Strategic Solution Gate 1 Submission: Preliminary Feasibility Assessment

Water Recycling

28 September 2020

Contents

Please refer to Annex 21 Submission Navigation and Glossary for the glossary of terms, definitions and abbreviations included in this PFA

1 Executive Summary

Strategic Challenge	This Preliminary Feasibility Assessment (PFA) describes work undertaken to develop water recycling-based options in response to RAPID's request for Southern Water (SW) to consider a number of alternatives to the Base Case. These options form part of the Water for Life Hampshire (WfLH) programme.
What SW has done to date	SW is progressing its Base Case (i.e. 75Ml/d desalination [redacted] as it is required to do so by its 'all best endeavours' obligation in its section 20 agreement and is also considering a range of alternatives to the Base Case as is required by the Ofwat Gate Process. SW has developed this PFA considering a wide range of factors that influence the feasibility and viability of five Water Recycling based options: B.1 – 61Ml/d recycled water with River Itchen discharge; B.2 – 61Ml.d recycled water to engineered lake; B3 – 61Ml/d direct recycled water; B.4 – 61Ml/d recycled water [redacted] and B.5 – Option B.2 with 75Ml/d capacity. The factors considered are primarily technical engineering, environmental, procurement, customer / stakeholder engagement, schedule, regulatory compliance, cost / benefit realisation and engagement with partners.
Key findings	• Internationally, water recycling is a viable water sourcing method, however, UK experience is limited. • Water recycling is a high cost technology due to its complexity and high power requirements, although comparatively less so than desalination. • The Drinking Water Inspectorate (DWI) has expressed concern regarding the test of wholesomeness in relation to direct water recycling. • At this stage, based on the current SW view of the schedules for water recycling options, the earliest delivery date is between Q4 2028 and Q3 2029, which is not aligned with the section 20 (s20) obligation to deliver by 2027, however, SW will optimise the schedule on an ongoing basis and will continue to use all best endeavours to deliver deployable output as early as possible and in accordance with the s.20 agreement. • Indirect water recycling is viewed more favourably by customers, due to perceived superior environmental performance, greater potential to off-set carbon emissions, acceptability to customers and ability to support a supply that is more resilient to shocks. • Water recycling has a degree of scalability, however any flexibility needs to be designed in prior to construction. Option B4 has a significant amount of flexibility [redacted] • Estimated CAPEX for Option B1 (included within WRMP) has increased [redacted] between WRMP19 and Gate 1. This is due to greater clarity in the scheme and the inclusion of optimism bias. • Each of the water recycling options will be considered further post Gate 1 to further assess and determine the feasibility of each option.
Key risks & assumptions	• Owing to the fact that water recycling technology requires key stakeholder (DWI, NE, EA) approval, there is a risk that the required approval is not achieved within the required timescales, which could result in Programme delay. • Owing to the relatively novel technique of water recycling, there is a risk that public perception (driven by Taste and Odour, source, etc.) is negatively skewed against it, leading to delays during the planning process as concerns are addressed. • Depending on the Option or Options selected for funding, there is a risk that SW might be required to update and re-consult on WRMP19, leading to additional resource costs to manage the process, and putting pressure on the Programme for delivery. In addition, if this were to be the case, any re-consultation on WRMP19 would fall at a similar time and likely overlap the consultation period for WRMP24. This would need to be carefully managed to ensure the validity of the relevant consultations and avoid confusion. • The extent of, and the interaction between, the DCO and DPC processes is greater than currently assumed within the timescales and impacts on the timescale for delivery. • SW's current laboratory service providers do not have accredited methods for saline water quality analysis for all of the parameters listed in the sampling plan, which includes all of the Schedule 1 and 2 parameters defined under the Water Supply (Water Quality) Regulations 2018, and a preliminary selection of additional risk and design/operational parameters, which could lead to incomplete data for advancing the design and obtaining regulatory approval.
Hierarchy of options when considered against a 'Best Value for Customers'	The hierarchy of options assessment considers a wide variety of factors against best value to SW customers. See Section 10 for more detail.

Option	Hierarchy rank – Water Recycling only	Overall Option Hierarchy position	NPV (£M)
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Quarterly dashboard	The methodology to identify and manage of all aspects of the assumptions, risks and issues of the WFLH Programme remains consistent between the quarterly dashboards and the content herein and in Annex 14 Risk Reports. Any variance between the key risks presented in the August quarterly dashboard and the Gate 1 submission content is due to ongoing review, as per the risk management process documented in Annex 14.0 Risk Report: Guidance.
Document maturity	This PFA is an interim step in determining the feasibility and viability for multiple water recycling-based options to bridge the water supply-demand deficit across the Hampshire region. The Gate 1 milestone is broadly aligned with the Strategic Outline Case (SOC) stage of the business case development process detailed in the HM Treasury's Green Book and assesses a long list of options. More detailed analysis will be completed post Gate 1 as Gate 2 activities.

2 Solution Description

2.1 Outline of the Solution

Water recycling is the process by which Final Effluent (FE) from a wastewater treatment works (WTW) is converted to clean water that can be used for various applications, such as agricultural, industrial, irrigation, and public water supply. Internationally, water recycling is commonly used as an alternative to natural sources, however there is limited experience in the UK. There are currently two Water Recycling Plants (WRP) in the UK, one of which (at Langford, which is operated by Essex and Suffolk Water) is similar to that being investigated by SW, as it is primarily utilised for supplementing water supply sources in drought scenarios.

Water recycling as a Solution is scalable to meet increases in demand as is likely to occur across the Hampshire region over time, although this is not an inherent quality of the solution and would require additional capital investment in infrastructure, such as pipelines, along with further negotiation of environmental permits and consents. If combined [redacted] the potential for expansion to meet a supply-demand deficit during an extreme drought requires less system upgrades.

For clarity, this PFA considers water recycling-based Options that meet the supply-demand balance during a 1-in-200-year severe drought scenario, in line with that detailed in Water Resource Management Plan 2019 (WRMP19).

2.2 Configuration and Options Considered

For desalination, PR19 Final Determinations required at least three size options to be considered in the concept design development. The constrained list of options included for the desalination solutions capacities of 75 Ml/d (the Base Case), 61 Ml/d and 40 Ml/d (See Summary and Guide).

Whilst PR19 did not require consideration of a particular number of alternative options in relation to water recycling, the consideration of alternatives is important in order to inform a number of key assessments both for the Gated Process and later for the planning and consenting process, and it also represents proactive risk management to ensure that SW's supply obligation can be met. As a result, the constrained list of options included a significant number of water recycling solutions.

In addition, the constrained list of options included four solutions relating to West Country Sources North (WCSN). These options were not included in WRMP19 and were a new opportunity considered as part of the PR19 Final Determinations.

Finally, the constrained list also included some hybrid solutions, considered to be an appropriate risk management measure and helpful for a proper consideration of alternatives for the purposes of SEA, HRA and WFD. The constrained list therefore included four potential hybrid options for consideration that built upon the unconstrained list of options in WRMP19.

Through the SW Asset Life Cycle Process (ALP), the constrained list was refined to a Long List of ten Options potentially capable of addressing the supply-demand deficit identified in WRMP. The initial steps, and interim design developments of the ALP were used in the development of the constrained list and those included on the Long List for Gate 1.

This process generated a list of ten Options, which includes the Base Case and five water recycling-based alternatives that SW is considering as potential options suitable to replace the Base Case, if the Base Case was undeliverable (as detailed in Table 1 and Section 4.1). Detail on the supply demand requirements can be found in Annex 2 WRMP & Supply Demand Balance Risk Assessment. Further detail as to the Option Hierarchy Development process is provided within Section 10 of this document and Annex 18 Option Hierarchy Development.

For consistency with the terminology used in PR19 Final Determinations and the RAPID Strategic Solution Accelerated Gate 1 Submission: Initial Concept Design template, these alternatives are described as, for example, 'Option A.1' or 'Option A.2'. However, because SW is using all best endeavours to deliver the Base Case, these are seen as strategic alternatives as described above, rather than 'options' as such.

Table 1 - Summary of water recycling options considered and analysed

Option No.	Option Name	Option Description	Option type	Proposed in WRMP19
B.1	61 Ml/d Recycled water sent to Lower Itchen, abstraction and transferred for treatment at Otterbourne Water Supply Works (WSW)	Budds Farm wastewater treatment works transfer to new WRP 61Ml/d, bulk transfer to lower Itchen. New 61Ml/d abstraction (Lower Itchen) transferred for treatment at Otterbourne water supply works.	Indirect recycling	×
B.2	61 Ml/d Recycled water sent to Upper Itchen / Environmental Buffer - treated at Otterbourne WSW	Budds Farm wastewater treatment works transfer to new WRP 61Ml/d, bulk transfer to a new constructed and lined environmental buffer. Abstraction and transfer for treatment at Otterbourne water supply works.	Indirect recycling	×
B.3	61 Ml/d Recycled water sent direct to Otterbourne Water Supply Works (WSW)	Budds Farm wastewater treatment works transfer to new WRP (61Ml/d), transfer direct to Otterbourne for treatment	Direct recycling	×
B.4	61 Ml/d Recycled water sent to Otterbourne Water Supply Works (WSW) via [redacted]	Budds Farm WWTW transfer to new WRP transfer [redacted] then direct raw water transfer to Otterbourne for treatment	Indirect recycling	×
B.5	75 Ml/d Recycled water sent to Environmental Buffer - treated at Otterbourne Water Supply Works (WSW)	Peel Common WTW transfer to a new WRP, Budds Farm WTW transfer to new WRP, A new Water Recycling Plant (75Ml/d), bulk transfer to an 'environmental buffer' (Otterbourne Lake).	Indirect recycling	✓

2.3 Diagrams and Schematics

High level schematics and process flow diagrams of the recycling process are included in Section 4.1 and initial site location plans are included in Section 4.2.

2.4 Overall Costs

2.4.1 Construction and Operation Costs

Initial cost estimates for the water recycling-based options (detailed in Table 1). The Whole Life Cost (WLC) has been estimated using PR19 rates from 2017/18, however, as required by the HM Treasury Green Book[2], the capital expenditure (CAPEX) has been adjusted to suit the current maturity using optimism bias (OB). Both CAPEX and operational expenditure (OPEX) have also been discounted using a Net Present Value (NPV) approach. NPV has been assessed in accordance with a four-year construction period and sixty-year period of operation.

Table 2 details the Class 4 'Association for Advancement of Cost Engineering' (AACE) estimates developed to date based upon the current concept level of design. Further detail regarding the approach taken in preparing the cost estimates is provided in Section 10 of this document and Annex 12 Cost Report.

Table 2 – Summary of costs: Water Recycling options

Option	CAPEX (£m)	OPEX (£m) (60 years)	WLC (£m)	NPV (£m)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Option	CAPEX (£m)	OPEX (£m) (60 years)	WLC (£m)	NPV (£m)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

CAPEX for the water recycling option included in WRMP19 (Option B.1) has increased from £224m to the current estimate of £497m. This is primarily due to the maturing level of understanding, which has revealed the extent of the capital works required over and above what was initial scoped, in the outline feasibility case proposed in WRMP19, and has then been adjusted using OB. Cost modelling information is detailed in Annex 12 Cost Report.

2.4.2 Costs to each gateway

Costs incurred to date and expected costs to be incurred through each stage of the RAPID process to determine the feasibility of the water recycling solution-based options are detailed in Table 3. Further detail is provided in Annex 20 Gate 2 Activity Plan and Annex 19 Efficiency of Expenditure.

Table 3 - Expected costs for developing feasibility and viability through RAPID Accelerated gate process

Cost Base	Gate 1 (£m) Actual Spend	Gate 2 (£m) Forecast	Gate 3 (£m) Forecast	Gate 4 (£m) Forecast	Total (£m) Forecast
Final determination (17/18)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Common Cost Base	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

2.5 Resource Benefit

Delivery of a water recycling option would provide water resource benefit to the Hampshire Resource Water Zone (HRWZ) and the South-East region as whole bridging the water-supply deficit in the event of a 1-in-200-year drought event. However, benefits specific to other companies are limited. Further detail of the benefits derived from each of the water recycling options is detailed in Section 4.3.5.

2.6 Summary of Social, Environmental and Economic Benefits

Inherent opportunities for social, environmental and economic benefits vary across the water recycling options considered. Typically, indirect water recycling options have the potential for greater social and environmental benefit when compared to direct water recycling methods. Environmental buffers have the ability to provide additional treatment benefits and providing amenity value to customers. These benefits are further detailed in Section 5.1.3.4.

2.7 Drinking Water Quality Considerations

SW has engaged, and continues to engage, with the DWI to ensure water meets drinking water standards and to develop a comprehensive Drinking Water Safety Plan (DWSP). Public and customer perception of water quality is a key consideration and influence on the success of the water recycling-based Options. Public perception and stakeholder management requirements related to water quality need to be managed closely, which is detailed further in Section 5.2.

2.8 Wider Resilience Benefits

The primary benefit of water recycling-based options is to increase the resilience of SW water supply sources up to a 1-in-200-year. Initial resilience considerations in relation to alignment to SW's '4Rs of Resilience' framework, are detailed in Section 5.1.3.3. SW extracted the key resilience requirements from the

RAPID Accelerated Gate 1 Submission template and aligned this with SW's interpretation of resilience criteria, as is detailed in Table 4.

