPID	**AMBER**: Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve acceptability of option. Further customer consultation will be undertaken by companies during WRMP24 on future water resource strategy for the region.	**AMBER:** Evidence to suggest stakeholders may actively oppose the option There are known pressure groups oppose SESRO.	**AMBER:** Planning constraints that can be overcome.	**AMBER:** Due to estimating uncertainties option has potential to become least cost, or potential to be part of the least cost programme for addressing anticipated needs	**AMBER:** Pipeline/transfer route does not directly impact on any European Designated Sites, but such sites are present within 100m of the proposed route	**AMBER**: Some concerns owing to SEA screening	**AMBER:** The Option is unlikely to cause an overall gain in Natural Capital Stocks, but they are unlikely to result in an unacceptable loss of Natural Capital Stocks. Option will include environmental mitigation to provide biodiversity net gain where possible.	**AMBER**: Option requires river crossings and as such there is a risk of deterioration but mitigation is possible. Option will not include transfer of water along natural watercourses.	**AMBER:** Does not directly impact on any European Designated Sites.	**AMBER**: 1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	**AMBER:** Between 100 and 299 residential properties likely to be affected by construction by noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome. Pipeline route predominantly through rural countryside.	**AMBER:** Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit. The pipeline will cross a number of chalk streams including the River Test. There are likely to be opportunities during design and construction for local habitat enhancement at these locations to provide net biodiversity gain.	**AMBER:** Does not directly impact on any European Designated Sites Mitigation required but not at a high cost
Option 5: Raw water transfer from Culham to Testwood WTW	**FAIL:** Raw water options have greater number of treatment sites compared to potable options, hence greater environmental impact and higher costs. Screen out at this stage.	**AMBER:** Some increase in complexity Agreement will be required between Thames Water and SWS concerning the quantity and timing of the bulk transfer, and procurement and operation of the project. Agreement will also be required with SEW if an offtake to Basingstoke is required.	**GREEN:** Option has potential for flexibility in capacity The option is scalable. Transfer volumes of 50, 80, and 120Ml/d were assessed for Gate 1. The maximum transfer rate will be adjusted as required to meet EA environmental ambition targets for the region.	**AMBER**: 50% to 100% uncertainty Water availability for the T2ST is dependent on deployable output of the Severn Thames Transfer and or SESRO. Uncertainty will be reduced following ongoing WRSE DO modelling.	**GREEN**: Option no more vulnerable to asset failures than average for the WRZ Standard industry design for bulk transfer and water treatment	**GREEN:** Transient catchment water quality risks no higher than average for the WRZ Water treatment process will be designed to mitigate any risks of transient water quality	**GREEN:** No risks identified SRO scheme approved for investigation by RAPID	**AMBER**: Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve acceptability of option. Further customer consultation will be undertaken by companies during WRMP24 on future water resource strategy for the region.	**AMBER:** Evidence to suggest stakeholders may actively oppose the option There are known pressure groups oppose SESRO.	**AMBER:** Planning constraints that can be overcome.	**RED:** Raw water options have greater land take compared to potable options due to multiple treatment sites, hence higher costs and carbon.	**AMBER:** Pipeline/transfer route requires crossing requires crossing the Solent and Southampton Water SPA, the River Lambourne SAC and SSSI, the River Kennet SSSI, the River Test SSSI in 3 locations, and the Lower Test Valley SSSI. Mitigation may be required, but option still feasible.	**AMBER**: Some concerns owing to SEA screening	**AMBER:** The Option is unlikely to cause an overall gain in Natural Capital Stocks, but they are unlikely to result in an unacceptable loss of Natural Capital Stocks. Option will include environmental mitigation to provide biodiversity net gain where possible.	**AMBER**: Option requires river crossings and as such there is a risk of deterioration but mitigation is possible. Option crosses the Winterbourne Stream multiple times near the village of Winterbourne, and crosses the River Enbourne multiple times to the south of Newbury. The transfer route should be modified in these locations in order to reduce the impact on these waterbodies. Option will not include transfer of water along natural watercourses.	**RED:** Options requires crossing the Solent and Southampton Water SPA, the River Lambourne SAC and SSSI, the River Kennet SSSI, the River Test SSSI in 3 locations, and the Lower Test Valley SSSI. Best practice construction methods will be used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be	**AMBER**: 1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	**AMBER:** Between 100 and 299 residential properties likely to be affected by construction by noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome. Pipeline route predominantly through rural countryside.	**AMBER:** Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit. The pipeline will cross a number of chalk streams including the River Lambourne, River Kennet and River Test. There are likely to be opportunities during design and construction for local habitat enhancement at these locations to provide net biodiversity gain.	**RED:** Requires works within the River Lambourne SAC and SSSI, the River Kennet SSSI, and the River Test SSSI in 2 locations. The potential impacts on these designated areas result in a Red RAG rating for European Designated Sites. Best practice construction methods will used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be expected to be sited outside of the

Option Description	Pass/Fail?	Thames to Southern Transfer T2ST SRO: Secondary Screening Stage (RAG)																			
																	expected to be sited outside of the designated boundary.				designated boundary.
Option 6: Raw water transfer from Reading to Testwood WTW	**FAIL:** Raw water options have greater number of treatment sites compared to potable options, hence greater environmental impact and higher costs. Screen out at this stage.	**AMBER:** Some increase in complexity Agreement will be required between Thames Water and SWS concerning the quantity and timing of the bulk transfer, and procurement and operation of the project. Agreement will also be required with SEW if an offtake to Basingstoke is required.	**GREEN:** Option has potential for flexibility in capacity The option is scalable. Transfer volumes of 50, 80, and 120Ml/d were assessed for Gate 1. The maximum transfer rate will be adjusted as required to meet EA environmental ambition targets for the region.	**AMBER**: 50% to 100% uncertainty Water availability for the T2ST is dependent on deployable output of the Severn Thames Transfer and or SESRO. Uncertainty will be reduced following ongoing WRSE DO modelling.	**GREEN**: Option no more vulnerable to asset failures than average for the WRZ Standard industry design for bulk transfer and water treatment	**GREEN:** Transient catchment water quality risks no higher than average for the WRZ Water treatment process will be designed to mitigate any risks of transient water quality	**GREEN:** No risks identified SRO scheme approved for investigation by RAPID	**AMBER**: Customers were generally neutral, or perception is uncertain/mixed; some mitigation may be required to improve acceptability of option. Further customer consultation will be undertaken by companies during WRMP24 on future water resource strategy for the region.	**AMBER:** Evidence to suggest stakeholders may actively oppose the option There are known pressure groups oppose SESRO.	**AMBER:** Planning constraints that can be overcome.	**RED:** Raw water options have greater land take compared to potable options due to multiple treatment sites, hence higher costs and carbon.	**AMBER:** Pipeline/transfer route requires crossing requires crossing the Solent and Southampton Water SPA, the River Test SSSI, and the Lower Test Valley SSSI. Mitigation may be required, but option still feasible.	**AMBER**: Some concerns owing to SEA screening	**AMBER:** The Option is unlikely to cause an overall gain in Natural Capital Stocks, but they are unlikely to result in an unacceptable loss of Natural Capital Stocks. Option will include environmental mitigation to provide biodiversity net gain where possible.	**AMBER**: Option requires river crossings and as such there is a risk of deterioration but mitigation is possible. Option will not include transfer of water along natural watercourses.	**RED:** Options requires crossing the Solent and Southampton Water SPA, the River Test SSSI, and the Lower Test Valley SSSI. Best practice construction methods will be used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be expected to be sited outside of the designated boundary.	**AMBER**: 1-10 major crossings required or contaminated land risks identified. Construction complexity is anticipated to have minor impacts on construction programme and cost.	**AMBER:** Between 100 and 299 residential properties likely to be affected by construction by noise and dust. Up to 10 residential dwellings located within the site. Route partly through built up areas and / or likely to have moderate impacts on local traffic. Issue or constraint can be overcome. Pipeline route predominantly through rural countryside.	**AMBER:** Site with a watercourse or surrounding woodlands. Scheme will bring some indirect improvement to the chalk stream. Scheme will provide minimal recreational benefit. The pipeline will cross a number of chalk streams including the River Test. There are likely to be opportunities during design and construction for local habitat enhancement at these locations to provide net biodiversity gain.	**RED:** Requires works within the Solent and Southampton Water SPA, the River Test SSSI, and the Lower Test Valley SSSI. The potential impacts on these designated areas result in a Red RAG rating for European Designated Sites. Best practice construction methods will used to limit any impacts on designated sites including the use of trenchless technology. It is expected at this stage that any direct impact on linear designated features such as river crossings would be avoided by tunnelling beneath protected areas. Any above ground structures such as chambers or buildings would be expected to be sited outside of the designated boundary.

