Strategic Solution Gate 1 Submission: Preliminary Feasibility Assessment

Desalination

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 saline water desalination 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. These alternatives include two desalination Options [redacted] – Option A.2 – 61 Ml/d capacity desalination and Option D.1- 40 Ml/d desalination for industrial use and 41 Ml/d water recycling for domestic use. SW has developed this PFA considering a wide range of factors that influence feasibility, primarily technical engineering, environmental impact, procurement, customer / stakeholder engagement, schedule, regulatory compliance, cost / benefit realisation and engagement with partners.
Key findings	• Internationally, desalination although complex, is a well-understood and is a viable source of water, however the limited UK market for desalination systems presents significant challenges for this Solution from multiple perspectives. • Desalination is the highest cost technology, financially and (without appropriate design and mitigation) environmentally, relative to other potential Solutions. • Recovery rates from a desalination plant are forecast at 37%, i.e. 100 litres processed produces 37 litres of water. • The chemical composition of water provided to customers from desalination will be different, the expectation is this will affect the taste. This will need to be managed closely to ensure wholesomeness and customer acceptability. • Whilst Fawley is the identified location for the Base Case in SW's WRMP19, potential environmental sensitivities at the site have been identified which means that SW is undertaking further on-going site selection work to explore the suitability of possible alternative sites as part of its risk management strategy. • At this stage, based on the current SW view of the schedules for desalination options, the earliest delivery date is between Q1 2028 and Q4 2028. However, SW will optimise the programme 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. • Desalination has a degree of scalability, due to the abundance of sea water, however, any flexibility for an extreme drought would need to be designed in and will attract additional cost and (without appropriate design and mitigation) environmental impact. • Customer and key stakeholder engagement indicated scepticism and a preference for other solutions. • [redacted] • Each of the desalination options will be progressed beyond Gate 1 to further assess and determine the feasibility of each option.
Key risks & assumptions	• Owing to the need to gain approval from a number of stakeholders (ABP, MMO and NE) and therefore the limitations on the number of viable locations, there is a risk that it is not feasible to physically locate the intake structure (incorporates all construction and operation approvals) within The Solent, leading to an alternative location having to be sought with increased costs and programme delays. • Owing to the number of environmental (proximity to the National Park) and spatial constraints affecting the pipeline corridor from Fawley to Testwood, there is a risk of formal objection to the route during the planning process, which could result in Programme delay. • There are no SWRO membranes that have achieved Drinking Water Inspectorate (DWI) approval. SW will therefore need 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 SWRO membrane is not achieved within the required timescales. • Owing to the use of saline water to produce drinking water, even following a two stage SWRO process, there is a risk that the water is not considered wholesome by consumers. Managing public perception through education will be key to attaining customer acceptability of desalination. • The schedule is built on the assumption of both DCO and DPC which creates a complex interaction between regulatory regimes that must be managed in the context of delivering against the ABE optimised programme. • The risks associated to the water recycling component of D.1 are detailed in PFA 2.
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 further detail.

Solution	Hierarchy rank – Desalination only	Overall Hierarchy position	NPV (£M)
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Alignment with Qtrly reporting 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 initial step in determining the feasibility and viability for multiple water desalination 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

Desalination is the physical removal of dissolved salt and minerals from seawater to produce a base water that can be further treated for applications such as drinking, agricultural or industrial water. Internationally, desalination is widely used, however, domestically there are few comparable applications, with construction and operational experience limited to small plants on Scottish and Channel Islands, with the only large-scale desalination (brackish water) scheme being Thames Water Gateway desalination plant at Beckton.

Given the abundance of seawater, desalination is scalable to meet increases in customer demand or as a means of providing additional resilience in more severe droughts. Although, this is not an inherent quality of the solution and any future capacity would need to be considered during design, planning and consenting and would require additional capital investment in infrastructure, such as larger subsea intakes, screens pumps and pipelines.

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

2.2 Configurations and Options Considered

PR19 Final Determinations included desalination, indirect effluent reuse via the River Itchen (or Recycling) and West Country Sources North (WCSN) within the accelerated gates.

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, 61 Ml/d and 40 Ml/d (see Submission Summary).