Table 4 - SW's interpretation of RAPID resilience guidance

Key principles extracted from the RAPID Accelerated Gate 1 Submission template	Interpreted set of Resilience Criteria
• Description of the interaction of this solution with other proposed water resources solutions.	• Integration with existing network strengthening solutions / plans
• The extent to which the solution is designed to operate during times of peak demand.	• Adaptability of operation / Emergency response in a stressed situation (e.g. peak week demand)
• Resource benefit of the solution and its potential conjunctive use benefit. • Drinking water quality considerations.	• Environmental Impact (water resource benefit)
• Explanation how this solution will meet the requirements set out in the National Framework and regional plan.	• Future adaptation for growth
• Wider resilience benefits, including those for other sectors – for example, benefits from reduced flood risk.	• Regional Resilience

Each of the five water recycling-based options have been assessed against the 4Rs of resilience, the results of which are summarised in Table 5 and detailed in Section 3 Annex 17 Alignment to Southern Water Resilience Plan.

Table 5 - Resilience assessment – water recycling options

Option	Resilience Criteria	Assessment
B.1, B.2, B.3 & B.5	Integration with existing network strengthening solutions / plans	Largely dependent on the operating regime of Budds Farm WTW and Otterbourne WSW. [redacted]
	Adaptability of operation / Emergency response in a stressed situation	In the event the plant is constantly run on low flow, although this operating regime is yet to be confirmed, the plant has greater ability to respond and recover to drought supply deficits, than compared to situations where it has been through non-use periods.
	Environmental Impact (water resource benefit)	Indirect water recycling options provide greater environment resilience benefits, but these are relatively low compared with Option B.4.
	Future adaptation for growth	Capital investment to construct plant that is suitable for increased flows is required if the capacity of the options were extended. Option B.5 have greater future growth resilience than the other Options (B.1 – B.3) due to the additional connection from Peel Common.
	Regional Resilience	Within Gate 1, it is assumed that the water recycling plant solution does not provide any regional resilience opportunities and is for sole use of Southern Water to meet its requirements.
B.4	Integration with existing network strengthening solutions / plans	As per other water recycling options, plus the provision of additional resilience (redundancy), due to [redacted]
	Adaptability of operation / Emergency response in a stressed situation	As per other water recycling Options
	Environmental Impact (water resource benefit)	Reduced reliance on natural chalk sources, while also increasing water available to be supplied to customers.
	Future adaptation for growth	[redacted]
	Regional Resilience	This potential option also provides resilience of supply benefits for Portsmouth Water, as an additional source that can be used if required.

2.9 Description of the Interaction

All water recycling-based Options, except for Option B.4, are standalone Options with no direct interaction with other proposed water sourcing. [redacted] Each of the five water recycling-based Options would need to interact with other water sourcing options considered through the non-accelerated gate process for delivery under WRMP24, plus existing water sourcing and distribution methods.

2.10 Meeting National Framework Requirements

SW is following National Framework for Water Resources requirements in developing the five water recycling options considered. This includes working with neighbouring water companies in across the Southern England to efficiently manage water resources at a regional level. Further detail related to the process and factors considering the associated feasibility of Options at this stage is provided in Section 11.2.

3 Outline Project Plan

3.1 Delivery Schedule

SW has developed a schedule for water recycling as a Solution that tests the ability to deliver output by 2027 in order to meet the timescale set out in WRMP19 that is linked to the Section 20 agreement 'all best endeavours' obligation. At this stage and noting the complexity of the projects and the level of uncertainty (as with any major infrastructure project at this stage in its lifecycle), feasibility studies and scheduling work currently indicate a later timeline for delivery of the Solution than 2027.

At present, the estimated earliest deployable date for the water recycling Options is Q3 2028. These schedules do not include contingency and represent an 'all best endeavours' approach, however, are reliant on the realisation of opportunities and the mitigation of risks. SW will continue to optimise the programme for delivery between Gate 1 and Gate 2 and will use all best endeavours to realise opportunities for earlier delivery.

Further detail regarding the current estimated schedules is provided in Annex 2 WRMP & Supply Demand Balance Risk Assessment. The water recycling options schedule is illustrated in Figure 1 and further detail is provided in Annex 16 Delivery Schedule.

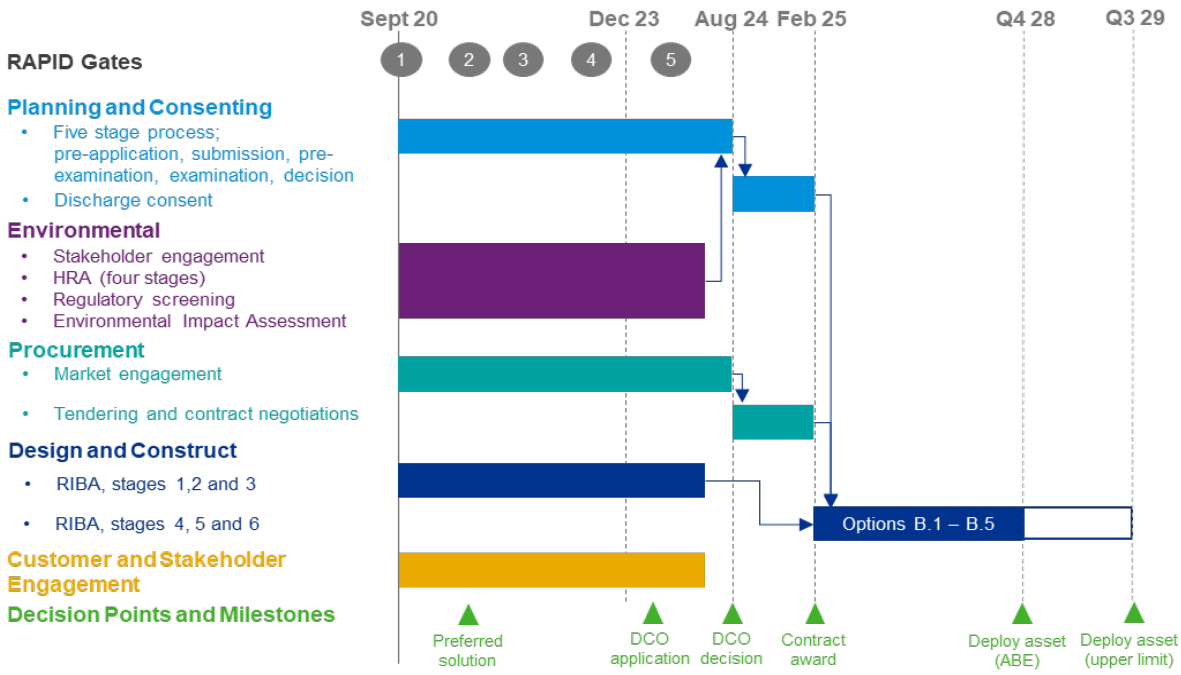

Figure 1 - Illustrative Schedule: water recycling

The phasing of key activities and milestones aligned to key decision points and each stage of the RAPID Strategic Solution Gated Process is detailed in Table 6.

Table 6 - Key activities and milestones in line with RAPID gates for water recycling solution-based options

Gate or milestone	Key Activities	Planned Completion Date
Gate 1 (current stage)	• Preliminary solution feasibility and viability analysis • Initial considerations regarding consent application route • Initial outline of the procurement strategy and approach • Initial engagement with customer and stakeholders to understand the early views of potential solution options • Schedule development for the programme, including development of detailed schedule for the Gate 2 activities of RAPID gated process.	September 2020
Gate 2	• Conceptual design development • Outline strategic SEA / HRA / WFD • Detailed procurement strategy including suitability assessment for DPC, as the programme procurement route • Update schedule for overall programme, including development of detailed schedule for Gate 3 activities of RAPID gate process	September 2021
Gate 3	• Updated final feasibility and viability analysis • Undertaking consent pre-application activities • Market engagement with potential bidding contractors for construction stage • Procurement process preparation • Land referencing • HRA Stage 1 and environmental impact screening • Update schedule for overall programme, including development of detailed schedule for Gate 4 activities of RAPID gate process • Developed design phase continuation	May 2022
Gate 4	• Tender process preparation, including document preparation • OJEU contract notice and tender phase • Developed design phase continuation • Continuation of consent application • Update schedule for overall programme, including development of detailed schedule for Gate 5 activities of RAPID gate process	April 2022
Gate 5 (if required)	• Finalise contract negotiations • Appoint contractor • Discharge consent and environmental conditions • Pre-construction technical design • Update and confirm construction phase delivery schedule	September 2023
Post Gate 5	• Construction • Commissioning and network integration	Feb 2025 to Q4 2028 to Q3 2029
	• Earliest feasible deployable output date – solution commences operations	Q4 2028 – Q3 2029

SW proposes that all water recycling options should be progressed beyond Gate 1, to further assess their feasibility in greater detail. It is possible that some of the alternatives may be determined to not be feasible or deliverable, in which case they will be discontinued prior to Gate 2, and information regarding their discontinuation will be provided at Gate 2. The Base Case and the alternatives which are not discontinued will be progressed to Gate 2. SW will engage with RAPID throughout the period between Gates 1 and 2, including in respect of any proposed discontinuation of alternatives.

At Gate 2, SW propose that a decision should be made by RAPID in its Gate 2 determination as to which Option should be progressed through the remaining gates in the Gated Process (i.e. a preferred solution, the Base Case or one of the alternatives, should be selected by RAPID, and all other solutions will 'fall away', save to the extent that they are relevant to WRMP24 and future programme delivery).

In this context it should be recognised that the Base Case and alternatives may evolve from the projects described at Gate 1, such as in relation to their specific locations, capacities, their relationship with some of the other projects or other factors, as further design, assessment and forward planning is undertaken, to reflect the optimal configuration for the relevant project both in isolation and as part of the wider Programme. In the event that such an evolution takes place between Gate 1 and Gate 2, SW will engage with RAPID in respect of the evolution, and information regarding the 'evolved' version of the relevant project will be submitted at Gate 2.

3.2 Schedule assumptions

Key assumptions made in developing the delivery schedules include, but are not limited to, the following:

- The procurement route will be a direct procurement for customers (DPC) model (refer to section 6);
- Consent is obtained via Development Consent Order (DCO). This assumes the DPC partner is willing to accept all DCO conditions and any associated delivery risk. Requirements and initial assessment regarding the suitability of DCO are detailed in section 7 and Annex 13 Planning Strategy;
- Suitably qualified and experienced resources shall be sourced and deployed to achieve the deliverables set out in the Gate 2 Activity Plan; and
- No requirement to change the approved WRMP.

Further scheduling assumptions are detailed in sections 2.1.4 and 2.2.3 of Annex 16 Delivery Schedule. These assumptions will be tested and validated through the delivery of the RAPID gate process.

3.3 Critical Path

Key activities on the critical path identified at this stage are the environmental survey, site selection and on-site testing Following Gate 3, the critical path moves to the procurement activities through Gate 5, from which point the critical path moves to the discharge of the consent and the construction stage of the project.

3.4 Programme Progress

SW is delivering on schedule against the 'Accelerated Gated Process', however, at this stage, and noting the complexity of the projects and the level of uncertainty (as with any major infrastructure project at this stage in its lifecycle), feasibility studies and scheduling work currently indicates a later timeline for delivery of the water recycling solutions than 2027. As detailed in Section 3.1, the earliest deployable date currently shown in the programme for the water recycling options is Q4 2028, delivering an ABE schedule, and ranges to an upper limit delivery estimate date of Q3 2029.

3.5 Information Status and Plan

The information provided by SW in response to the RAPID requirements and criteria[1] is detailed in Table 7.

Table 7 - Information development

Category	RAPID Requested information - RAPID Accelerated Gate One Assessment Summary of Process and Criteria	Included and location in document?
Solution Design	Is the solution, and all sub options under consideration, well described to allow the assessment to proceed?	• Yes, sections 2.2 & 4
	What evidence is there of solution development and is this sufficient for the development to progress?	• Technical information included sections 2.2 & 4
	Are the benefits the project will bring in terms of water resources clearly articulated and defined?	• Yes, sections 4.3.5
Evaluation of cost and benefits	To what extent do the costs for the project delivery and operation represent evidenced, efficient costs?	• Cost estimate and Gate 1 spend tracking included section 4.3.4.2 & 14.1
	Are all the non-water resource benefits, societal and environmental, costed and/or evaluated as appropriate?	• Yes, sections 4.3, 5.1 & 10
	Does the submission clearly demonstrate that the delivery of the solution is on track?	• Yes, sections 3.1 & 3.2

[1] https://www.ofwat.gov.uk/wp-content/uploads/2020/06/Accelerated-Gate-One-assessment-summary-of-process-and-criteria-v1.pdf

Category	RAPID Requested information - RAPID Accelerated Gate One Assessment Summary of Process and Criteria	Included and location in document?
Risk and programme management	Does the programme plan set out key milestones; clear identification of any changes, delays and mitigation measures?	• Yes, section 3.1 – schedule risks to be analysed quantitatively post Gate 1
	To what extent are water quality and environmental risks assessed and evaluated?	• Yes, section 5.2
	Are assessments carried using monitoring and methods agreed with regulators?	• Industry good practice and methods used and aligned to SW Policy
	What evidence is there that regulatory barriers have been considered?	• Yes, sections 7 & 10
	Initial option-level environmental assessments, meeting local requirements as well as complying with SEA and HRA legislation, including consideration of in-combination effects and identification of environmental risks that need mitigating through the solution design and costing.	• Yes, section 5.1
	Are areas of uncertainty identified and how well developed are there proposals to manage the uncertainty?	• Yes, throughout technical areas. Further investigations completed post Gate 1, included in section 15
	How well have the parties evidenced that expenditure to date has been efficient?	• Yes, section 14
Consistency and context	How well has the solution been placed in context of company/regional/national plans?	• Yes, section 11
	To what extent are data and methods of analysis consistent with those recommended / agreed / used in regional plans and other solutions?	• Yes, section 11
	How well are dependencies identified and issues managed?	• Understood, Section 3. Further detail to be developed post Gate 1
	What evidence is there of engagement with stakeholders and to what extent is the engagement robust and representative?	• Yes, section 8
	Is a clear recommendation made for the scheme to proceed/stop and what evidence is this recommendation based on?	• Further feasibility investigation to recommend option deselection
Assurance and board engagement	What strength of evidence is there in terms of internal assurance and 3rd party assurance?	• Strong, detailed in section 12
	To what extent is evidence of continued Board engagement provided?	• Completed, detailed in section 12
	Is it clear that the Board endorse the scheme and its continuation?	• Yes, detailed in Section 12

4 Technical Information

4.1 Option Configuration

4.1.1 The water recycling process

Water recycling is the process by which FE from a WTW is converted to clean water that can be used for various applications, such as agricultural, industrial, irrigation, and public water supply. Internationally, water recycling is commonly used as an alternative to natural sources, however there is limited experience in the UK.