Appendix B. Infrastructure requirements

B.1. T2ST Options Appraisal: Gate 2 – Infrastructure Summary Table 80Ml/d capacity

Option 1 – Culham to Otterbourne, Potable	Option 2 – Culham to Otterbourne, Raw	Option 3 – Reading to Otterbourne, Raw	Option 4 – Reading to Otterbourne, Potable	Option 5 – Culham to Testwood, Raw	Option 6 – Reading to Testwood, Raw
WTW and Pumping Station at SESRO WTW and Pumping Station located at SESRO site to the northeast of the reservoir embankment on land used previously for the construction compound of the reservoir. No new abstraction required from the River Thames at Culham, water is drawn from the reservoir into the WTW. a) Gravity connection from reservoir control tower to new WTW. b) Footprint of new WTW site 200m x 200m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area. c) 6hr treated water storage tank (20Ml). Buried concrete tank. 65m x 65m. d) High Lift pumping station (2,626kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**Pre-treatment works at SESRO and Pumping Station** Pre-treatment works to remove INNS risk and Pumping Station located at SESRO site to the northeast of the reservoir embankment on land used previously for the construction compound of the reservoir. No new abstraction required from the River Thames at Culham, water is drawn from the reservoir into the WTW. a) Gravity connection from reservoir control tower to new pre treatment works. Coarse and fine Inlet screens. b) Coarse and fine inlet screens and pre-treatment works 100m x 100m in plan area, including all required treatment infrastructure, comprising screening, coagulation and flocculation, clarification, filtration and sludge processing. Access roads, buildings and car parking. Single storey and two storey structures across works area. c) 6hr raw water storage tank (20Ml). Buried concrete tank. 65m x 65m. d) High Lift pumping station (2,239kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**New River Intake at Reading, pre-treatment works and pumping station** New river intake west of Reading. Low lift pumping station on banks of Thames, and new pre-treatment works to remove INNS risk. a) River screens and low lift pumping station on banks of the Thames. 30m x 20m concrete structure buried into river bank housing coarse and fine screens and low lift pumps. Above ground control building 10m x 10m single storey. Short term water quality impacts on the river during construction. b) 900mm buried pipeline to pre-treatment works. 1000m long c) New pre-treatment works 100m x 100m in plan area, including all required treatment infrastructure, comprising screening, coagulation and flocculation, clarification, filtration and sludge processing. Access roads, buildings and car parking. Single storey and two storey structures across works area, including all required treatment. d) 6hr raw water storage tank (20Ml). Buried concrete tank. 65m x 65m. e) High Lift pumping station (2,626kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**New River Intake at Reading, pre-treatment works and pumping station** a) River screens and low lift pumping station on banks of the Thames. 30m x 20m concrete structure buried into river bank housing coarse and fine screens and low lift pumps. Above ground control building 10m x 10m single storey. Short term water quality impacts on the river during construction. b) 900mm buried pipeline to WTW. 1000m long c) Footprint of new WTW site 200m x 200m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area. d) 6hr treated water storage tank (20Ml). Buried concrete tank. 65m x 65m. e) High Lift pumping station (2,626kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**Pre-treatment works at SESRO and Pumping Station** Pre-treatment works to remove INNS risk and Pumping Station located at SESRO site to the northeast of the reservoir embankment on land used previously for the construction compound of the reservoir. No new abstraction required from the River Thames at Culham, water is drawn from the reservoir into the WTW. a) Gravity connection from reservoir control tower to new pre treatment works. Coarse and fine Inlet screens. b) Coarse and fine inlet screens and pre-treatment works 100m x 100m in plan area, including all required treatment infrastructure, comprising screening, coagulation and flocculation, clarification, filtration and sludge processing. Access roads, buildings and car parking. Single storey and two storey structures across works area. c) 6hr raw water storage tank (20Ml). Buried concrete tank. 65m x 65m. d) High Lift pumping station (2,626kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**New River Intake at Reading, pre-treatment works and pumping station** New river intake west of Reading. Low lift pumping station on banks of Thames, and new pre-treatment works to remove INNS risk. a) River screens and low lift pumping station on banks of the Thames. 30m x 20m concrete structure buried into river bank housing coarse and fine screens and low lift pumps. Above ground control building 10m x 10m single storey. Short term water quality impacts on the river during construction. b) 900mm buried pipeline to pre-treatment works. 1000m long c) New pre-treatment works 100m x 100m in plan area, including all required treatment infrastructure, comprising screening, coagulation and flocculation, clarification, filtration and sludge processing. Access roads, buildings and car parking. Single storey and two storey structures across works area. d) 6hr raw water storage tank (20Ml). Buried concrete tank. 65m x 65m. e) High Lift pumping station (2,239kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.
Pipeline to BPT No.1 a) 900mm diameter buried pipeline from SESRO site to break pressure tank. 8,900m long.	**Pipeline to BPT No.1** a) 900mm diameter buried pipeline from SESRO site to break pressure tank. 8,900m long.	**Pipeline to Intermediate Pumping Station** a) 900mm diameter buried pipeline from Reading to pumping station. 32,260m long.	**Pipeline to Intermediate Pumping Station** a) 900mm diameter buried pipeline from Reading to pumping station. 32,260m long.	**Pipeline to BPT No.1** a) 900mm diameter buried pipeline from SESRO site to break pressure tank. 8,900m long.	**Pipeline to Intermediate Pumping Station** a) 900mm diameter buried pipeline from Reading to pumping station. 32,260m long.
BPT No.1 a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No.1** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 1 at Intermediate Pumping Station** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 1 at Intermediate Pumping Station** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No.1** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 1 at Intermediate Pumping Station** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank
Pipeline from BPT No. 1 to Intermediate Pumping Station a) 1000mm diameter buried pipeline from BPT No.1 to intermediate pumping station. 26,821m long.	**Pipeline from BPT No. 1 to Intermediate Pumping Station** a) 1000mm diameter buried pipeline from BPT No.1 to intermediate pumping station. 26,821m long.	**Intermediate Pumping Station** a) High Lift pumping station (2,239kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**Intermediate Pumping Station** a) High Lift pumping station (2,239kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**Pipeline from BPT No. 1 to Intermediate Pumping Station** a) 1000mm diameter buried pipeline from BPTNo.1 to intermediate pumping station. 26,821m long.	**Intermediate Pumping Station** a) High Lift pumping station (2,239kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.
BPT No. 2 at Intermediate Pumping Station a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 2 at Intermediate Pumping Station** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**Pipeline from Intermediate Pumping Station to BPT No.2** a) 900mm diameter buried pipeline from intermediate pumping station to BPT No.2. 25,050m long	**Pipeline from Intermediate Pumping Station to BPT No.2** a) 900mm diameter buried pipeline from intermediate pumping station to BPT No.2. 25,050m long	**BPT No. 2 at Intermediate Pumping Station** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**Pipeline from Intermediate Pumping Station to BPT No.2** a) 900mm diameter buried pipeline from intermediate pumping station to BPT No.2. 25,050m long
Intermediate Pumping Station a) High Lift pumping station (2,017kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	**Intermediate Pumping Station** a) High Lift pumping station (2,017kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.		-	**Intermediate Pumping Station** a) High Lift pumping station (2,017kW), 30m x 20m two storey building, within 70m x 70m site area, including access road and parking.	-
Pipeline from Intermediate Pumping Station to BPT No.3 a) 900mm diameter buried pipeline from intermediate pumping station to BPT No.3. 33,700m long.	**Pipeline from Intermediate Pumping Station to BPT No.3** a) 900mm diameter buried pipeline from intermediate pumping station to BPT No.3. 33,700m long.			**Pipeline from Intermediate Pumping Station to BPT No.3** a) 900mm diameter buried pipeline from intermediate pumping station to BPT No.3. 33,700m long.	
BPT No. 3 a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 3** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 2** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 2** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 3** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank	**BPT No. 2** a) 6hr storage tank (20Ml). 65m x 65m buried concrete tank
Pipeline from BPT No.3 to Otterbourne a) 900mm diameter buried pipeline from Sparsholt break pressure tank to Otterbourne North. 5,390m long.	**Pipeline from BPT No.3 to Otterbourne** a) 900mm diameter buried pipeline from Sparsholt break pressure tank to Otterbourne North. 5,390m long.	**Pipeline from BPT No.2 to Otterbourne** a) 900mm diameter buried pipeline from BPT No.3 to Otterbourne North. 5,390m long.	**Pipeline from BPT No.2 to Otterbourne** a) 900mm diameter buried pipeline from BPT No.3 to Otterbourne North. 5,390m long.	**Pipeline from BPT No.3 to Testwood** a) 900mm diameter buried pipeline from BPT No.3 to Otterbourne North. 19,380m long.	**Pipeline from BPT No.2 to Testwood** a) 900mm diameter buried pipeline from BPT No.3 to Otterbourne North. 19,380m long.