Whilst PR19 did not require consideration of a particular number of alternative solutions in relation water recycling, the consideration of alternatives is important in order to inform a number of key assessments both for the Gated process and for the later planning and consenting process, and 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 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 Strategic Environmental Assessment (SEA), Habitats Regulation Assessment (HRA) and Water Framework Directive (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 three desalination-based Options, the characteristics of which are summarised in Table 1 and detailed in sections 4.1 and 4.2. Further detail as to the Option hierarchy development process is provided within Section 10 of this document and Annex 18 Option Hierarchy Development. Detail on the supply demand requirements can be found in Annex 2 WRMP and Supply Demand Balance Risk Assessment.

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 desalination options considered and analysed,

Configuration Type	Option No.	Solution Name	Solution Description	Proposed in WRMP19
Desalination	A.1	75 Ml/d desalinated water direct to Testwood water supply works (Base Case)	75 Ml/d of drinking water produced by desalination plant [redacted] area supplying the Hampshire Water Resource West Zone (HSW WRZ), with the interface between the new and existing distribution system located at Testwood WSW	✓
	A.2	61 Ml/d desalinated water direct to Testwood water supply works	61 Ml/d of drinking water produced by desalination plant [redacted] area supplying the HSW WRZ, with the interface between the new and existing distribution system located at Testwood WSW	✗
Alternatives	D.1	40 Ml/d of industrial water supplied to a large coastal industrial facility by desalination plant situated within the site boundary of the industrial facility	40 Ml/d desalinated water for industrial use to at a large coastal industrial facility. The existing 30 Ml/d supply to the large coastal industrial facility site is redirected to the HSW WRZ and re-purposed for drinking water supply, in addition to the proposed 20 Ml/d bulk supply from Knapp Mill. Additional 41 Ml/d water recycling plant utilising effluent from Budds Farm Wastewater Treatment Plant. This is a cumulative 81 Ml/d when both the Desalination and Water Recycling Components are operating at full capacity.	✗

2.3 Diagrams and Schematics

High-level schematics and process flow diagrams of the treatment processes are included in Section 4.1.1 (for Options A.1 and A.2) of this document.

2.4 Overall Costs

2.4.1 Construction and Operation Costs

Initial cost estimates (detailed in Table 2) have been developed. 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 sections 4.1.5 and 4.2.6 of this document and Annex 12 Cost Report.

Table 2 – Summary of costs: Desalination options

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 desalination option included in WRMP19 (Option A.1) has increased from £255m to the current estimate of £802m. 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 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 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
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

2.5 Resource Benefit

Delivery of desalination would provide water resource benefit to Hampshire Region Water Zone (HRWZ) and the South-East region as a 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.

2.6 Summary of Social, Environmental and Economic benefits

Inherent opportunities for social, environmental and economic benefit realisation are limited, with material benefits needing to be specifically designed into the Options through the project lifecycle. Further detail of the potential opportunity for social, environmental and economic benefit realisation from each Option is detailed in Section 5.2.2.4 (for Options A.1 and A.2) and Section 5.3.2.3 (for Option D.1).

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 perception regarding the 'acceptability' of water from a recycled source and other stakeholder management requirements related to water quality need to be managed closely, as is detailed further in sections 5.4 and 8.

For Options A.1 and A.2, drinking water supply is provided solely from the desalination process. The operation of a desalination plant is complex with careful blending and re-mineralisation being required to manage mineral composition, post desalination, to avoid discoloration and taste and odour issues effecting water quality. This will need to be closely monitored and managed and customers will need to be educated, as further detailed in Section 5.4. The re-mineralisation process, which replaces some of the minerals stripped-out during the treatment process, will enable the provision of water to a chemical composition that is more likely to be acceptable to customers. For Option D.1, drinking water supply is provided through the water recycling component.

2.8 Wider Resilience Benefits

The primary benefit of desalination-based options is to increase the resilience of SW water supply sources up to a 1-in-200-year drought scenario. Initial resilience considerations in relation to alignment to SW's '4Rs of Resilience' framework, are detailed in sections 5.2.2.3 (options A.1 and A.2) and 5.3.2.2 (Option D.2). 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 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) • Drinking water quality considerations.
• 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 desalination Option has been assessed against the 4Rs of resilience, the results are summarised in Table 5 and detailed in Section 3 of Annex 17 Alignment to Southern Water Resilience Plan.