Both direct and indirect water recycling options have been considered by SW, as detailed in Table 1. The key technical variance between the two approaches is the use of an 'environmental buffer'. In indirect water recycling schemes, the water is passed through or blended with the 'environment', as opposed to direct where it is transferred direct to the subsequent process or system. This is further detailed in Section 2.1 of Annex 5 Water Recycling: Technical Report. The key steps in the direct and indirect water recycling process are illustrated in Figure 2 and 3, respectively.

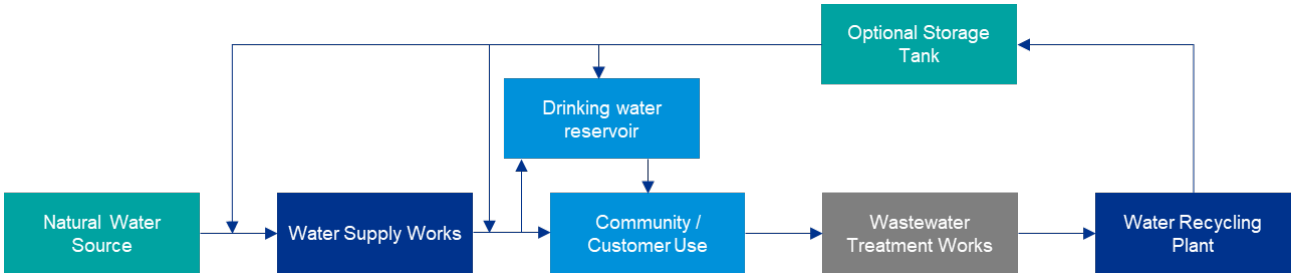

Figure 2 - Direct water recycling process

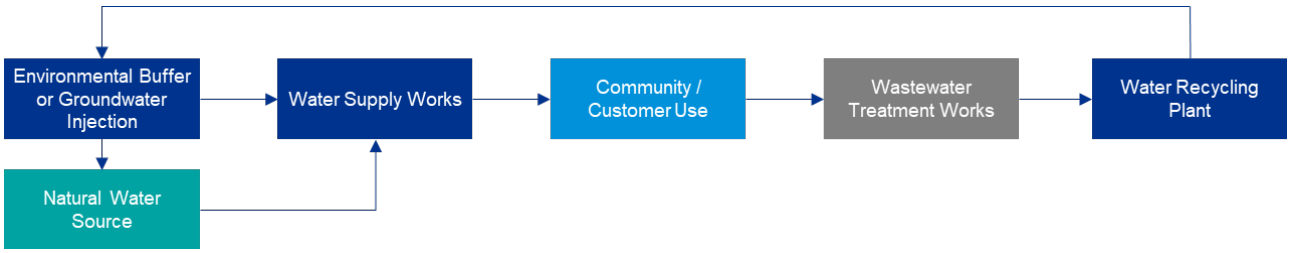

Figure 3 - Indirect water recycling process

The treatment process illustrated in Figure 2 and 3 consist of multiple treatment stages and the expected flow rates of each is illustrated in Figure 4, with further detail of the flow rates and losses at each stage included in Section 4.1.2 Annex 5 Water Recycling: Technical Report. It should be noted that the recycled water process generally operates at a 78% recovery rate i.e. 78l out of every 100l of abstracted water treated will enter the distribution network to customers. For context, recovery rates from normal surface water supply works is commonly accepted to be approximately 90% or higher.

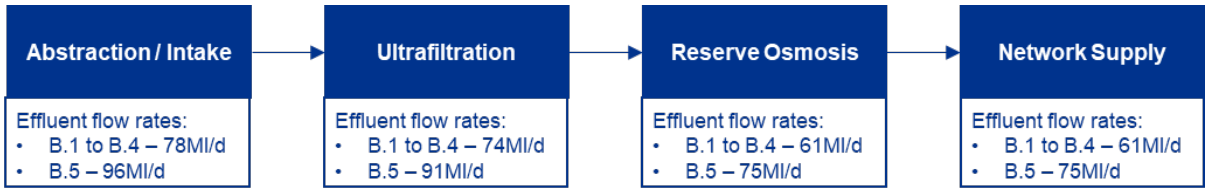

Figure 4 - Water recycling plant treatment process including effluent flow rates

4.1.2 Water Recycling Source

Budds Farm Wastewater Treatment Works (WTW) is the primary source for all water recycling-based Options. Other potential source WTWs were considered included Woolston, Portswood, Peel Common, Slowhil Copse and Millbrook. Each was discounted due to the low dry weather flow (DWF) being insufficient to meet demand requirements alone.

For Options B.1 to B.4, Budds Farm WTW is expected to be the sole source plant to the water recycling process due to the DWF being sufficient to support the required supply-demand of 61 Ml/d at peak capacity, as illustrated in Figure 4. For Option B.5, the expansion of the supply capacity of the WRP to 75 Ml/d will require the Budds Farm WTW influent flows to be supplemented with Peel Common WTW flows. This has the benefit of providing greater redundancy of supply for Otterbourne WSW when compared with options B1, B2 and B3. [redacted] Option B.4 would provide greater reliability and resilience in terms of the water available for use [redacted]

The potential for the use of Peel Common WTW as a water recycling source will continue post Gate 1 to identify if additional treatments are required through the water recycling process. Peel Common WTW is currently hosting the water recycling pilot. Further detail is provided in Section 2.2 Annex 5 Water Recycling: Technical Report.

4.2 Site Selection

A five-stage site selection methodology has been developed and is in the process of being delivered by SW, as illustrated in Figure 5. The proposed methodology is further detailed in Section 2.1 of Annex 9.2 Site Selection Report: Water Recycling.

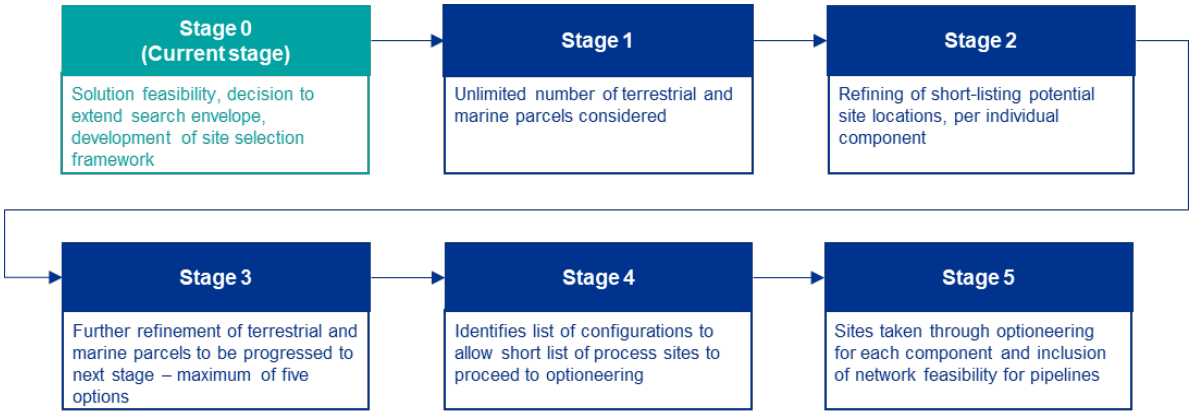

Figure 5 - Site Selection process - water recycling

Desktop studies undertaken to date, as detailed in Annex 5 Water Recycling: Technical Report and Annex 9.2 Site Selection Report: Water Recycling, demonstrate shorter pipeline lengths between the WTW and the WRP are preferable due to the likelihood of reduced OPEX. The potential of locating the WRP within the Budds Farm WTW site has been explored. However, the site is constrained due to existing neighbouring land use and has limited opportunity for expansion. Therefore, a search area within a 5km radius of the Budds Farm WTW has been identified, illustrated in Figure 6, although in the event that a suitable site cannot be found within this search area, the radius will be extended to consider other potential site locations.

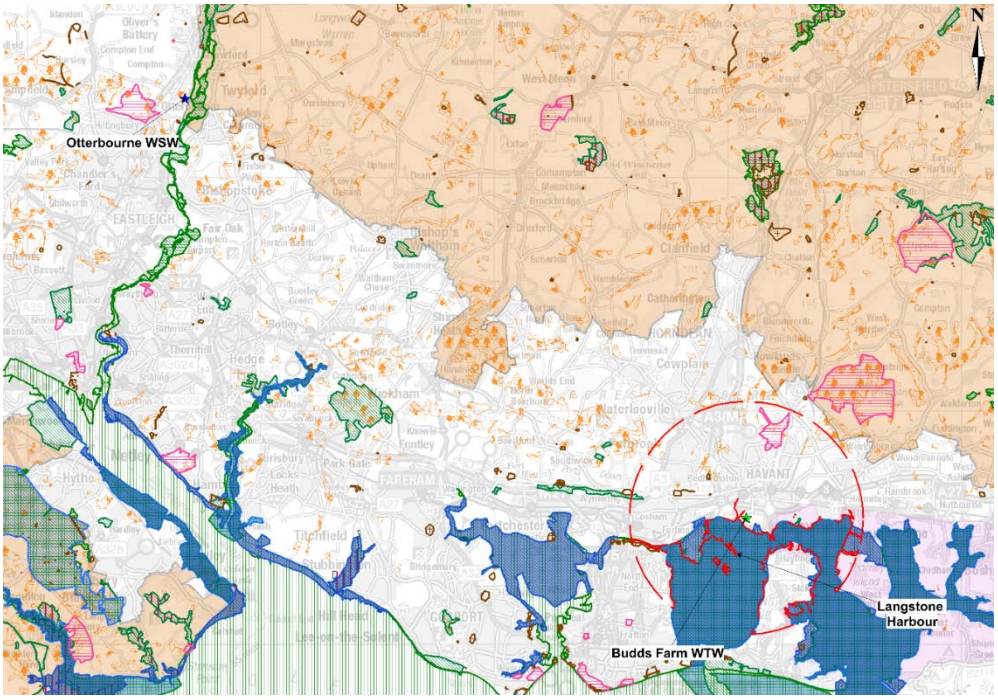

Figure 6 - WRP initial site search area

4.3 Operations and Maintenance Considerations

4.3.1 Operating Need

Drought modelling completed by SW has identified that the WRP (or desalination plant) would be required during a 1-in-200-year scenario to operate for 138 days/year, providing a total of approximately 6,500 Ml and at an approximate maximum flow rate of 61Ml/d. Existing and proposed water sourcing and transfers are sufficient to bridge the supply-deficit up to 1-in-10-year drought scenarios, which represents the point at which the WRP would be required to become operational. Further explanation of this analysis is provided Annex 7 Strategic Modelling.

4.3.2 Operating Approach

The WRP is expected to be used during droughts only, however, due to the process technology, a 'minimum flow' operating regime is preferred, but would be operated above this only when required i.e. demand is greater or forecasted to be greater than that able to be supplied from all other sources.

Water recycling infrastructure will be operated alongside the existing distribution and supply network. Initial modelling completed by SW, and experience from other water companies, indicates limiting the number of interfaces between water recycling infrastructure and the existing network is advantageous as it minimises potential negative impacts to the existing distribution network and therefore customers.

It is assumed that the network will be controlled utilising a holistic real-time system, as this will bring better control and stability. SW would install a consistent monitoring system across the new and key point of the existing infrastructure, which would be integrated together and controlled through the Regional Control Centre (RCC). This holistic approach also supports SW's calm network management ethos. Examples of the benefits of automated control include predictive analytics of demand, lower pumping costs and more effective management of production and turnover within storage assets (environmental buffers) for indirect water recycling options. Further detail regarding the controls of the operating approach are provided in Section 2 Annex 8.2 Network Technical Report: Water Recycling.