Option 1 – Culham to Otterbourne, Potable	Option 2 – Culham to Otterbourne, Raw	Option 3 – Reading to Otterbourne, Raw	Option 4 – Reading to Otterbourne, Potable	Option 5 – Culham to Testwood, Raw	Option 6 – Reading to Testwood, Raw
-	**WTW at Otterbourne North** a) Footprint of new 80Ml/d WTW site 200m x 200m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	**WTW at Otterbourne North** a) Footprint of new 80Ml/d WTW site 200m x 200m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	-	**WTW at Testwoood** a) Footprint of new 80Ml/d WTW site 200m x 200m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	**WTW at Testwoood** a) Footprint of new 80Ml/d WTW site 200m x 200m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.
Treated water storage tank at Otterbourne a) 24hr treated water storage tank (80Ml). Buried concrete tank. 125m x 125m. Located at Otterbourne North.	**Treated water storage tank at Otterbourne** a) 24hr treated water storage tank (80Ml). Buried concrete tank. 125m x 125m. Located at Otterbourne North.	**Treated water storage tank at Otterbourne** a) 24hr treated water storage tank (80Ml). Buried concrete tank. 125m x 125m. Located at Otterbourne North.	**Treated water storage tank at Otterbourne** a) 24hr treated water storage tank (80Ml). Buried concrete tank. 125m x 125m. Located at Otterbourne North.	**Treated water storage tank at Testwood** a) 24hr treated water storage tank (80Ml). Buried concrete tank. 125m x 125m.	**Treated water storage tank at Testwood** a) 24hr treated water storage tank (80Ml). Buried concrete tank. 125m x 125m.
Spur main from T2ST to Kingsclere a) 400mm diameter buried pipeline from T2ST pipeline to Kingsclere. 7,100m long.	**Spur main from T2ST to Kingsclere** a) 400mm diameter buried pipeline from T2ST pipeline to Kingsclere. 7,100m long.	**Spur main from T2ST to Kingsclere** a) 400mm diameter buried pipeline from T2ST pipeline to Kingsclere. 6,280m long.	**Spur main from T2ST to Kingsclere** a) 400mm diameter buried pipeline from T2ST pipeline to Kingsclere. 6,300m long.	**Spur main from T2ST to Kingsclere** a) 400mm diameter buried pipeline from T2ST pipeline to Kingsclere. 7,100m long.	**Spur main from T2ST to Kingsclere** a) 400mm diameter buried pipeline from T2ST pipeline to Kingsclere. 6,280m long.
-	**WTW at Kingsclere** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	**WTW at Kingsclere** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	-	**WTW at Kingsclere** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	**WTW at Kingsclere** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.
Storage tank at Kingsclere a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Kingsclere** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Kingsclere** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Kingsclere** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Kingsclere** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Kingsclere** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.
Spur main from T2ST to Andover at Micheldever a) 400mm diameter buried pipeline from T2ST pipeline to Andover at Micheldever. 8,900m long.	**Spur main from T2ST to Andover** a) 400mm diameter buried pipeline from T2ST pipeline to new Andover WTW. 11,000m long.	**Spur main from T2ST to Andover** a) 400mm diameter buried pipeline from T2ST pipeline to new Andover WTW. 16,350m long.	**Spur main from T2ST to Andover at Micheldever** a) 400mm diameter buried pipeline from T2ST pipeline to Andover at Micheldever. 14,200m long.	**Spur main from T2ST to Andover** a) 400mm diameter buried pipeline from T2ST pipeline to new Andover WTW. 11,000m long.	**Spur main from T2ST to Andover** a) 400mm diameter buried pipeline from T2ST pipeline to new Andover WTW. 16,350m long.
	WTW at Andover a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	**WTW at Andover** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.		**WTW at Andover** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.	**WTW at Andover** a) Footprint of new 10Ml/d WTW site 100m x 100m in plan area, including all required treatment infrastructure, access roads, buildings and car parking. Single storey and two storey structures across works area.
Storage tank at Andover a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m. Located at Micheldever	**Storage tank at Andover** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Andover** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Andover** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m. Located at Micheldever	**Storage tank at Andover** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.	**Storage tank at Andover** a) 24hr treated water storage tank (10Ml). Buried concrete tank. 50m x 50m.
Note: Gate 1 Option assumes delivery of treated water to Micheldver. An alternative location for the spur and new tank would be to Upper Enham.			**Note:** Gate 1 Option assumes delivery of treated water to Micheldever. An alternative location for the spur and new tank would be to Upper Enham.		
Note: Spur connection to Northgate is currently outside of the SRO scope has not been assessed. Consultation is ongoing with SEW. The spur may still be required but no route or confirmed location yet. This may be developed in Gate 2 subject to WRSE outputs.	**Note:** Spur connection to Northgate is currently outside of the SRO scope has not been assessed. Consultation is ongoing with SEW. The spur may still be required but no route or confirmed location yet. This may be developed in Gate 2 subject to WRSE outputs.	**Note:** Spur connection to Northgate is currently outside of the SRO scope has not been assessed. Consultation is ongoing with SEW. The spur may still be required but no route or confirmed location yet. This may be developed in Gate 2 subject to WRSE outputs.	**Note:** Spur connection to Northgate is currently outside of the SRO scope has not been assessed. Consultation is ongoing with SEW. The spur may still be required but no route or confirmed location yet. This may be developed in Gate 2 subject to WRSE outputs.	**Note:** Spur connection to Northgate is currently outside of the SRO scope has not been assessed. Consultation is ongoing with SEW. The spur may still be required but no route or confirmed location yet. This may be developed in Gate 2 subject to WRSE outputs.	**Note:** Spur connection to Northgate is currently outside of the SRO scope has not been assessed. Consultation is ongoing with SEW. The spur may still be required but no route or confirmed location yet. This may be developed in Gate 2 subject to WRSE outputs.