Table 5 - Resilience assessment - desalination options

Option	Resilience Criteria	Assessment
A.1 and A.2	Integration with existing network strengthening solutions / plans	Designed to strengthen the network and to prevent disruption during a 1 in 200-year drought scenario, increasing network reliability.
	Adaptability of operation / Emergency response in a stressed situation	Increase operational adaptability for drought planning as they include utilisation of a real time control system and analytical techniques to predict demand patterns
	Environmental impact (water resource benefit)	Desalinated water plant may be blended with existing water supplies in varying ratios required remineralisation is expected to be chemically intensive regardless of the chosen strategy to match the water chemistry going into Testwood WSW
	Future adaptation for growth	Capital investment to construct plant that is suitable for increased output will be required if the capacity of the options were extended.
	Regional Resilience	Designed for the sole use of SW but this does provide an opportunity in the future for SW to bulk transfer water to other water companies in the region
D.1	Integration with existing network strengthening solutions / plans	The diversity of the sources available provides additional reliability and redundancy for D1 over the A1 and A2 Options
	Adaptability of operation / Emergency response in a stressed situation	As per Options A.1 and A.2
	Environmental Impact (water resource benefit)	As per Options A.1 and A.2, however, the recycling component offers additional water storage and resilience benefit during times of increased demand
	Future adaptation for growth	As per Options A.1 and A.2
	Regional Resilience	Removed single point of failure risk at Testwood WSW, inherently increasing resilience.

2.9 Description of Interaction

Options A.1 and A.2 are standalone Options, with no direct interaction with other proposed water sources. Option D.1 includes balancing the interaction between the industrial supply desalination component and the water recycling component for drinking water supply. Outside of Option D.1 there is no direct interaction with other proposed water source options.

Each Option will need to interact with other water source options considered through the non-accelerated gate process for delivery under WRM24, plus existing sources and distribution infrastructure.

2.10 Meeting National Framework Requirements

SW is following the requirements of the National Framework for Water Resources in developing desalination. This includes working with neighbouring water companies across Southern England to efficiently manage water resources at a regional level. Further detail related to the process and associated factors considering the 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 each option testing the ability to deliver the solution by 2027 in order to meet the 'all best endeavours' obligation in the Section 20 agreement. 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 desalination solution than 2027.

At present, the estimated earliest deployable date of the desalination Options is Q1 2028 (Option A.1) and Q3 2028 (Options A.2 and D.1). 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 schedule 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 Annex 16 Delivery Schedule and the schedule is illustrated in Figure 1.