4.3.3 Asset and Design Life

Asset and design life assumptions included in the cost estimate are detailed in Table 8. These assumptions are further detailed throughout Annex 12 Cost Report.

4.3.4 Cost and Benchmarking

Initial CAPEX, OPEX and WLC estimates and CAPEX benchmarking undertaken to date is detailed in Table 8. Further detail is included in Annex 12 Cost Report.

Table 8 - Initial cost estimate: Water Recycling

Component	Option	Section	CAPEX				OPEX (£m) (60 years)	WLC (£m)
			Estimated Construction Cost (£m)	Estimate Benchmark Value (£m)	Equivalent Benchmark Value (£m)	Variance (%)		
WRP	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Pipelines	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Component	Option	Section	CAPEX				OPEX (£m) (60 years)	WLC (£m)
			Estimated Construction Cost (£m)	Estimate Benchmark Value (£m)	Equivalent Benchmark Value (£m)	Variance (%)		
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Operating Expenditure considerations / Asset Life Expectancy, (OPEX* not separated out for pipeline)

- Mechanical and Electrical, 20 years (unless specified)
- Instrumentation, 10 years
- All concrete structures and all components, 60 years
- Concrete service reservoirs, tunnels and shafts, 100 years
- All pipelines including pressurised pipelines, 60 years
- Intakes and outfalls, 100 years
- Chambers and manholes, 60 years
- Masonry and steel framed buildings and all components, 60 years
- Pumps – major overhaul, 10 years and full replacement, 20 years
- Membranes, 5 years

- The above asset life expectancies assume assets are maintained regularly, following an assumed maintenance profile, which supports assets to be operational for the expected asset duration. These maintenance costs have been included in the OPEX costs detailed in this table.
- Other items considered within the OPEX calculations include chemical usage, electric consumption, maintenance labour requirements and additional operational and maintenance requirements are variable costs, so assumptions have been made relating to these considerations.

Further detail supporting the cost estimating process and analysis is included in Annex 12 Cost Report, with further information relating to the supporting network infrastructure components in Annex 8.2 Network Technical Report: Water Recycling.

4.3.5 Water Resource Benefit

SW is focused on delivering upon the obligations in its s20 agreement, which is to deliver a long-term strategic solution to bridge the supply-deficit during a 1-in-200-year drought scenario. SW is actively participating in regional water resource modelling and planning, which is managed by Water Resources South East (WRSE), in-line with the national framework[2] requirements to ensure that the water recycling-based options optimise hydrology across the region.

Aware of future water supply resilience requirements, water recycling could be designed to include redundancy to allow expansion capacity. The proposed Option B.4 provides the greatest resilience [redacted] to provide redundancy and resistance to failure of supply. Further detail is provided in Section 3.1.1 Annex 17 Alignment with Southern Water Resilience Plan.

SW is considering the ability to expand the capacity of the options in the future, although this would require additional capital investment in relevant infrastructure and appropriate programme extensions as further detailed in Section 10.

[2] Meeting our future water needs: a national framework for water resources, 16 March 2020

5 Environmental and Drinking Water Quality Considerations

5.1 Strategic Environmental Assessment (SEA) and Habitat Regulations Assessment (HRA) appraisals

As detailed in Section 4.2, site selection work for the WRP and supporting infrastructure is ongoing, and completion is a key dependency for Initial option level environmental assessments. In the absence of a short list of potential sites, Initial option level environmental assessments to date have been conducted as desktop exercises, with more detailed analysis to be completed post Gate 1, as detailed in Annex 16 Delivery Schedule.

5.1.1 SEA and HRA appraisals – Stage 1

The initial environmental appraisal undertaken for Gate 1 included an assessment of the solutions following the principals of Habitat Regulations Assessment (HRA), Strategic Environmental Assessment (SEA), Water Framework Directive (WFD) and Natural Capital Assessment (NCA), as described in Table 9. It should be noted that these are not formal statutory documents, but to maintain consistency have been completed in a similar way to the assessments undertaken as part of the WRMP19. Further detail of the initial environmental appraisal process applied is included in Section 3 Annex 10.2 Environmental Appraisal: Water Recycling.

Table 9 - Initial option level environmental appraisal considerations: Water Recycling

Environment Appraisal	Appraisal consideration
Strategic Environmental Assessment (SEA) Further detail of the SEA appraisal considerations are included in Section 6.1 in Annex 10.2 Environmental Appraisal: Water Recycling	• Biodiversity, flora and fauna • Population and human health • Material assets and resource use • Water; Soil, geology; and land use • Air and climate • Archaeology and cultural heritage • Landscape and visual amenity
Habitat Regulations Assessment (HRA) Further detail of the HRA appraisal considerations are included in Section 6.1 in Annex 10.2 Environmental Appraisal: Water Recycling	• Biodiversity, flora and fauna (HRA specific open source data) • Likely significant effects on European designated conservation sites under the Habitats Regulations (Stage 1 Screening)
Water Framework Directive (WFD) Further detail of the WFD appraisal considerations are included in Section 6.2 in Annex 10.2 Environmental Appraisal: Water Recycling	• Biodiversity (fauna and) flora (WFD specific open source data) • Water (WFD chemical and quantitative status; Bathing Water Directive; Drinking Water Directive: Drinking water protected area; Shellfish Directive: Shellfish water; Nitrates Directive: Nitrate Vulnerable Zones; Urban Waste Water Treatment Directive: Nutrient sensitive area or eutrophication sensitive area)
Natural Capital Assessment (NCA) Further details of the NCA appraisal considerations are included in Annex 10.2 Environmental Appraisal: Water Recycling	• Environmental benefits • Environmental disbenefits • Opportunities for achieving net gain and improving environmental resilience

5.1.2 Appraisal results – stage 1

The high-level environmental screening was assessed against the structured rating scale detailed in Table 10. The results of the stage 1 screening completed to date are detailed in Table 11.

Table 10 - Stage 1 screening RAG status legend

Risk of adverse effects grade (SEA, WFD, NC)		Risk of adverse effects grade (HRA)		Opportunity for beneficial effects grade (NC)	
	Negligible		No risk to European designated sites		No beneficial effects / not applicable
	Minor adverse impacts likely, 'standard' best practice mitigation activities		Potential adverse impacts on European designated sites considered possible		Potential for beneficial effects
	Moderate adverse impacts likely, mitigation required to overcome		Potential adverse impacts on European designated sites considered likely		Potential for moderate beneficial effects
	Major adverse impacts likely, very challenging to overcome				Potential for major beneficial effects
	Substantial adverse impacts, cannot be overcome with mitigation				

Table 11 - Summary of environmental screening results for key components of the water recycling options considered

Area of assessment	Common to all water recycling option				B.1 – 61 Ml/d Recycled water to Lower Itchen			B.2 – 61Ml/d bulk transfer to a new constructed and lined environmental buffer (and B.5, at 75Ml/d capacity)			B.3 – Direct to Otterbourne	B.4 – 61 Ml/d to Otterbourne [redacted]		
	Budds Farm to WRP	Water Recycling Plant	Waste stream via Eastney	Blending tank at Otterbourne WSW	Riverside Park discharge	Chicken Hall discharge	Gaters Mill to Otterbourne – both routes	Discharge	Pipeline	Upper Itchen Environmental buffer	Recycled water transfer pipeline	[redacted]		
Water resources and water quality														
Biodiversity, flora and fauna														
Archaeology and cultural heritage assets				n/a		n/a								
Landscape and visual amenity	n/a		n/a											
Other environmental considerations						n/a								
WFD							n/a	n/a		n/a	n/a			n/a
Natural capital														
HRA Stage 1 Screening														

The variance between water recycling Options B.2 and B.5 is the capacity only. As a result, the environmental impacts for Options B.2 and B.5 have been assumed to be the same. To avoid duplication, these environmental appraisal results for Option B.5 have not been included directly.

A high-level cumulative effects assessment has been undertaken with other relevant plans, programmes and projects, including other water companies WRMPs, DPs and other development plans in the area. The initial results are detailed in Table 12. Further assessment will be undertaken as part of the Gate 2 activities, as detailed in Annex 20 Gate 2 Delivery Plan.

Table 12 - Cumulative environmental effects: Water Recycling Options

Stakeholder Group	Project / Programme / Region	Effects
SW	Central and Eastern Zones	Pending option and final transfer pipeline route selection, there is possible potential need for pipeline construction through the South Downs National Park. There are other central zone pipeline transfer projects in the early stages of development that are expected to require physical works through the South Downs National Park.
	Drought Plans	Unable to confidently model at this stage, as any cumulative effects are dependent on the pipeline route and construction method selected.
Neighbouring Water Companies	Affinity Water	None identified
	South West Water	
	Bournemouth Water	
	Thames Water	
	Wessex Water	
	Cholderton and District Water Company	
	Sutton and East Surrey Water	
	South East Water	
	Portsmouth Water	[redacted] here is potential of combined environmental impacts caused by construction.
Other industries and developments	N/A	There are no impacts on other industries and developments that SW is currently aware of.

5.1.3 Other Appraisal Results

5.1.3.1 Contribution to environmental net gain

At this stage high level opportunities for environmental net gain have been identified for water recycling. These include, but are not limited to, the following:

- Contribution to net biodiversity gain;
- Wider environmental benefits of restored habitat, such as carbon sequestration, air and water purification, can be captured in natural capital appraisal;
- In combination with additional commitments to utilise renewable energy sources, the carbon sequestration effect of habitat re-creation could help the solution to be consistent with the UK Government's net-zero carbon target[3]; and

[3] UK Government target to achieve net-zero carbon by 2050 as per the Climate Change Act 2008 (2050 Target Amendment) Order 2019.

- Habitat restoration within the near National Parks could create wider social benefits, such as improved visual amenity.

Any offsetting or mitigation schemes will be included in the design so that future stages of natural capital assessment can take account of any potential social and environmental benefits. More detail will be provided for Gate 2.

5.1.3.2 Carbon considerations

An initial carbon impact appraisal has been completed that models the anticipated carbon emissions associated with each option. The results of the appraisal, that include consideration of total carbon, embodied carbon and carbon emissions associated with each option considered are detailed in Table 13.

Table 13 - Carbon appraisal results: water recycling

Option	Carbon – from capital delivery (tCO_2e)	Carbon – from operational life (tCO_2e)	Carbon – Whole of Life (WoL) (tCO_2e)	Carbon per water treatment (over 60-year lifespan) (tCO_2e / Ml)
B.1	65,400	266,00	331,000	5,430
B.2	63,100	194,000	257,000	4,220
B.3	57,900	193,000	251,000	4,120
B.4	59,700	198,000	258,000	4,220
B.5	119,000	291,000	410,000	5,460

Further detail of the approach applied to conduct the appraisal and the results is provided in Annex 10.2 Environmental Appraisal: Water Recycling.

The results in Table 13 are based upon a full flow operating scenario which is the maximum flow and greatest expected carbon impact, representing a worst case scenario. The carbon assessment will be refined once the preferred operating regime for the water recycling-based options has been selected, post Gate 2. 'On / off' and minimum operating regimes are expected to have less total carbon consumption, but the processes of commissioning and decommissioning a WRP into, or out of, service is energy intensive, leading to higher net energy consumption per unit of water.

Multiple components of the water recycling plant construction and operation result in net carbon emissions, as detailed in Table 13. The Government has committed to achieve net zero carbon emissions by 2050, and the UK water sector has committed to be net carbon neutral by 2030, and SW will take this into account in its further design and assessment of the desalination solution

5.1.3.3 Resilience Considerations

The primary benefit of the water recycling is to provide greater resilience of water supply to customers during a severe drought (1-in-200 year). A key resilience benefit of indirect water recycling is the storage provided by the 'environmental buffer'. Options B.2, B.4 and B.5 include environmental buffers, as an intermediately step between treatment and supply. From a supply perspective, environmental buffers provide greater certainty that sufficient water quantities are available to meet customer demand and this increases with volume.

Option B.1, allows for increased flows in the River Itchen during drought periods, however, it is currently unclear that increases in the abstraction licenses would be supported by the EA.

5.1.3.4 Social and Environmental Benefit

The proposed Option B.4 provides the greatest opportunity for social and environmental benefits of the water recycling options, [redacted] Option B.1 [redacted] less environmentally beneficial when compared to Options B.2, B.4 and B.5. Option B.3 does not include an environmental buffer and therefore is considered to be the least beneficial from a social and environment and benefit perspective. During the design process additional benefits will be built into the final solution as required to satisfy consenting requirements.

5.1.3.5 Value for Customers

As detailed in Section 5.1.3.3, the primary benefit to customers is the provision of a secure water source for the Hampshire region during a severe drought. At this stage in the design process, the wider benefits for customers have not yet been identified, this will happen as options are developed through Gate 2 and beyond.

5.2 Water Quality Considerations

5.2.1 Source Water Considerations

Water quality testing is currently ongoing at sixteen key locations across the wastewater catchments and the intakes to WSW in order to have a detailed understanding of the water recycling treatment requirements. The testing programme in progress considers biochemical oxygen demand; dissolved oxygen; total dissolved solids; disinfection by-products; sucralose (wastewater tracer); microbial indicators; consumer and cleaning products; pharmaceuticals; sterols and hormones; pesticides, herbicides, fungicides; flame retardants; volatile organic compounds; and metals. Details of the testing process and the results to date are provided in Section 5.2 Annex 5 Water Recycling: Technical Report.