Appendix C. Environmental and social considerations

C. Environmental and Social considerations

C.1 Gate 1 data and conclusions

As part of Gate 1, environmental and social assessments were undertaken on the six unconstrained options for T2ST. The assessments undertaken at Gate 1 were:

- Habitats Regulations Assessment (HRA) Stage 2/ Appropriate Assessment (AA);
- Level 2 Water Framework Directive (WFD) assessments;
- options level Strategic Environmental Assessment (SEA);
- Invasive Non-Native Species (INNS) Risk Assessment; and
- Natural Capital (NC) and Biodiversity Net Gain (BNG) assessments.

A summary of the conclusions and comparisons made at Gate 1 is included in Table 1.

The data behind the summary are included in Table 2 to Table 7 which summarise the outcomes of the Gate 1 assessments for each of the options.

Table 1: Comparison of the options against environmental assessments

Option	Habitats Regulations Assessment	Water Framework Directive	Strategic Environmental Assessment	Invasive Non-Native Species risk assessment	Biodiversity Net Gain and Natural Capital	Wider Benefits	High-level Carbon Assessment
1	Directional drilling required to cross River Lambourn SAC	Potential precautionary WFD compliance risks associated with the operation of the new abstractions	Greater residual effects on biodiversity during construction. Additional effects likely from inclusion of the WTW at the outlet.	N/A potable water transfer	Lowest total percentage loss of BNG habitat units. Likely to show in the least overall loss of NC stocks.	Same for all options	Potable water options have a lower embedded carbon requirement than the raw options. Higher operational carbon requirement
2	Directional drilling required to cross River Lambourn SAC	Potential precautionary WFD compliance risks associated with the operation of the new abstractions	Greater residual effects on biodiversity during construction Additional effects likely from inclusion of the WTW at the intake and the outlet.	Lower risk of INNS spread	Lowest total percentage loss of BNG habitat units. Likely to show in the least overall loss of NC stocks	Same for all options	Raw water options have a higher embedded carbon requirement than the potable options. Higher operational carbon requirement
3	Directional drilling required to cross River Lambourn SAC	Potential precautionary WFD compliance risks associated with the operation of the new abstractions - particularly for this option where hydrology/river flow is an existing limiting factor	Greater residual effects on population and health during construction Additional effects likely from inclusion of the WTW at the intake and the outlet.	Lower risk of INNS spread	Results in the least loss in value of ecosystem services per year.	Same for all options	Raw water options have a higher embedded carbon requirement than the potable options
4	Directional drilling required to cross River Lambourn SAC	Potential precautionary WFD compliance risks associated with the operation of the new abstractions - particularly for this option where hydrology/river flow is an existing limiting factor	Greater residual effects on population and health during construction Additional effects likely from inclusion of the WTW at the intake and the outlet.	N/A potable water transfer	Results in the least loss in value of ecosystem services per year.	Same for all options	Potable water options have a lower embedded carbon requirement than the raw options. Lowest operational carbon requirement.

Option	Habitats Regulations Assessment	Water Framework Directive	Strategic Environmental Assessment	Invasive Non-Native Species risk assessment	Biodiversity Net Gain and Natural Capital	Wider Benefits	High-level Carbon Assessment
5	Route to be altered to avoid intersecting the Solent and Southampton Water Ramsar and SPA sites. Directional drilling required to cross River Lambourn SAC and River Test.	Potential precautionary WFD compliance risks associated with the operation of the new abstractions	Greater residual effects on biodiversity during construction. Additional effects likely from inclusion of the Testwood site	Higher risk of INNS spread	Shows average loss of NC and BNG stock	Same for all options	Raw water options have a higher embedded carbon requirement than the potable options. Higher operational carbon requirement.
6	Route to be altered to avoid intersecting the Solent and Southampton Water Ramsar and SPA sites Directional drilling required to cross River Lambourn SAC and River Test	Potential precautionary WFD compliance risks associated with the operation of the new abstractions - particularly for this option where hydrology/river flow is an existing limiting factor	Greater residual effects on population and health during construction Additional effects likely from inclusion of the WTW at the intake. Additional effects likely from inclusion of Testwood site.	Higher risk of INNS spread	Highest percentage loss of BNG habitat units. Likely to show the greatest overall loss of NC stocks. Results in the highest loss in value of ecosystem services per year.	Same for all options	Raw water options have a higher embedded carbon requirement than the potable options