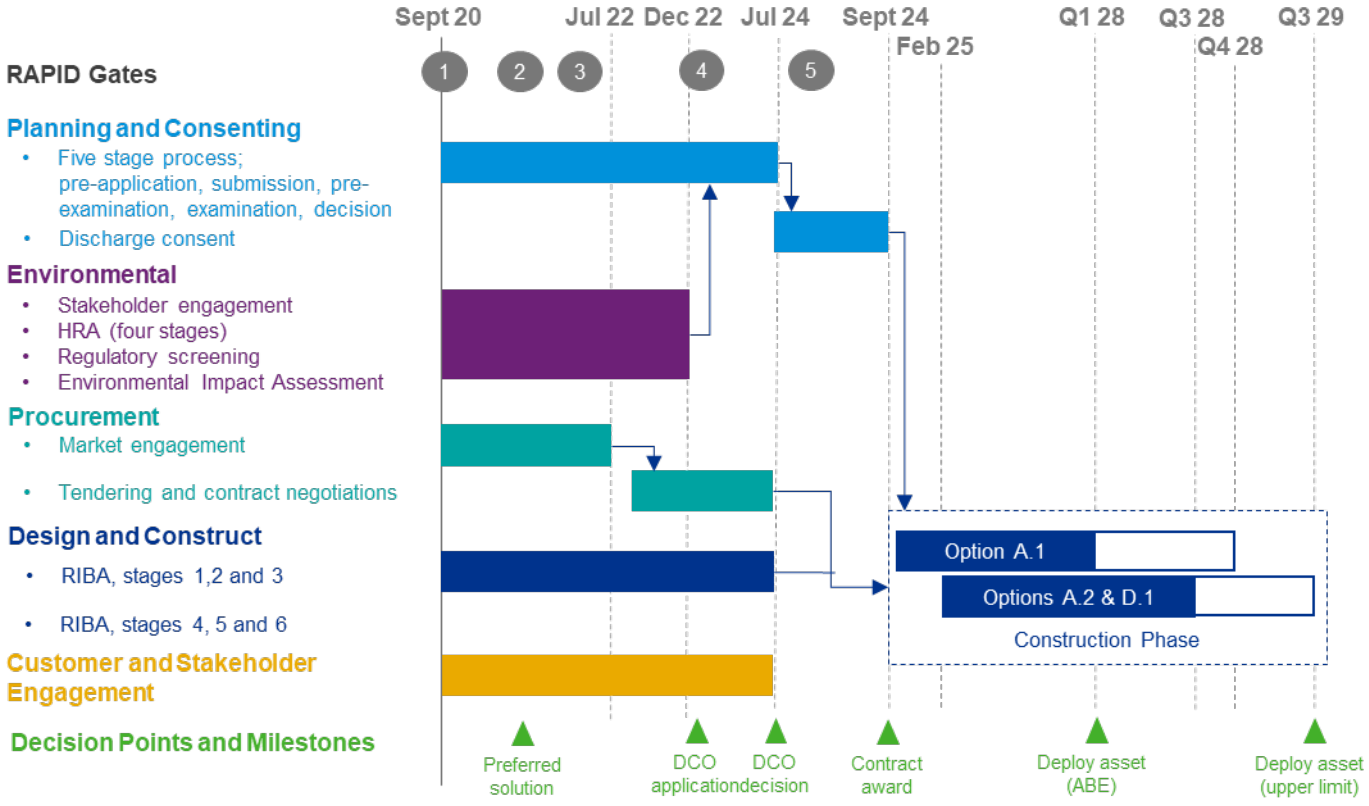

Figure 1 - Project Plan – desalination options

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

Table 6 – Key activity and milestones in line with RAPID gates for desalination-based options

Gate or milestone	Key Activities	Planned Completion Date
Gate 1 (current stage)	• Preliminary solution feasibility and viability analysis • Initial considerations of 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 • Develop schedule for the programme overall, including development of detailed schedule for the Gate 2 activities of the programme.	September 2020
Gate 2	• Conceptual design development • Conduct on-site surveys and sampling for site and location specific considerations • 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 detail for Gate 3 activities of RAPID gate process	September 2021
Gate 3	• Updated final feasibility and viability analysis of desalination options • 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 stage 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 • Earliest feasible deployable output date – solution commences operations	Option A.1 – Q1 2028 Options A.2 and D.1 – Q3 2028

SW proposes that the Base Case and all of the alternatives should be progressed beyond Gate 1, to further assess and determine their feasibility between Gate 1 and Gate 2. 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 proposes that a decision should be made by RAPID in its Gate 2 determination as to which Option/Solution 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 utilised 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.

SW scheduling assumptions are detailed in sections 2.1.4 and 2.2.3 of Annex 16 Delivery Schedule.

3.3 Critical Path

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

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 indicate a later timeline for delivery of the desalination solution than 2027. As detailed in Section 3.1, the earliest deployable date currently shown in the programme is Q1 2028 and an upper limit of Q4 2028, for Options A.2 and D.1. The current delivery schedule for the solution is detailed in Annex 16 Delivery Schedule.

3.5 Information Status and Plan

The information provided by SW as part of this Gate 1 submission, shown against the RAPID requirements in the Accelerated Gate one assessment summary of process and criteria[1], is detailed in Table 7.

Table 7 - Information developed to date and to be developed after Gate 1 submission

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 4.1.5
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 4.2.4 & 14.1
	Are all the non-water resource benefits, societal and environmental, costed and/or evaluated as appropriate?	• Yes, evaluated as appropriate for this stage, see sections 4.2.4.1, 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, sections 5.2, 5.3 & 5.4
	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, 5.2 & 5.3
	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 Options A.1 & A.2

Desalination is a technically complex process for removing dissolved salts from sea or brackish water. The technology relies on high pressure membranes, which by their nature have relatively low recovery rates, therefore it is essential to understand the required yield during the design process. The process can be broadly split into 5 key stages; abstraction, pre-treatment, desalination, disinfection and conditioning. The majority of these process elements are on shore; however, a considerable amount of the civil construction elements will need to be constructed in either the marine or foreshore environment adding to the complexity of delivery. For the Base Case the saline inlet will need to be sized and screened to facilitate a 202 Ml/d abstraction with the necessary subsea pipeline / tunnel to bring this water in to the production facility. Similarly, the waste stream infrastructure will need to be sized to return 128 Ml/d into the Solent at full operating capacity.

4.1.1 Option Configuration: Options A.1 and A.2

The key process components and minimum influent flow rates required through each stage of the desalination process for drinking water are illustrated in Figure 2. Treatment loss through the desalination process is such that, based on current modelling, there is an estimated 37% recovery rate from the seawater water abstracted, i.e. 37l of every 100l of abstracted water treated will enter the network for distribution to

customers. For context, recovery rates from normal surface water supply works is commonly regarded to be approximately 90% or higher.