Similar parameters are being tested on the final effluent from Budds Farm and Peel Common WTWs. The detail of water quality testing has been limited to that originally planned and intended due to Covid19 lockdown and, when possible, sampling will continue post Gate 1.

5.2.2 Condition Requirements

5.2.2.1 Receiving Waters

As detailed in Table 1 and Section 2.2, options B.1, B2, B4 and B5 are an indirect water recycling Options that need to pass through, or blend with, the 'environment'.

For Option B1, the River Itchen acts as the 'environmental buffer'. The WRP discharges to river and will therefore require adherence to Common Standards Monitoring Guidance (CSMG), so that the discharge does not significantly impact the naturalised flow of receiving waters, negatively impacting biota nor biodiversity. The River Itchen is a chalk river, which is known to be a highly complex ecosystem, and therefore increases the complexity for ensuring that the discharged is aligned chemically and physically with the river water. Further detail regarding CSMG requirements are provided in Section 2.1.4 of Annex 5 Water Recycling: Technical Report.

For option B.2 and B5, includes a dedicated lake as the environmental buffer and, if required, blending could be done with abstracted water from either the river or groundwater (this volume would be within SW licence). Blending with river water, is less complex from hydraulic and engineering infrastructure perspectives, while bending with groundwater provides greater water quality benefits.

[redacted]

5.2.2.2 Drinking Water

As detailed in sections 5.1.3 and 5.1.3.2, there is a need for a 'multi-barrier' approach, which would include a reverse osmosis (RO) membrane process. Including this within the water recycling treatment train will ensure appropriate treatment and deliver SW's obligation to ultimately provide a 'wholesome' water supply to customers.

Regulation 4 of Water Supply (Water Quality) Regulations 2018 relates to customer perception and acceptability of water provided to customers. Customer perception is a key risk for all water recycling options, as subtle changes to taste and odour could impact customer "acceptability" of the final product. To mitigate this risk, SW favours using a RO membrane treatment, which will provide improved water quality relative to other treatment methods.

The use of an environmental buffer also helps to manage customer perception as it provides an intermediary step between recycled water and supply to customers, making the water perceptibly closer to that of a 'natural' source, like a river or reservoir. Engagement completed to date, detailed in Section 8, has shown that direct water recycling would not be acceptable to the DWI at this stage, due to risks

surrounding customer perception of water quality, meaning that if Option B.3 is progressed there are likely to be significant complexities in obtaining the required approvals, from regulators, to deliver and operate the scheme.

To control taste impacts recycled water needs to align with and be of similar chemical profile to that of the existing water source. The profile treated surface water at Otterbourne WSW, from testing completed between April 2015 and April 2020, is detailed in Table 14.

Table 14 – Otterbourne Surface Water WSW treated water quality sampling

Parameter	Units	Min	Average	Max
[redacted]				

5.2.3 Drinking Water Safety Plan Development

SW is following a five-step process aligned to British Standard (BS EN 15975-2:2013 (BS15975-2)) to develop the Drinking Water Safety Plan (DWSP). Source water quality sampling, a key input into the DWSP, has commenced and will continue post Gate 1. Further detail of the DWSP process is provided in Section 3.2 and Annex 5 Water Recycling: Technical Report.

Specific drinking water safety hazards are to be identified and assessed following this process and will be used to inform a Water Quantitative Risk Assessment prior to Gate 2. To inform this process, sampling, similar to that detailed in Section 5.2.2.2, will take place following a structured sampling plan, with hazards included in the DWSP database. This sampling plan will form the basis for the risk identification, assessment and verification stage, managed by SW's Water Quality team, of the DWSP development process. One round of source water sampling has been completed, with detailed results provided Section 5.4 Annex 5 Water Recycling: Technical Report.

5.2.4 Regulatory barriers

SW has regularly engaged with multiple regulators, including DWI, throughout the Gate 1 process, and plans to continue to this engagement following Gate 1. A key purpose of this engagement is to ensure that the DWSP meets DWI requirements and provides appropriate detail on how to manage and ensure water safety, once operational. This includes ensuring that water is acceptable to customers, while also meeting drinking water safety standards. Further detail of the engagement with regulators completed during the Gate 1 stage is provided in Section 8.2.

The proposed membrane treatment technology to supply drinking water (recycling option B.3) will require Regulation 31 approval as it will be new technology / material use in the England and Wales. This regulation represents a significant challenge for direct recycling, however, will be required to meet the Regulation 4 test of wholesomeness. For the indirect recycling options, approval under Regulation 31 of the Water Supply (Water Quality) Regulations 2018 is not required for the RO membrane process, as this passes through an environmental buffer.

6 Procurement and Operation Strategy

6.1 Procurement Strategy

SW has investigated the most appropriate procurement strategy for the successful delivery of water recycling as an option by focussing on option B.1 as it is deemed to be representative of all procurement activities for the water recycling-based options. The investigation included, but is not limited to, the following:

- Direct Procurement for Customers (DPC) eligibility for the purpose of Gate 1
- DPC tender model assessment; and
- Fall back strategy for delivery of the scheme through alternative routes other than DPC.

The findings of this investigation are summarised below and further detailed in Annex 11 Commercial Strategy.

Based on Ofwat's guidance within the Draft Determination, Initial Assessment of Plans (IAP) and Final Determination (FD), SW has developed and applied an eligibility framework to determine the most appropriate procurement route. Some aspects of the framework criteria have been interpreted to enable a practical application as part of the assessment. The framework comprises a three-step test, as detailed in Table 15.

Table 15 - DPC eligibility framework

Test Parameter	Test Parameter characteristics	Assessment	Suitability
Size Test based on the £100m threshold for whole life costs Section 4.2.1 of Annex 11 Commercial Strategy.	Scheme costs will be considered on a nominal and real basis, including development costs, initial CAPEX, renewal CAPEX and OPEX.	The total cost of option B.1 solution on a real and nominal basis over the 25-year contract period is expected to be of sufficient size to exceed the £100m threshold see Annex 11 Commercial strategy	**Deemed suitable based on currently developed information**
Discreteness Test Section 4.2.2 of Annex 11 Commercial Strategy.	Consider specific operational and technical considerations of the asset within the wider context of SW's network based on Ofwat technical report: • Interactions with the network. • Asset and operational failures. • Contributions to supply capacity and ability to specific outputs. • Stakeholder interactions and statutory obligations.	The water recycling B.1 option has characteristics making it 'discrete' and somewhat suitable for DPC, particularly in relation to interoperability, economies of scope and output definition. However, there are significant risks that could reduce the suitability of the project for DPC such as potential changes to environmental conditions or regulations leading to additional required investment. Overall, the characteristics of the option as currently understood make it broadly more suitable for DPC.	**Deemed suitable based on currently developed information**
Quantitative VfM Test Section 4.2.3 of Annex 11 Commercial Strategy.	• The options are compared on a Net Present Value (NPV) basis of required revenues between a factual and counterfactual. • Factual: a project finance type framework for delivery of the scheme via DPC. • Counterfactual: delivery of the scheme by SW under a regulatory price control framework.	Based on Ofwat's input assumptions the scheme delivers greater value for customers across all sensitivity inputs.	**Deemed suitable based on currently developed information**

The current options appear suitable for delivery via DPC in terms of the size, discreteness and the potential VfM it could deliver for customers. SW will test whether these assumptions and methodology continue to be relevant ahead of Gate 2 following the development of a more fully developed project specification, more specific risk mitigation plans as feasibility information matures and additional market engagement. There are four core options for the tender model ('very early', 'early', 'late' and 'split' models), which can be used dependant on which entity is best placed to manage the risk and delivery of the design, planning & consenting and preconstruction works. Which in this case will be either SW[4] or the Competitively Appointed Provider (CAP).

As part of the tender model evaluation SW engaged in informal bilateral market engagement sessions with twelve potential participants, including bespoke technology providers, contractors, developers and investors. SW assessed the late and early DPC tender models in detail against a qualitative assessment framework made up of fourteen criteria across three key categories: SW, supply chain, and regulations/obligations. On balance the emerging view is a late DPC tender model is more suitable than the early DPC tender model. However, a key issue with the core late DPC tender model, is that a successful bidder for the pre-DPC activity may have gained commercial advantage if bidding for the DPC procurement.

The emerging finding therefore is that a bespoke later DPC model, delivered with urgency to suit the overall delivery needs of the water recycling options is deemed more appropriate for SW, although further investigation is needed. The final bespoke model will be determined by the risk allocation and overall commercial structure.

In addition to DPC, there are immediate procurement needs to support the programme critical path, reduce risk and create cost efficiency. The pre-DPC procurement is for three activity groups: Design, DCO and the client role. The procurement strategy has been assessed against the same criteria categories as the DPC tender model, as well as against four principles core to SW's strategy: (i) Securing skilled design resource, (ii) obtaining an integrator option, (iii) be an intelligent client and (iv) progress with urgency.

In support of Programme critical path, immediate progress needs to be made on pre-DPC activity, covering a refined procurement plan including market engagement, a commercial and contraction strategy and the implementation of the activity in an updated delivery model. This must occur in alignment with the DPC model next steps, to allow for best VfM overall and to mitigate risks.

SW has completed initial work on a fall-back procurement strategy, should the Programme not be progressed under DPC at any point in future. Depending on the point in time in the lifecycle at which delivery returns to the traditional delivery model, the following strategic options have been considered.

- **Option 1** – Split Design/DCO and Build: Integrator package for design and DCO, followed by a separate build package for detailed design, build and commission
- **Option 2** – Integrated Design and Build: One large integrator package covering design, DCO, build and commission that is procured early in the lifecycle.
- **Option 3** – Split Design/DCO and Build, with early contractor engagement: As option 1, but the Build partner is involved via a formal early contractor engagement strategy.

These options would be subject to refinement and full validation via market engagement. Further detail of the investigation into the fall-back procurement strategies is included in Annex 11 Commercial Strategy.

6.2 Asset Utilisation

Ofwat stated that it expects the Water Recycling option in the PR19 Final Determination to be delivered through DPC and therefore, ownership of the asset in all Water Recycling Options would sit with the CAP for at least the duration of the financing period, however the CAP will be contracted to provide services back to the Appointee. [redacted]

[4] This could be undertaken by SW's supply chain outside of DPC

The water recycling plant is expected to be in use for droughts more severe than a 1-in-10-year scenario, and is expected to be utilised for 138 days in a 365 day period during a 1-in-200-year scenario, the maximum capacity of the asset, and when it will operate at peak demand.

Table 16 details the expected as expected asset utilisation of the water recycling solution-based options, in terms of days and total water volume expected to be transferred in various drought scenarios.

Table 16 - Asset utilisation: Water Recycling

Drought Return Period (years)	Annual Days Operation	Annual Volume Transferred (Ml)
1	0	0
2	0	0
5	0	0
10	4	18
20	26	341
50	76	2,322*
100	99	3,557*
200	138	6,476*

***Note**: Aquator modelling is currently over-predicting transfer rates by c. 8Ml/d, which is equivalent to up to 1,104 Ml of volume transferred during a 1 in 200-year drought event

As detailed in Section 4.3.1, two operating scenarios for the asset have been considered, 'on / off' and 'minimum flow', both of which allow for increases in supply, to meet customer demand. The minimum flow operating scenario is being considered to reduce extreme increases in asset use and 'moth-balling' the asset during times of where it is not required, which can be financially costly.

Options B.2, B.4 and B.5 include an element of storage capacity that provide SW with the ability to 'smooth' out increases in demand. Option B.4 includes the greatest potential storage capacity, relative to other options, [redacted] Greater storage also provides greater resilience in meeting customer demand in the event there are failures or other emergencies in the recycling process. Option B.1 and B.3 provide negligible storage capacity and as a result would likely experience the greatest 'surge' in treated flow rate and use of supporting resources, such as power.

SW plans to utilise a real time control system to analyse demand patterns calling sources to run as required. This system can be used to schedule production operations 48 hours in advance, using smart systems to control / manage situations of unanticipated network events. This is detailed further in Section 4.3 and Section 3.1.1 Annex 17 Alignment with Southern Water Resilience Plan.

7 Planning Considerations

7.1 Preferred Planning Route

A Development Consent Order (DCO), under the Planning Act 2008, or planning consent under the Town and Country Planning Act 1990 (TCPA) are the consent and planning regime options available. SW undertook a screening process of the DCO and TCPA planning approaches to determine the suitability of each approach. DCO is the preferred consenting route for all desalination Options. Key benefits that the DCO planning route provides includes, but are not limited to, the following:

- Greater certainty and clarity over the decision-making process and the timings associated with the planning process;
- Greater alignment and support with national policy;
- Greater opportunity for community and stakeholder participation;
- Greater powers and other provisions that go beyond those of alternative planning approaches; and
- Compulsory land purchase and temporary land occupation applications to be completed in the same process – saving time and resources with multiple applications.

The key risks and opportunities of the DCO process are summarised in Table 17. Further detailed explanation of the key risks and opportunities are detailed in detailed in Section 2.1 of Annex 13 Planning Strategy.