Table 2: Option 1 results of the Gate 1 assessments

Gate 1 assessment		Assessment conclusion
HRA		Five sites assessed to Stage 2 HRA and AA: River Lambourn SAC Kennet and Lambourn Floodplain Kennet Valley Alderwoods SAC River Itchen SAC Mottisfont Bats SAC No adverse impacts resulting from the implementation of this option (alone) are reasonably foreseeable on the integrity of the identified habitats sites, if the suggested mitigation measures are observed
WFD		The Level 1 WFD assessment indicated one waterbody required further assessment: Thames (Evenlode to Thame) The Level 2 WFD assessment identified possible deterioration risks to fish, invertebrates and hydrological regime. These are primarily due to a potential risk of reduced flow due to increased abstraction, and the additional intake structure required. It also identified potential impediments to meeting Good Ecological Status
SEA Topic	**SEA Objective**	
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	See HRA for habitats assessment. In addition to the designated sites assessed within the HRA Stage 2 assessment, the route intersects four SSSIs, seven ancient woodlands and a variety of priority habitats including deciduous woodland, coastal and floodplain grazing marsh and lowland calcareous grasslands. There could be direct habitat loss and disturbance for species during construction. Land will be reinstated above the pipeline but habitats and species disturbed may take time to recover. Operation is unlikely to have effects unless maintenance is required within designated sites.
Soil	Protect and enhance the functionality, quantity and quality of soils	The scheme intersects three historic landfill sites. Agricultural land is classed as grades 1-4 but the majority would be reinstated above the pipeline. Pollution of soils may be possible during construction, with permanent land take possibly required for construction of pumping stations and other above ground structures.
Water	Increase resilience and reduce flood risk	Parts of the scheme lie in flood zones 2 and 3 and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. See WFD for impacts on WFD waterbodies. The site lies within SPZ1 and 2. The site also lies within a nitrate vulnerable zone and crosses several rivers. Potential for water quality effects during construction.
Air	Reduce and minimise air emissions	The route does not pass through or near any AQMAs. Vehicle emissions and dust from construction activities will be generated but effects will be short-term.
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	The site intersects the North Wessex Downs AONB and Thames Basin Heaths, Hampshire Downs, Upper Thames Clay Vales and Berkshire and Marlborough Downs NCAs. Construction will result in visual effects, however, the majority of the pipeline infrastructure will be below ground and land reinstated above it. Operational infrastructure not assessed as details were not available at time of review
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	There are numerous listed buildings within 500m of the route and several scheduled monuments. There is also a registered battlefield (Battle of Newbury 1643) and four registered parks and gardens within 500m of the scheme. There are unlikely to be direct affects, although the route is adjacent to several of the identified assets. During construction there will be temporary effects on the setting of these assets. There is also potential to uncover archaeology during excavation works for the pipeline. The majority of the pipeline infrastructure is underground and land will be reinstated above, therefore, operational effects on setting are unlikely. Operational infrastructure not assessed as details were not available at time of review

Gate 1 assessment		Assessment conclusion
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	The scheme intersects a golf course and the boundary of a primary school. Construction may require the closure of the golf course and school playing fields. The route is also within 500m of allotments, churches, schools, a playing field and a cemetery. Construction is likely to cause noise and visual disruption for users of these assets. Land will be reinstated following construction. The scheme intersects the Ridgeway National Trail, sports facility and three cycle routes, therefore causing temporary disruption during construction. Land will be reinstated and it is likely that diversions would be put in place. However, the sports facility may need to temporarily close.
Material Assets	Avoid negative effects on built assets and infrastructure	The scheme intersects motorways at three locations, a number of A-roads and one railway line potentially causing disruption during construction. It is likely that directional drilling would be implemented under the railway and motorways. Potential road closures on smaller roads may cause disruption. Operational effects are unlikely as the pipeline will be underground.
INNS		Potable transfer. No risk of INNS spread
NC and BNG		
Loss of Orchards and top fruit (ha)		-0.06
Loss of Ancient Woodland (ha)		-0.59
Total Net loss of Habitat units (Grassland, Woodland and forest)		-218.96
Loss in value of ecosystem services per year (£)		-901.80

Table 3: Option 2 results of the Gate 1 assessments

Gate 1 assessment	Assessment conclusion
	All results as per Option 1 with the exception of INNS
INNS	The proposed abstraction intake from the River Thames to supply SESRO/STT is located within area 73 of the classification map in *Invasive Non-Native Species Isolated Catchment Mapping*. Area 73 is classified as 'Canal – CRT', meaning that hydrological connections to areas beyond the catchment already exist through intersection of the river network with Canal and Rivers Trust (CRT) navigable canals. Connecting watercourses listed include the Kennet and Avon Canal, Wiltshire and Berkshire Canal, Thames and Severn Canal, Oxford Canal and Grand Union Canal. The receptor site at Otterbourne is located within area 44. Area 44 is classified as 'Isolated', meaning that they do not have existing hydrological connections to any other catchments. Therefore, this raw water transfer would create a connection between a 'Canal-CRT' catchment and a previously 'Isolated' catchment

Table 4: Option 3 results of the Gate 1 assessments

Gate 1 assessment	Assessment conclusion
HRA	One site assessed to Stage 2 HRA and AA: River Itchen SAC No adverse effects resulting from the implementation of this option (alone) are reasonably foreseeable on the integrity of the River Itchen SAC, if the suggested mitigation measures are observed
WFD	The Level 1 WFD assessment indicated one waterbody required further assessment: Thames (Wallingford to Caversham) The Level 2 WFD assessment identified possible deterioration risks to fish, macrophytes and phytobentos and hydrological regime. These are primarily due to a potential risk of reduced flow due to increased abstraction, and the additional intake structure required. It also identified

Gate 1 assessment		Assessment conclusion
		potential impediments to meeting Good Ecological Status. The potential hydrological effects could conflict with achieving WFD status objectives. This is particularly the case for Options 3, 4 and 6 where hydrology/river flow is an existing limiting factor, recorded in WFD baseline data as a 'reason for not achieving good'. This option possibly compromises water body objectives
SEA Topic	**SEA Objective**	
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	See HRA for habitats assessment. In addition to the designated sites assessed within the HRA Stage 2 assessment, the route intersects one SSSI, four ancient woodlands and a variety of priority habitats including coastal and floodplain grazing marsh, deciduous woodland and good quality semi-improved grassland. There is likely to be direct loss of this habitat, although certain habitat types can be reinstated following construction of the pipeline. Operation is unlikely to have effects unless maintenance is required within designated sites.
Soil	Protect and enhance the functionality, quantity and quality of soils	The scheme intersects two authorised landfill sites and one historic landfill. Agricultural land classifications range from grade 1-4 but the majority would be reinstated above the pipeline. Pollution of soils may be possible during construction, with permanent land take possibly required for construction of pumping stations and other above ground structures.
Water	Increase resilience and reduce flood risk	Parts of the scheme lie in flood zones 2 and 3 and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. See WFD for impacts on WFD waterbodies. The scheme intersects SPZ1 and 2. The site also lies within a nitrate vulnerable zone and crosses several rivers. Potential for water quality effects during construction.
Air	Reduce and minimise air emissions	The route does not pass through or near any AQMAs. Vehicle emissions and dust from construction activities will be generated but effects will be short-term.
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	The site intersects the North Wessex Downs AONB and three NCAs: Thames Basin Heaths, Chilterns and Hampshire Downs. Construction will results in visual effects, however, the majority of the pipeline infrastructure will be below ground and land reinstated above it. Operational infrastructure not assessed as details were not available at time of review.
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	There are numerous listed buildings within 500m of the route and several scheduled monuments. The scheme intersects two registered parks and gardens and runs along the boundary of a scheduled monument. During construction there will temporarily effects on the setting of these assets and direct impacts on the two registered parks and gardens. There is also potential to uncover archaeology during excavation works for the pipeline. The majority of the pipeline infrastructure is underground and land will be reinstated above, therefore, operational effects on setting are unlikely. Operational infrastructure not assessed as details were not available at time of review
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	The scheme intersects: Theale Golf course; Theale Green School; Tadley Rugby Club (playing fields); Tadley Community School; Drummer cricket club (playing fields); Ashe Park (public park; Picket Twenty Sports Grounds. The route is also within 500m of additional community facilities. Therefore, construction is likely to have a significant impact on the local community. Land will be reinstated following construction. The scheme intersects two cycle routes and a sports facility, therefore causing temporary disruption during construction. Land will be reinstated and it is likely that diversions would be put in place. However, the sports facility may need to temporarily close.
Material Assets	Avoid negative effects on built assets and infrastructure	The scheme intersects motorways at three locations, several A-roads and three railway lines potentially causing disruption during construction. It is likely that directional drilling would be implemented under the railways and motorways. Potential road closures on smaller roads may cause

Gate 1 assessment	Assessment conclusion
	disruption. Operational effects are unlikely as the pipeline will be underground.
INNS	"The proposed abstraction intake from the River Thames at Pangbourne, Reading is located within area 73 of the classification map in Invasive Non-Native Species Isolated Catchment Mapping. Area 73 is classified as 'Canal – CRT', meaning that hydrological connections to areas beyond the catchment already exist through intersection of the river network with Canal and Rivers Trust (CRT) navigable canals. Connecting watercourses listed include the Kennet and Avon Canal, Wiltshire and Berkshire Canal, Thames and Severn Canal, Oxford Canal and Grand Union Canal. The receptor site at Otterbourne is located within area 44. Area 44 is classified as 'Isolated', meaning that they do not have existing hydrological connections to any other catchments. Therefore, this raw water transfer would create a connection between a 'Canal-CRT' catchment and a previously 'Isolated' catchment"
NC and BNG	
Loss of Orchards and top fruit (ha)	-0.22
Loss of Ancient Woodland (ha)	-0.38
Total Net loss of Habitat units (Grassland, Woodland and forest)	-217.07
Loss in value of ecosystem services per year (£)	-887.22

Table 5: Option 4 results of the Gate 1 assessments

Gate 1 assessment	Assessment conclusion
	All results as per Option 3 with the exception of INNS
INNS	Potable transfer. No risk of INNS spread

Table 6: Option 5 results of the Gate 1 assessments

Gate 1 assessment		Assessment conclusion
HRA		Ten sites assessed to Stage 2 HRA and AA: River Lambourn SAC Kennet and Lambourn Floodplain Kennet Valley Alderwoods SAC River Itchen SAC Mottisfont Bats SAC Emer Bog SAC Solent Maritime SAC Solent and Southampton Water SPA Solent and Southampton Water Ramsar Site Solent and Dorset Coast Potential SPA No adverse impacts resulting from the implementation of this option (alone) are reasonably foreseeable on the integrity of the identified habitats sites, if the suggested mitigation measures are observed
WFD		The Level 1 WFD assessment indicated one waterbody required further assessment: Thames (Evenlode to Thame) The Level 2 WFD assessment identified possible deterioration risks to fish, invertebrates and hydrological regime. These are primarily due to a potential risk of reduced flow due to increased abstraction, and the additional intake structure required. It also identified potential impediments to meeting Good Ecological Status
SEA Topic	**SEA Objective**	
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	See HRA for habitats assessment. In addition to the designated sites assessed within the HRA Stage 2 assessment, the route intersects five SSSIs, 11 ancient woodlands and a variety of priority habitats including coastal and floodplain grazing marsh, deciduous woodland and good quality semi-improved grassland. There is likely to be direct loss of this habitat, although certain habitat types can be reinstated following construction of the pipeline. Operation is unlikely to have effects unless maintenance is required within designated sites.
Soil	Protect and enhance the functionality, quantity and quality of soils	The scheme intersects seven historic landfills. Agricultural land is classed as Grades 1-4 but the majority would be reinstated above the pipeline. Pollution of soils may be possible during construction, with permanent land take possibly required for construction of pumping stations and other above ground structures.
Water	Increase resilience and reduce flood risk	Parts of the scheme lie in flood zones 2 and 3 and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. See WFD for impacts on WFD waterbodies. The scheme intersects SPZ1 and 2. The site also lies within a nitrate vulnerable zone and crosses several rivers. Potential for water quality effects during construction.
Air	Reduce and minimise air emissions	The route does not pass through or near any AQMAs. Vehicle emissions and dust from construction activities will be generated but effects will be short-term.
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	The site intersects the North Wessex Downs AONB and five NCAs: Thames Basin Heaths, Hampshire Downs, Upper Thames Clay Vales, Berkshire and Marlborough Downs and South Hampshire Lowlands NCAs. Construction will results in visual effects, however, the majority of the pipeline infrastructure will be below ground and land reinstated above it. Operational infrastructure not assessed as details were not available at time of review.
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	There are numerous listed buildings within 500m of the route and several scheduled monuments. There is also a registered battlefield (Battle of Newbury 1643) and five registered parks and gardens within 500m of the scheme. There are unlikely to be direct affects, although the route is adjacent to several of the identified assets. During construction there will be temporary effects on the setting of these assets. There is also potential to uncover archaeology during excavation works for the pipeline. The