Table 17 - Summary of risks and opportunities of the DCO and TCPA consenting routes

key risks and opportunities	Key risks and disadvantages	Opportunities and benefits
DCO approach – under Planning Act 2008	• Secretary of State may refuse a request for a direction to make the project qualify as a NSIP (where a solution does not automatically meet the threshold set out in PA 2008 e.g. 80 MLD) • Likely to take longer to secure than Planning Permission (if no public inquiry and TCPA advisory timescales are met) • Requires significant investment upfront 'front loaded' (e.g. surveys, consultation with stakeholders and the community) • Cost is likely to be more for DCO compared to TCPA (cost of front-loading documents, consultation and examination, expert team)	• Requirement for extensive pre-application with PINS, stakeholders and the community reduces risk of unforeseen issues/objections • Provides certainty and 'positivity' in process (i.e. NPS establishes the needs case) • High success rate, particularly for projects with NPS support. Front loaded nature and PINS acceptance gate before examination helps to reduce successful judicial review challenges • Greater potential to avoid historic issues of lengthy / costly delays during considerations of the consent application. Inquisitorial examinations are typically more favourable than adversarial inquiries
Planning Application under TCPA 1990	• Multiple planning permissions required due to the scale of the project, may present difficulties in terms of coordination of approach/lead authority. • PPAs can be implemented, public inquiry potentially lengthens consenting process and does not have defined duration. • Increases the number of separate consent applications required.	• More common consenting route, familiarity by local authorities. • Can be quicker to obtain planning permission over a DCO (assuming no lengthy public enquiry) • A lower level of detail required at the submission. Greater emphasis on post consent discharge of conditions / investigations.

7.2 DCO Planning Steps

The use of the DCO planning process is limited to projects that are defined as National Significant Infrastructure Projects (NSIP), under section 14 of the Planning Act 2008. Types of projects considered to be NSIPs include:

- Development relating the transfers of water resources;
- The construction or alteration of a desalination plant; and
- The construction or alteration of a reservoir or dam.

Due to the definitions above, water recycling schemes do not immediately qualify as NSIPs, limiting the eligibility of the water recycling options to utilise the DCO planning route. The delivery of a water recycling option under the DCO planning route is still possible if the applicant makes a successfully request for a Direction from the Secretary of State under section 35 of the Planning Act 2008 for the development to be treated as an NSIP, and consequently brought into the DCO regime.

SW would need to demonstrate as part of its request for a section 35 Direction that the project is of national significance or would benefit in being treated as a NSIP. For example, SW would need to demonstrate time efficiencies that are achieved as a result of the DCO regime, that it would allow greater certainty regarding delivery costs and timeframes or that the DCO regime allows for greater community, customer and stakeholder involvement and engagement in the pre-construction stages of the project.

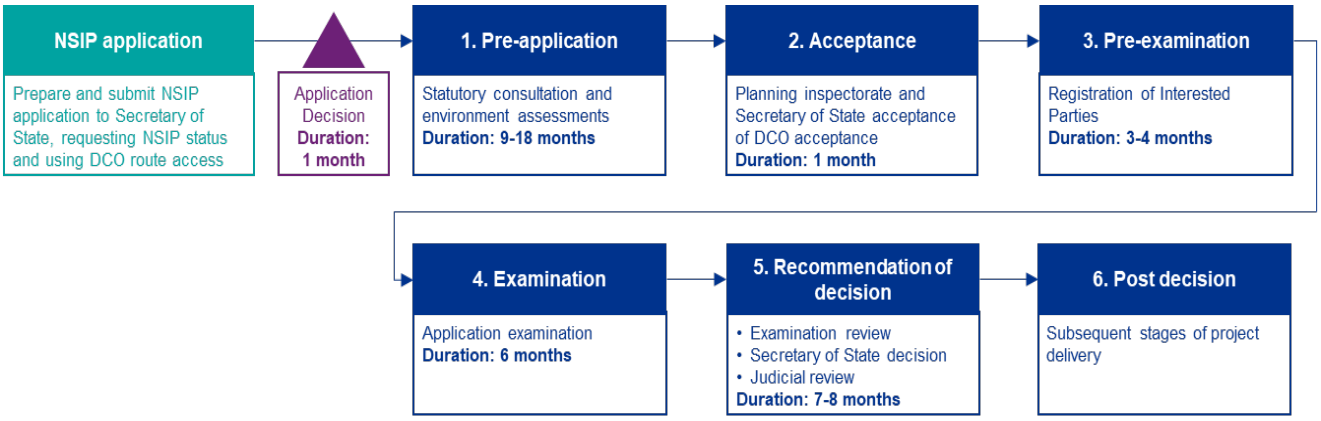

Figure 7 – DCO process

The DCO planning approach process is illustrated in Figure 7, including the initial request to the Secretary of State for a Direction under section 35 of the Planning Act 2008 for the project to be treated as a NSIP and the overall timeline of the DCO process in the event the request for a section 35 Direction is successful. This includes statutory timeframes which will drive the overall project schedule for this part of the programme, and is detailed further in Section 10.

In the event that the NSIP application to the Secretary of State is unsuccessful, then the TCPA route would be the consenting regime for the water recycling options.

8 Stakeholder Engagement

8.1 Customer and Stakeholder Complexity and Views

Engaging proactively and openly with regulators, stakeholders and customers is essential to the success the W4LH programme. Customer and stakeholder perceptions have the power to shape programme delivery, irrespective of option selection.

Water recycling is a complex option from a technical and stakeholder perspective, which was initial viewed favourably during customer and stakeholder engagement as part of the WRMP19 process. A wide range of views held across the customer and stakeholders involved with the WFLH programme – many of which directly conflict one another. Water recycling is a relatively new technology to the UK, although there is wider experience overseas, detailed in Section 2.1.5 Annex 5 Water Recycling: Technical Report.

SW has engaged with a broad range of customers and stakeholders regarding the W4LH programme. The customers and stakeholders engaged with to date, and to be engaged with as the programme continues, are detailed in Table 18. A summary of the engagement conducted to date with is detailed in Annex 15 Stakeholder and Customer Report.

Table 18 - Customer and stakeholder groups

	Customer and Stakeholder groups engaged with	Customer or Stakeholder definition
1	Customers	**Customers** defined as *"those that play a role within our region which includes a diverse range of life stages, believes and experiences such as; bill payers (household, non-household), diverse cultures, future, those in vulnerable circumstances, stakeholders and different customer segments."*
2	Customer Action Group	
3	Businesses	
4	Hampshire Chamber of Commerce	
5	Community groups	
6	SW staff	**Stakeholders** Defined as *"A representative of an organisation or group with an interest in the planning, delivery or impact of Water for Life – Hampshire. These include regulators, planning authorities and environmental groups".*
7	Regulatory bodies (Ofwat, Natural England, Environment Agency, DWI)	
8	Consumer Council for Water	
9	Government organisations (e.g. councils)	

	Customer and Stakeholder groups engaged with	Customer or Stakeholder definition
10	Environment groups and regulators	
11	Wildlife trust	
12	Members of Parliament	
13	National Farmers Union	
14	Media	

Key trends in the views of customers and stakeholders observed during the engagement conducted to date are detailed in Table 19. In some cases there are directly conflicting views between varying customers and stakeholders and these will need to be managed as engagement activities continue.

Table 19 - Trends is customers, stakeholders and objector views

	Customers	Stakeholders
Challenge	• Little or no knowledge of the water supply deficit • Low understanding of droughts and water abstraction • Impacts on personal water bill is paramount • Hold concerns for future generations and the environment • Low trust in water companies communicating the safety of water to drink	• Very knowledgeable about water supply deficit • Environmental groups prefer more longer-term focus and improved catchment management
Possible solutions	• Support desalination to a degree, as a temporary solution • Some people prefer water use restrictions • Water recycling preferred	• Desalination is acceptable, but not ideal. • Direct water recycling favoured from environmental perspective, however, indirect favoured from water quality perspective environmental buffers provide
Engagement approach	• 'Front-load' engagement where possible	• Demonstrate the actions taken in response to engagement with stakeholders

The four-stage engagement process applied by SW is detailed in Section 6 Annex 15 Stakeholder and Customer Report, with future engagement activities planned to Gate 2 detailed in Section 9 Annex 15 Stakeholder and Customer Report. This engagement process is illustrated in Figure 8.

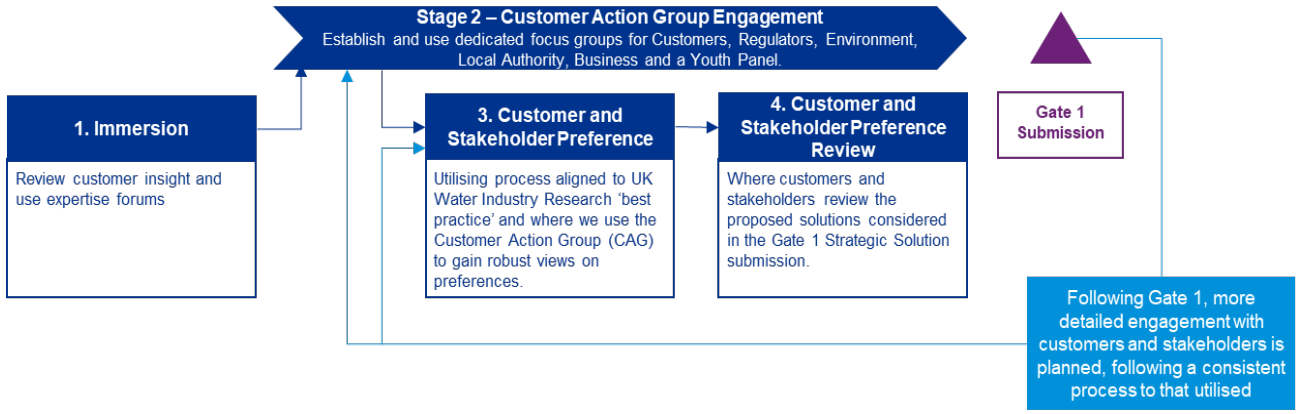

Figure 8 - Customer and Stakeholder Engagement Process

8.2 Engagement with Regulators

SW has regularly engaged with key regulators during Gate 1, including RAPID, EA, NE and DWI, to ensure transparency in regard to the work undertaken prior to Gate 1, the acknowledgement of opinion and regulation in the development of technical information submitted as part of SW's RAPID Gate 1 submission. This engagement will continue post Gate 1, as SW continues to investigate the Base Case and alternatives.

9 Key Risks and Mitigation Measures

Individual registers for assumptions, risks, issues and opportunities have been developed for each water recycling solution-based Option. Registers. The key assumptions, risks, issues and opportunities are detailed in Annex 14.2 Risk Report: Water Recycling, and consider the stability, sensitivity, validation / mitigation and provide an overall RAG status.

Table 20 - Summary of Water Recycling option risks

Risk ID	Risk description	Technical category	Current Score	Mitigation Strategy	Residual Score
Prog-R31	Depending on the solution or solutions selected for funding, there is a risk that SW might be required to update and re-consult on WRMP19, leading to additional resource costs to manage the process, and putting pressure on the programme for delivery. In addition, if this were to be the case, any re-consultation on WRMP19 would fall at a similar time and likely overlap the consultation period for WRMP24. This would need to be carefully managed to ensure the validity of the relevant consultations and avoid confusion.	Legal	25	Updating and re-consulting on the WRMP would need to be completed prior to making a DCO application, as this would all SW to benefit from the presumption of 'need' case for the project. Keep the position under review as SW moves through the Gated process. Further work is being undertaken on Programme Risk to refine the high-level programme and identify opportunities to optimise it.	24
Prog-R22	Owing to the benefits of being able to apply for a number of consents through a DCO application, this is viewed as the preferred planning route by SW. B.1 is for a 61 Ml/d Water Recycling Plant. However, there is a risk that a direction under Section 35 of the Planning Act 2008 might not be made to enable the preferred solution to progress via the DCO consenting process, leading to SW having to utilise the Town and Country Planning process instead.	Planning and Consent	24	Keep the position under review as SW moves through the Gated process. The delivery schedule includes a programme for making a s.35 Direction request, and for prior engagement with PINS to mitigate against the risk of a s.35 Direction not being made. .	24
Recycle-R2	Owing to the Pilot being a complex and time critical process, and in light of the extraordinary circumstances around COVID-19, there is a risk that there is insufficient data generated to support further assessments in relation to water recycling, which could lead to delays.	Contractor Performance	24	The Pilot is currently suspended owing to COVID-19. All original items relating to commissioning have been resolved. SW are however working with the contractor to undertake final tests on the infrastructure prior to the Pilot starting. Through dialogue with the DWI and RAPID, it is assumed that an agreed approach can be found in the event that physical water quality data is not available, thus reducing the probability of the risk event occurring.	21
Prog-R50	There is risk that the extent of, and the interaction between the DCO and DPC processes is greater than currently assumed within the timescales, and impacts on the timescale for delivery	Commercial and Supply Chain	22	Undertake further Programme Risk analysis to validate assumptions used and understand and mitigate potential risks to timely delivery of the Base Case. Undertake further work on the durations and dependencies to formulate improvement plans and identify opportunities.	22
Prog-R59	There is a risk that SW's current laboratory service providers do not have accredited methods for saline water quality analysis for all of the parameters listed in the sampling plan, which includes all of the Schedule 1 and 2 parameters defined under the Water Supply (Water Quality) Regulations 2018, and a preliminary selection of additional risk and design/operational parameters, which could lead to incomplete data for advancing the design and obtaining regulatory approval.	Commercial and Supply Chain	19	If existing suppliers are unable to support the requirements of this scheme, alternative service providers will be engaged. Desalination plants are operated in several European countries, all subject to the European Drinking Water Directive (upon which the UK Regulations are based), indicating that appropriate analyses will be available to support the planned sampling programme. Alternative suppliers are currently being investigated to ensure that the requirements can be met.	19
Recycle-R49	Owing to the fact that there are no current regulations on expected hydraulic retention time for environmental buffers in the UK, SW have assumed a retention time based on blending with river water of 24 hours. However, there is a risk that the DWI could request a significant increase in this retention time, leading to the requirement for an environmental buffer that cannot be accommodated at Otterbourne, and therefore making this Option unfeasible.	Stakeholders & Approvals	21	There are no current regulations on the expected retention time in environmental buffers. SW is pioneering this approach with a Pilot Trial to test for parent and daughter compounds known to be harmful to public health that are on the DWI's guidelines as well as globally available water reuse guidelines. The results of this trial are intended to provide confidence in the proposed 24 hours retention time in an environmental buffer mixed with a natural river water, and support DWI approval.	21

Risk ID	Risk description	Technical category	Current Score	Mitigation Strategy	Residual Score
Recycle-R41	Owing to the relatively novel technique of Water Recycling, there is a risk that public perception is negatively skewed against Water Recycling, leading to delays to during the planning process as concerns are addressed. (Perception driven by taste, odour, source, etc.).	Stakeholders & Approvals	21	SW will undertake a purposeful customer consultation to build an informed picture of current perception, and how that perception may be influenced. The consultation will test acceptability of recycled water on future customers. SW will also work with the local media in order to prevent sensational, negative articles from being written and instead highlight positive, fact based messaging.	19
Recycle-R35	Owing to the fact that Water Recycling technology requires key stakeholder (DWI, NE, EA) approval, there is a risk that the required approval is not achieved within the required timescales, which could result in programme delay.	Stakeholders & Approvals	23	Work is being undertaken on developing closer engagement with local customers to assess their acceptance of the process. Other specific engagement includes working with the EA on the discharge of waste water from the recycling process, working with the DWI on data to support suitability for drinking (wholesome water), and working with NE on discharge effects on the natural environment	19
Recycle-R34	Currently, there are no RO membranes that have achieved DWI approval. SW will therefore have to obtain approval under Regulation 31 of the Water Supply (Water Quality) Regulations 2018 from DWI. There is a risk that DWI approval of a suitable RO membrane is not achieved within the required timescales, leading to a delay to the delivery of the B.3	Stakeholders & Approvals	22	Feedback from the DWI has encouraged SW to identify the most appropriate product, or a selection of appropriate products, for this specific application and pursue Regulation 31 approval via the standard application route (or encourage the supplier to pursue approval).	22
Recycle-R46	Owing to the high level of permissions required to construct the pipeline route through designated environmental areas (River Itchen SAC/SSSI) and across roads (A3M), rivers (ecological constraints at Botley) and rail infrastructure (Network Rail approvals), there is a risk that formal objection to the route is received during the planning process, which could result in programme delay.	Stakeholders & Approvals	19	To mitigate this risk item, SW will continue to work through the route selection process, identifying key risks to enable specific mitigation plans to be developed as appropriate.	19
Recycle-R48	[redacted]	Stakeholders & Approvals	21	Continue to work through route selection assessment identifying key risks. Use “what if” scenario testing to understand impacts of amending the selected route. Perform detailed land referencing work to identify land owners and continue to develop detailed stakeholder communication plan to begin stakeholder discussions as early as possible to discuss concerns. Develop mitigation plans in collaboration with the relevant stakeholders to address their concerns including reviewing relevant elements of alternative routes. Work closely with the planning officer throughout the planning submission.	21

10 Cost and Benefit

One of the RAPID requirements at Gate 1 is to provide 'A statement from SW articulating the current hierarchy of solutions (i.e. in the absence of a regional plan which of the available solutions/combinations are considered to provide the best value for customers)'.

RAPID has requested that, as part of the gated process, SW considers a number of alternatives in addition to the Base Case. The assessment of alternatives in this way also represents prudent risk management and business planning, to ensure that should it be required, there is an alternative available to meet SW's supply obligation if it is not possible to implement the base case, despite using all best endeavours to do so. In addition, the consideration of alternatives is required in order to support important assessments such as SEA, HRA and Water Framework Directive Assessment (WFDA) as part of the gated process, and EIA, HRA and WFDA in the context of the subsequent planning and consenting process for the base case.

In order to identify and give appropriate consideration to alternatives in comparison to the Base Case, it was necessary for SW to progressively develop a suite of Options. In order to identify alternatives, the following two phases of Options Hierarchy Development have been completed:

- Phase 1 – Emerging Option Development
- Phase 2 – Hierarchy Development

It is important to note that at Gate 1 the purpose of the hierarchy is to consider 'best value for customers' at this concept development stage, as opposed to the original option development that took place for the WRMP. It is also not intended to be used as a tool to discontinue or deselect any of the solutions being put forward through the SRO process.

In Phase 1 a number of steps were taken, as detailed below:

a) PR19 Final Determinations set out the solutions for which Ofwat allocated funding to be progressed through the Gated Process and SW used this as the basis for developing a constrained list of appropriate additional solutions to the Base Case, as detailed in Annex 18 Option Hierarchy Development.
b) This constrained list of options was subject to SW's Asset Lifecycle Process (ALP) that enabled the development of the Long List of ten solutions, which are the subject of this submission

To develop the constrained list of options, a review was undertaken of desktop feasibility studies in respect of the unconstrained list as set out in WRMP19 and refined as appropriate to reflect updated information since WRMP19. SW then applied the WRMP19 screening criteria in order to develop the constrained list of twenty-one solutions/options for consideration (including the Base Case), as detailed Annex 18 Option Hierarchy Development.

Through the SW ALP the constrained list was refined to a Long List of ten Options capable of addressing the supply-demand deficit identified in WRMP. The initial steps, and interim design developments, of the ALP (outlined below) were used in the development of the constrained list detailed in Annex 18 Option Hierarchy Development, and those included on the Long List for Gate 1. The ALP initial and intermediate steps are:

- Understanding the need and basis for the project, together with the root causes of the need.
- Review of the WRMP 'Preferred Strategy' (desalination) and 'Strategic Alternative' (recycling) options.
- A detailed review of the proposed process technologies together with the source water constraints (e.g. water quality, maximum availability of the Water Treatment Works in the Southampton to Portsmouth area).
- From the above, the constrained list was developed taking into account, in particular, feedback from Natural England (NE) & the EA on the use of the River Itchen and from the DWI on requirements for water recycling. This resulted in alternative transfer being considered from a Water Recycling Plant to Otterbourne WTW.
- In parallel with steps 3 and 4, a water resource model was developed, based on the WRMP scenarios, to understand not only the peak of the drought, but also the shape (volume of water required) of the drought.

- The above information was presented to the Strategic Working Group to agree the final Long List.

Due to having ten Options, and thus a long list, under consideration at the point of submission to RAPID, SW consider that RAPID Gate 1 is approximately aligned to HM Treasury Green Book Strategic Outline Case[7] (SOC) 1 stage. Based on this, in accordance with the HM Treasury Green Book guidance[1], a Multi-Criteria Decision Analysis (MCDA) has been used to develop the hierarchy for this Gate 1 submission and was applied as part of Phase 2.

MCDA is a structured technique of looking at complex problems that are typically characterised by monetary and non-monetary objectives in order to break the problem down into manageable pieces. The technique is used to support decision making in the context of assessing multiple options against a range of objectives and considering their relative importance. It is typically used in the early stages of scheme appraisal; providing a practical and robust means of assessing options against both quantitative and qualitative criteria and is complimentary to other techniques which primarily use monetary valuations, such as Cost Benefit Analysis (CBA). Due to the Base Case and strategic alternatives being at the concept design stage, consistent with Gate 1, and there remaining to be some uncertainties over matters such as the technology to be employed and the precise site locations, a full Cost Benefit Analysis (CBA), as detailed within the HM Treasury Green Book, is not appropriate at this stage and will be undertaken prior to Gate 2 after further design and assessment work has been undertaken.The MCDA consisted of 33 individual criteria allocated across five themes that are considered to contribute to determining 'best value for customers', as detailed below:

1. Extent of Alignment to National, Regional and Corporate Objectives;
2. Perceived Level of Delivery Risk;
3. Perceived Level of Operational Risk;
4. Impacts on the Environment and Potential Benefits; and
5. Impacts on our Stakeholders and Potential Benefits.

The criteria were developed through consideration of the strategic challenge, customer and stakeholder high priority success factors, the SW definition of 'best value for customers', WRMP screening criteria and the HMT Greenbook Critical Success Factors, as detailed in Annex 18 Option Hierarchy Development.

Following the development of the MCDA criteria, SW reviewed each criterion to determine a weighting factor so as to place the required importance/emphasis on those that most influence/impact 'best value for customers. The weighting allocation is detailed in Annex 18 Option Hierarchy Development.

The MCDA process was undertaken by key SW and WCSN programme personnel from the following disciplines:

- Programme Strategy;
- Infrastructure Engineering;
- Process Engineering;
- Environmental and Planning;
- Procurement;
- Customer and Stakeholder Management;
- Project Management;
- Risk Management; and
- WCSN project lead (with support from appropriate SW personnel to give comparator perspectives for options that the WCSN project lead would not have knowledge of)

The MCDA results are informed by feasibility evidence currently available to SW, which is detailed throughout the technical annexes of the SW Gate 1 submission.

The MCDA can necessarily only be informed by and based on the feasibility evidence that is currently available to SW at this concept design stage. As noted above, there remains uncertainty over a number of key elements of the various solutions, including technology, specific location and other matters. There is also considerable further design and assessment work to be undertaken on all of the Options. This means that a range of assumptions have had to be made for the purposes of this Gate 1 submission and in the context of the MCDA, a number of which are conservative and are expected to be refined prior to Gate 2. This must be borne in mind in the context of the hierarchy resulting from the MCDA process, which is essentially based on a 'snapshot' of the ongoing assessment of the solutions.

It must also be borne in mind that the hierarchy that SW has been asked to produce is intended to reflect best value for customers, to the extent possible at this concept design stage, for the purposes solely of satisfying the requirement for such a hierarchy at Gate 1 by RAPID. This means that the criteria used to score the various solutions, and the weighting applied to them, have been developed based on the issue of 'best value for customers' and considerations relevant from this perspective, as described above. The MCDA and resulting hierarchy therefore necessarily cannot and do not reflect the wider range of considerations that SW is required to consider when progressing the development of the solutions, including SW legal obligations under the s.20 Agreement, assessment of alternatives from the perspective of SEA, HRA or WFD or wider issues relating to deliverability and risk.

For example, the MCDA, being focused around the issue of 'best value for customers', therefore places only limited weight on matters such as SW' obligations under the s.20 agreement, which is one reason why desalination ranks lower in the hierarchy than would be expected if the MCDA was not strictly based around 'best value for customers'.

The hierarchy, as a result of the MCDA is detailed in Table 21. CBA assessments will be undertaken post Gate 1.

Table 21 - Current indicative MCDA driven option hierarchy

Options no.	Option Name	Overall Scores	MCDA Hierarchy	NPV	ABE Target Date	Upper Limit Target Date
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The solution costs detailed in Table 21 have been developed in-line with relevant HM Treasury Green Book guidance. The process followed is detailed in Annex 12 Cost Report.

Whilst CBA is not appropriate at this stage, SW has conducted a qualitative high-level benefit and impact assessment for all water recycling-based Options, which is independent of, and does not contribute to, the MCDA process. As a result of the current uncertainties which are to be expected at SOC stage,

benefits for each Option have been assessed qualitatively on a 'high', 'medium and 'low' basis, as detailed below:

- = Net benefit expected i.e. the benefits are expected to exceed the costs
- = Negligible net benefit expected i.e. the magnitude of costs and benefits are expected to be similar to one other and 'offset' each other in calculating the cost benefit ratio
- = Costs are expected to exceed benefits i.e. net disbenefit is expected to be realised.

The high-level benefit and impact assessment outcomes are detailed in Table 22.