Gate 1 assessment		Assessment conclusion
		majority of the pipeline infrastructure is underground and land will be reinstated above, therefore, operational effects on setting are unlikely. Operational infrastructure not assessed as details were not available at time of review
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	The scheme intersects a golf course and the boundary of a primary school. Construction may require the closure of the golf course and school playing fields. The route is also within 500m of allotments, churches, schools, a playing field and a cemetery. Construction is likely to cause noise and visual disruption for users of these assets. Land will be reinstated following construction. The scheme intersects the Ridgeway National Trail, sports facility and three cycle routes, therefore causing temporary disruption during construction. Land will be reinstated and it is likely that diversions would be put in place. However, the sports facility may need to temporarily close.
Material Assets	Avoid negative effects on built assets and infrastructure	The scheme intersects several motorways and A-roads and two railway lines potentially causing disruption during construction. It is likely that directional drilling would be implemented under the railways and motorways. Potential road closures on smaller roads may cause disruption. Operational effects are unlikely as the pipeline will be underground.
INNS		The proposed abstraction intake from the River Thames to supply SESRO/STT is located within area 73 of the classification map in Invasive Non-Native Species Isolated Catchment Mapping. Area 73 is classified as 'Canal – CRT', meaning that hydrological connections to areas beyond the catchment already exist through intersection of the river network with Canal and Rivers Trust (CRT) navigable canals. Connecting watercourses listed include the Kennet and Avon Canal, Wiltshire and Berkshire Canal, Thames and Severn Canal, Oxford Canal and Grand Union Canal. The receptor site at Testwood is located within area 42. Area 42 is classified as 'Isolated', meaning that they do not have existing hydrological connections to any other catchments. Therefore, this raw water transfer would create a connection between a 'Canal-CRT' catchment and a previously 'Isolated' catchment. A risk of INNS spread exists in the transfer of raw water to a lake. This option would require removal of all INNS risk at source to allow partially treated water to be transferred for full treatment to drinking water standard at the receiving water treatment works. Transfer of raw water to a WTW provides effective and total removal of INNS, therefore Option 5 meets EA criteria
NC and BNG		
Loss of Orchards and top fruit (ha)		-0.06
Loss of Ancient Woodland (ha)		-1.62
Total Net loss of Habitat units (Grassland, Woodland and forest)		-323.17
Loss in value of ecosystem services per year (£)		-1275.06

Table 7: Option 6 results of the Gate 1 assessments

Gate 1 assessment		Assessment conclusion
HRA		Five sites assessed to Stage 2 HRA and AA: Emer Bog SAC Solent Maritime SAC Solent and Dorset Coast Potential SPA Solent and Southampton Water Ramsar Site Solent and Southampton Water SPA Site No adverse impacts resulting from the implementation of this option (alone) are reasonably foreseeable on the integrity of the identified habitats sites, if the suggested mitigation measures are observed
WFD		The Level 1 WFD assessment indicated one waterbody required further assessment: Thames (Wallingford to Caversham) The Level 2 WFD assessment identified possible deterioration risks to fish, macrophytes and phytobentos and hydrological regime. These are primarily due to a potential risk of reduced flow due to increased abstraction, and the additional intake structure required. It also identified potential impediments to meeting Good Ecological Status. The potential hydrological effects could conflict with achieving WFD status objectives. This is particularly the case for Options 3, 4 and 6 where hydrology/river flow is an existing limiting factor, recorded in WFD baseline data as a 'reason for not achieving good'. This option possibly compromises water body objectives
SEA Topic	**SEA Objective**	
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	See HRA for habitats assessment. In addition to the designated sites assessed within the HRA Stage 2 assessment, the route intersects two SSSIs, eight ancient woodlands and a variety of priority habitats including coastal and floodplain grazing marsh, deciduous woodland and good quality semi-improved grassland. There is likely to be direct loss of this habitat, although certain habitat types can be reinstated following construction of the pipeline. Operation is unlikely to have effects unless maintenance is required within designated sites.
Soil	Protect and enhance the functionality, quantity and quality of soils	The scheme intersects two authorised landfill sites and five historic landfills. Agricultural land classification ranges from grades 1-6 but the majority would be reinstated above the pipeline. Pollution of soils may be possible during construction, with permanent land take possibly required for construction of pumping stations and other above ground structures.
Water	Increase resilience and reduce flood risk	Parts of the scheme lie in flood zones 2 and 3 and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. See WFD for impacts on WFD waterbodies. The scheme intersects SPZ1 and 2. The site also lies within a nitrate vulnerable zone and crosses several rivers. Potential for water quality effects during construction.
Air	Reduce and minimise air emissions	The route does not pass through or near any AQMAs. Vehicle emissions and dust from construction activities will be generated but effects will be short-term.
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	The site intersects the North Wessex Downs AONB and four NCAs: Thames Basin Heaths, Chilterns, Hampshire Downs and South Hampshire Lowlands NCAs. Construction will results in visual effects, however, the majority of the pipeline infrastructure will be below ground and land reinstated above it. Operational infrastructure not assessed as details were not available at time of review.
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	There are numerous listed buildings within 500m of the route and several scheduled monuments. The scheme intersects three registered parks and gardens and runs along the boundary of a scheduled monument. During construction there will be temporary effects on the setting of these assets and direct impacts on the three registered parks and gardens. There is also potential to uncover archaeology during excavation works for the pipeline. The majority of the pipeline infrastructure is underground and land

Gate 1 assessment		Assessment conclusion
		will be reinstated above, therefore, operational effects on setting are unlikely. Operational infrastructure not assessed as details were not available at time of review.
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	The scheme intersects a golf course, two playing fields, Ashe Park, Main Road Methodist church, and the boundary of two schools, and is within 500m of additional community facilities. Therefore, construction is likely to have a significant impact on the local community. Land will be reinstated following construction. The scheme intersects two cycle routes and a sports facility, therefore causing temporary disruption during construction. Land will be reinstated and it is likely that diversions would be put in place. However, the sports facility may need to temporarily close.
Material Assets	Avoid negative effects on built assets and infrastructure	The scheme intersects motorways and several A-roads and three railway lines potentially causing disruption during construction. It is likely that directional drilling would be implemented under the railways and motorways. Potential road closures on smaller roads may cause disruption. Operational effects are unlikely as the pipeline will be underground.
INNS		The proposed abstraction intake from the River Thames at Pangbourne, Reading is located within area 73 of the classification map in Invasive Non-Native Species Isolated Catchment Mapping. Area 73 is classified as 'Canal – CRT', meaning that hydrological connections to areas beyond the catchment already exist through intersection of the river network with Canal and Rivers Trust (CRT) navigable canals. Connecting watercourses listed include the Kennet and Avon Canal, Wiltshire and Berkshire Canal, Thames and Severn Canal, Oxford Canal and Grand Union Canal. The receptor site at Testwood is located within area 42. Area 42 is classified as 'Isolated', meaning that they do not have existing hydrological connections to any other catchments. Therefore, this raw water transfer would create a connection between a 'Canal-CRT' catchment and a previously 'Isolated' catchment A risk of INNS spread exists in the transfer of raw water to a lake. This option would require removal of all INNS risk at source to allow partially treated water to be transferred for full treatment to drinking water standard at the receiving water treatment works. Transfer of raw water to a WTW provides effective and total removal of INNS, therefore Option 5 meets EA criteria
NC and BNG		
Loss of Orchards and top fruit (ha)		-0.22
Loss of Ancient Woodland (ha)		-1.41
Total Net loss of Habitat units (Grassland, Woodland and forest)		-321.61
Loss in value of ecosystem services per year (£)		-1346.72

C.2 Abstraction locations

The Gate 1 Strategic Environmental Assessment (SEA) Annex provides information on the likely effects due to the abstraction locations for T2ST.

The abstraction location for Options 1, 2 and 5 is west of Culham from SESRO/STT.

The abstraction location for Options 3, 4 and 6 is a new river abstraction from the River Thames located to the west of Reading

The SEA assessment for these abstraction locations in Gate 1 is included in Table 8.

Table 8: Comparison of the potential abstraction locations

Abstraction from SESRO/STT, west of Culham	Abstraction from the River Thames to the west of Reading
Water The abstraction site lies partially within Flood Zones 2 and 3 and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. Measures to reduce the impact of flooding during the construction phase are likely to be implemented, however a potential residual flood risk is likely to remain. **Landscape** The abstraction site lies within the Upper Thames Clay Vales NCA. Construction will result in visual effects. The site may require screening for landscape effects. Further investigation into the potential landscape effects should be undertaken in Gate 2.	**Biodiversity, flora and fauna** The abstraction site is within 500m of the Sulham And Tidmarsh Woods And Meadows SSSI. There are several other designated sites within 2000m. There are likely to be disturbance effects during construction. In addition there may be direct habitat loss of a variety of priority habitats; and disturbance for species during construction. Mitigation should be implemented such as undertaking detailed ecological surveys and assessment; introducing habitat compensation, creation and/or species relocation schemes where required. **Water** The Abstraction site lies within Flood Zones 2 and 3, and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. Measures to reduce the impact of flooding during the construction phase are likely to be implemented, however a potential residual flood risk is likely to remain. In addition, the Abstraction site lies within SPZ 2 and a nitrate vulnerable zone. As such, there is potential for water quality effects during construction. Mitigation should be included such as implementing pollution prevention and control measures to reduce the likelihood of contaminants leaching through soil and entering groundwater. **Landscape** The Abstraction site lies within the North Wessex Downs AONB, the Chilterns AONB and the Chilterns NCA. Construction will result in visual effects. The site may require screening for landscape effects. Further investigation into the potential landscape effects should be undertaken in Gate 2. **Historic Environment** A number of listed buildings and a Registered Park and Garden lie within 500m of the Abstraction site. During construction there may be temporary effects on the setting of these assets. Further investigation into the potential Historic Environment effects should be undertaken in Gate 2. **Population and Human Health** The Abstraction site lies within 500m of community facilities including playing fields, schools, allotments and religious grounds. Construction may have an effect on the local community. Land will be reinstated following construction. Best practice construction methods should be employed to reduce amenity effects for the community. Potential opportunities to enhance the local areas should be explored when reinstating land.

C.3 Transfer destinations

The Gate 1 Strategic Environmental Assessment (SEA) Annex provides information on the likely effects due to the transfer destinations for T2ST.

The transfer destination for Options 1, 2, 3 and 4 is Otterbourne. At Otterbourne due to the limited space available for future development at the existing water treatment works site, (and scale of the T2ST transfer volumes) it was assumed for Gate 1 that a new satellite site, (Otterbourne North), would be required to provide space for the necessary treatment/storage infrastructure to receive water from T2ST.

The transfer destination for Options 5 and 6 is Testwood. The Testwood raw water options were included within the Gate 1 options on the basis that potential storage capacity at Testwood Lakes could reduce the required capacity of the transfer.

The SEA assessment for these transfer destinations in Gate 1 is included in Table 9.

Table 9: Comparison of the potential transfer destinations

Otterbourne North	Testwood
Biodiversity, flora and fauna The Otterbourne site is within 500m of the River Itchen SSSI and SAC There are several other designated sites within 2000m. There are likely to be disturbance effects during construction. In addition there may be direct habitat loss of a variety of priority habitats; and disturbance for species during construction. Mitigation should be implemented such as undertaking detailed ecological surveys and assessment; introducing habitat compensation, creation and/or species relocation schemes where required. **Soil** The Otterbourne site lies within 500m of the Otterbourne pumping station historic landfill site. Pollution of soils may result during construction. Mitigation suggested includes implementation of pollution prevention and control measures to reduce the likelihood of contaminants leaching through soil and entering groundwater. **Landscape** The Otterbourne site lies within the Hampshire Downs NCA and approximately 300m west of the South Downs National Park. Construction will result in visual effects. The site may require screening for landscape effects. Further investigation into the potential landscape effects should be undertaken in Gate 2. **Historic Environment** Four listed buildings lie within 500m of the Otterbourne site: During construction there may be temporary effects on the setting of these assets. Further investigation into the potential Historic Environment effects should be undertaken in Gate 2. **Population and Human Health** The Otterbourne site lies within 500m of community facilities including a playing field. Construction may have an effect on the local community. Land will be reinstated following construction. Best practice construction methods should be employed to reduce amenity effects for the community. Potential opportunities to enhance the local areas should be explored when reinstating land.	**Biodiversity, flora and fauna** The Testwood site is within 500m of the Solent & Southampton Water Ramsar site and SPA, the Lower Test Valley SSSI, and the River Test SSSI There are several other designated sites within 2000m. There are likely to be disturbance effects during construction. In addition there may be direct habitat loss of a variety of priority habitats; and disturbance for species during construction. Mitigation should be implemented such as undertaking detailed ecological surveys and assessment; introducing habitat compensation, creation and/or species relocation schemes where required. **Soil** The Testwood site lies within 500m of the "East of Nutsey Lane" historic landfill site. Pollution of soils may result during construction. Mitigation suggested includes implementation of pollution prevention and control measures to reduce the likelihood of contaminants leaching through soil and entering groundwater. **Water** The Testwood site lies within Flood Zones 2 and 3 and a nitrate vulnerable zone, and therefore, there is a risk of flooding during construction works. Operational effects are unlikely. Measures to reduce the impact of flooding during the construction phase are likely to be implemented, however a potential residual flood risk is likely to remain. **Landscape** The Testwood site lies within the South Hampshire Lowlands NCA. Construction will result in visual effects. The site may require screening for landscape effects. Further investigation into the potential landscape effects should be undertaken in Gate 2. **Historic Environment** Nursling Mill, Grade II listed building lies within 500m of the Testwood site. During construction there may be temporary effects on the setting of this asset. Further investigation into the potential Historic Environment effects should be undertaken in Gate 2

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