Table 22 – Qualitative benefit and impact assessment

Benefit		B.1	B.2	B.3	B.4	B.5
1	**Resilience:** Provides greater resilience of water supply to the Hampshire region during drought scenarios	**Commentary:** All options increase the resilience of supply to customers. Water recycling solutions are constrained by dry weather flows (DWFs) of WTWs. Option B4, [redacted] has potential greatest resilience in terms of influent flows to support customer demand.				
2	**Water resources:** Aligns with National Policy requirements, where SW considers the efficient use of water resources at a regional level	**Commentary:** All proposed options meet National Policy and guidance requirements. This is detailed further in Annex 2 WRMP & Supply Demand Balance Risk Assessment.				
3	**Environmental**: Enhanced provision for biodiversity, flora and fauna	**Commentary:** Water recycling is highly energy intensive process (although less than desalination), causing high carbon emissions during operations. Indirect water recycling options have capacity to offset carbon emissions as they include an 'environmental buffer1. However, Option B1 impacts the River Itchen with its new discharge and abstraction.				
4	**Amenity value:** Increased amenity provision for the local community(ies)	**Commentary:** Environmental buffers provide amenity value to customers and communities, as the buffers can be used for alternative uses, such as recreational activities. Direct water recycling has less initial scope for this to be included. Option B3, together with the desalination options, have a lower capacity for enhancements.				
5	**Customer and Stakeholder:** Preferential customer and stakeholder solution	**Commentary:** Option D.2 is favoured by stakeholders compared to all other options, followed by water recycling options and then desalination.				
6	**Water Quality:** Enhanced water quality for customers	**Commentary:** Water Recycling produces exceptionally clean water. However, to make it 'wholesome' for customers the use of environmental buffers is required by the DWI, therefore Option B.3 (Direct) is red. In addition, Option B.1 and B.4 [redacted] will have a similar T&O to the current abstraction.				
7	**Carbon Emissions:** Offsets carbon emissions and potential for carbon net zero without need of external initiatives (e.g. tree planting)	**Commentary:** All water recycling options will require external initiatives to offset the high carbon emissions. However, these are low than all desalination options.				
8	**Deliverable and Operable:** Southern Water has experience delivering and operating the required technology and systems	**Commentary:** Desalination and water recycling would be a new technologies for SW. Although both are used internationally, there is limited experience delivering and operating these systems in the UK. Option D2, being a transfer is already within SW operational experience.				
9	**Futureproof:** Option capacity can be expanded to 1-in-500 year without significant capital investment required	**Commentary:** Only Option B4, [redacted] has the potential ability to extend to a 1:500 yr capacity without significant				

Benefit		B.1	B.2	B.3	B.4	B.5
		capital investment [redacted]				
10	**Supply chain development:** Improved knowledge and expertise across the UK supply chain / market	**Commentary:** Delivering new technology solutions would develop the UK market, but due to the limited experience of delivering and operating water recycling in the UK there is a risk, international support is likely to be required.				
11	**Affordability:**					
	Aligns with Southern Water customer's willingness to pay	**Commentary:** Desalination and water recycling solution-based options are costly to deliver and operate, which is expected to have an impact to customer bills. At this stage, the expected impact on customer bills has yet to be determined.				

11 Impacts on Current Plan

11.1 Supply-demand Balance Impacts

The demand surplus is detailed in Table 23, with the original WRMP19 scenario based upon a total deficit of 190 Ml/d during a 1-in-200-year drought scenario (requiring 75Ml/d to be supplied by the Base Case). In this scenario WRMP19 delivers a surplus of 21-31Ml/d. In the reduced supply and demand scenario, the capacity is reduced to 61Ml/d and the surplus changes from 17 to 27 Ml/d. This is further detailed in Annex 2 WRMP & Supply Demand Balance Risk Assessment.

Table 23 - Supply-demand modelling surplus at 2029 / 2030

Option Capacity	Original WRMP19 (50% scenario) Surplus		Reduced Supply-Demand Balance (50% scenario) Surplus	
	MDO (Ml/d)	PDO (Ml/d)	MDO (Ml/d)	PDO (Ml/d)
75Ml/d	+21	+31	+31	+41
61Ml/d	n.a.	n.a.	+17	+27

These scenarios are the minimum deployable output (MDO) which occurs when available water is at its lowest, usually in the autumn, and peak deployable output (PDO) which occurs when demand is highest, usually in the summer.

11.2 National Framework and Regional Plan Requirements

SW conducted an assessment of the alignment between the water recycling-based solutions considered, as detailed in Table 1, and their alignment to the National Framework for Water Resources. The results of this assessment are that each of the five options align to the National Framework, as detailed in Table 24.

Table 24 - National Framework alignment for water recycling-based options

Option	Aligns to National Framework	Commentary
All options		**Applicable to all water recycling options:** • Increase SW's resilience to drought • Increase overall supply capacity and facilitate the movement of water to where it is needed • New water supply method would contribute to increased resilience – during 'normal' and drought conditions
B.1	✓	As above, plus:

Option	Aligns to National Framework	Commentary
		• Through transfer of highly treated effluent to a discharge point in the Lower Itchen, an environmentally sustainable abstraction can be secured for public water supply
B.2 (and B.5)	✓	As above, plus: • Through transfer of highly treated effluent to a discharge point in the Upper Itchen, or an environmental buffer, an environmentally sustainable abstraction can be secured for public water supply
B.3	✓	No additional points
B.4	✓	As above, plus: • Storage [redacted] further increases the resilience of the scheme, in accordance with the National Framework

12 Assurance

12.1 Assurance Process

SW has adopted a 'three lines of defence' assurance framework for reporting governance and assurance activities. This framework illustrated in Figure 9.

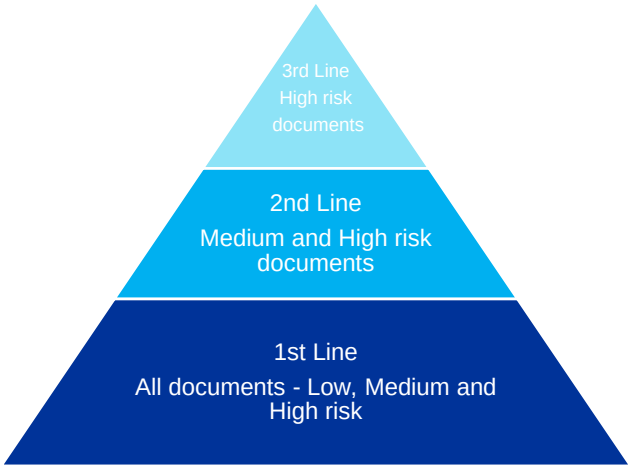

Figure 9 - 'Three lines of defence' framework

Key components of the assurance activities within each line of defence are included in Table 25, with further detail provided in Annex 1 Assurance Process

Table 25 - WFLH programme components of the 'three lines of defence' model

Line of defence	Key components involved in assurance process (Further details provided in Annex 1 Assurance Process)
First line	• Each area had a nominated lead responsible for reviewing, checking and validating content • The Executive Programme Board reviewed and challenged key content prior to sharing with the Board. • Workstreams consulted a range of external experts and resources • Data checking and accuracy of key facts and data was confirmed by data providers and verified by reviewers to identify potential inconsistencies.
Second line	• Workstream independent compliance and completeness review and check, completed by the central programme management team
Third line	• The first round of assurance – All high-risk areas assessed in line with the scope, highlighting areas of improvement and focussing on defined areas of risk. • The second round of assurance – Review that initial recommendations had been addressed and measuring the overall maturity and quality of the documents against Regulators' requirements.

Line of defence	Key components involved in assurance process (Further details provided in Annex 1 Assurance Process)
	• Strategic assurance, completed by PwC, and technical Assurance, completed by Jacobs

SW's third-party assurance providers have completed assurance reports, detailing the assurance process and the findings of the assurance process, which is provided in Annex 1 Assurance Process.

The WFLH programme working group have been regularly engaged with during the development of the Gate 1 submission. This engagement has provided regular review as part of the first line of defence assurance activities. The schedule of Board engagement is detailed in Section 3 Annex 1 Assurance Process.

12.2 Board Assurance Statements

The Board has challenged and satisfied itself that the overall strategy for the approach to the Gate 1 submission and data assurance is appropriate. This submission progresses solutions to meet a 1-in-200-year drought scenario in SW's Western Area. We recognise from the Draft Water Resource Planning Guideline that solutions to meet 1-in-500-year resilience will be required in the future, and we are therefore considering options which could be scaled up to meet this future requirement. We look forward to working with Water Resources South East (WRSE) to assess regional solutions that provide best value customer and environmental outcomes as part of the next water resources management plan.

We confirm that:

- all the elements add up to an accelerated Gate 1 submission that is high quality and meets the requirements as set out in the PR19 Final Determination and subsequent guidance from RAPID.
- we have put in place a risk-based assurance process to help improve the accuracy and robustness of the data and estimates used to develop the Gate 1 submission.
- we endorse the solutions in scope at this stage, for continuation to the next stage of the RAPID process, and the addition of [redacted] an additional solution to the accelerated gate process.
- we are committed to transparent reporting of high-quality data that can be trusted.

The Board is aware of the West Country Sources North solution, developed jointly with Wessex Water and Bristol Water. We understand our role as water resource recipient in this submission and are satisfied that an appropriate strategy has been implemented to assure the approach and data. We will continue to monitor the progress of this solution and associated risks during the accelerated gate process.

How the Board has Satisfied Itself

- We adopted an assurance framework for the Gate 1 submission which follows the 'three lines of defence' model.
- The Board reviewed the proposed scope and approach of third-party assurance.
- PWC provided strategic assurance, confirming the quality of the submission and consistency with documents referred to.
- Jacobs provided technical assurance, focussing on reliability, consistency and quality of data, and efficient cost expenditure.
- We established a Board working group which reviewed key parts of the submission.
- The Board working group met directly with PwC and Jacobs in September 2020 to discuss their findings, PWC also attended the Audit Committee in September 2020. Final assurance reports were provided to the full Board for consideration in approving the submission.

Further evidence

- Engagement with the submission team through the Board working group (Table 6, Annex 1 Assurance Process).
- The executive programme board challenged key areas of the plan, informing the Board working group (Table 6, Annex 1 Assurance Process).
- Detailed assurance framework.
-

Assurance reports (Jacobs and PwC reports, Appendix 1)

13 Solution or Partner Changes

13.1 Options B.1, B2, B3 and B.5

Options B.1 to B.3 and B.5 are standalone, in that they do not rely on, or require the direct involvement from partners or other water companies to deliver.

13.2 Option B.4

[redacted] SW is exploring this scheme as a potential alternative option to the Base Case, as required by the Gated Process and as part of SW's alternatives testing and prudent risk management strategy.

[redacted]

14 Efficient spend of gate allowance

14.1 Costs and activities to Gate 1

The spend breakdown to Gate 1 and the key activities completed to date are detailed in Table 26. [redacted] The final determination allowance to Gate 1 is £3.58m.

Table 26 – Activity spend preparing Gate 1 submission for water recycling-based options

Activity	Total Gate 1 Spend
Management Costs – shared costs with water recycling options Portion of costs for Desalination Options shown only	
Mobilisation – Establish project structure, work stream briefs, governance	[redacted]
Gate 1 PMO delivery	[redacted]
Work stream Project Management	[redacted]
Preliminary feasibility conceptual design report	[redacted]
Water resource, network modelling and supply demand balance validation	[redacted]
DPC and procurement strategy	[redacted]
Legal support for planning and assurance activities	[redacted]
Stakeholder and customer engagement and preference assessments	[redacted]
Gate 1 Assurance	[redacted]
Management sub-total	[redacted]
Technical Costs – Desalination options only	
Engineering and technical	[redacted]
Pilot trial to pause point in March 2020 due to COVID 19	[redacted]
Brown and Caldwell input to Gate 1	[redacted]
Environmental appraisals	[redacted]
Project Management	[redacted]
Technical Sub-total	[redacted]
Total (combined management and technical costs)	[redacted]
Total (combined management and technical costs)	[redacted]

14.2 Forecasted spend to Gate 2

The estimated spend preparing the Gate 2 submission is [redacted] as detailed in Table 3, in line with the allowance defined in the final determination allowance between Gates 1 and 2. Key activities to be delivered to support the preparation of the Gate 2 submission include conceptual design, pre-planning, stakeholder consultation, schedule development, cost estimating and procurement preparation. Further detail regarding the activity plan to Gate 2 is provided in Section 15, and in Annex 20 Gate 2 Activity Plan.

15 Proposed Gate 2 Activities and Outcomes

SW will be progressing all water recycling options for further considerations beyond Gate 1, to further assess and determine their feasibility in greater detail. Examples of the key activities planned to be completed prior to Gate 2 are summarised below, with further detail provided in Annex 20 Gate 2 Activity Plan.

15.1 Design

- Conceptual designs of water recycling plants, Site selection, transfer pipelines and other supporting infrastructure.
- Next stage cost estimating and Risk Assessment.
- Further detailed hydraulic modelling and hydraulic optimisation modelling.
- Constructability review, to determine the feasibility, assess the complexity and inform construction sequencing.

15.2 Environmental

- Environmental Assessments, Including HRA and WFD.
- More detailed natural capital, carbon and benefit assessments.
- Water quality sampling.

15.3 Stakeholder communication

- Continue regular engagement with existing customers and stakeholders, with more focus and detail towards specific options which are.
- More detailed quantitative data to support qualitative data collected to support the preparation of the Gate 1 submission.

15.4 Planning and commercial

- Prepare and submit documentation required to seek direction under section 35 of the Planning Act 2008.
- Preparation of an updated technical note supported by further legal and planning advice on selection and confirmation of preferred consenting route.
- Preparation of a Planning Strategy setting out deliverables and strategy for the confirmed consenting route.

15.5 Procurement

- Outline development of the tender and commercial models
- Identification and allocation of commercial risk
- Development of the contractual structure and detailed procurement strategy

At Gate 2 a more detailed plan will be presented for those solutions that are proposed to continue beyond Gate 2. This will detail the specific activities and deliverables associated with Gate 3 and 4. It will also propose the Gate 3 date for agreement with RAPID.

It is the intention of SW, where reasonably practicable and utilising an ABE approach, to maintain the Regulatory Milestone Dates as detailed in Annex 20 Gate 2 Activity Plan.

The penalty / reward scales and assessment mapped to the RAPID Gate 2 assessment criteria and associated penalty scales is detailed in Annex 20 Gate 2 Delivery Plan.