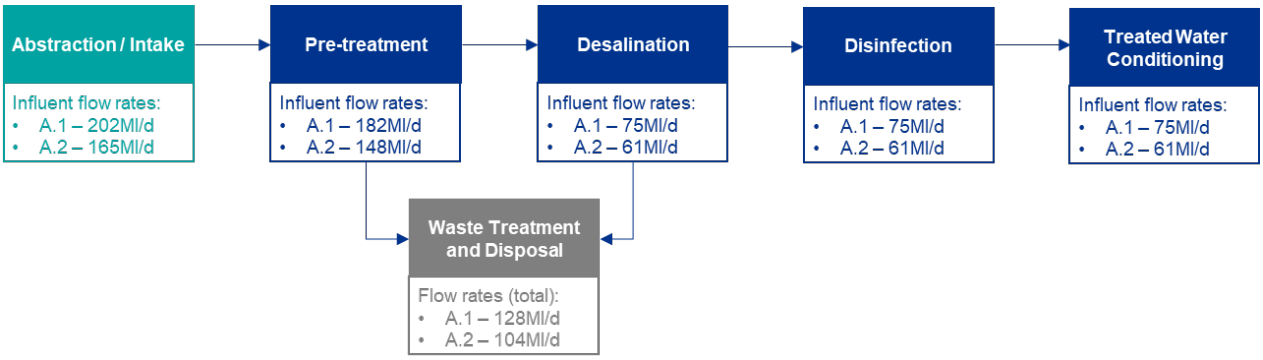

Figure 2 - High-level desalination process flow diagram

Further detail regarding the desalination process are provided in Section 4 of Annex 4 Desalination: Technical Report. Geographical and site considerations are currently at an early stage. The process followed to identify and consider potential desalination plant sites is detailed in Section 4.1.2.

4.1.2 Site selection

A five-stage site selection methodology has been developed and is being delivered by SW, as illustrated in Figure 3. Site selection is ongoing and a preferred site for the desalination plant is expected to be identified as part of the Gate 2 activities.

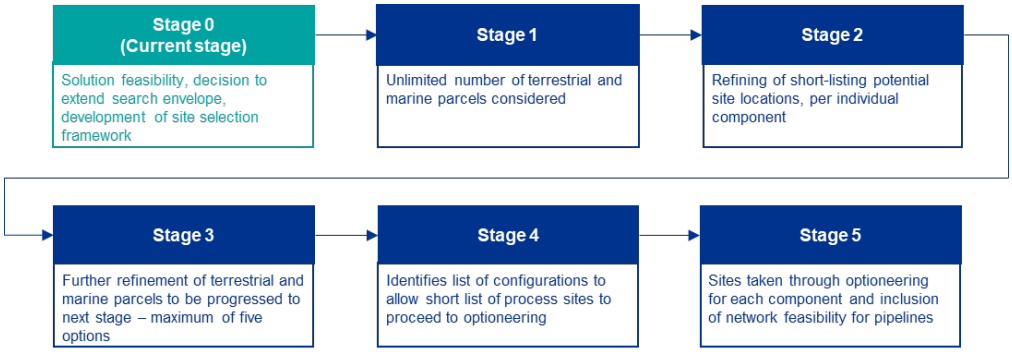

Figure 3 - Site selection process – desalination

Fawley was identified as a potential location for the desalination plant proposed in WRMP19. SW is testing existing and alternative locations to understand any change in material circumstances since WRMP 19 and to ensure technical, environmental and planning considerations are understood and addressed as part of the site selection process. Due to uncertainty surrounding Fawley, SW has taken the prudent step to extend the site search area both East and West. The Isle of Wight was initially considered as a possible location but was withdrawn due to anticipated high WLC, engineering complexity, security of supply risk in pumping desalinated water under the Solent and a lack of available power. Further detail of the site selection methodology is provided in Section 3.1 of Annex 9.1 Site Selection Report: Desalination.

4.1.3 Operations and Maintenance considerations

4.1.3.1 Operating Need

Drought modelling completed by SW has identified that the 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 61 Ml/d. Existing and proposed water sourcing and transfers are sufficient to bridge the supply-deficit up to 1-in-10-year drought, which represents the point at which the plant would be required to become operational. Further explanation of this analysis is provided Annex 7 Strategic Modelling.

4.1.3.2 Operating Approach

Due to high cost and operational complexity, the plant is expected to be used predominantly during droughts. Two operating regimes have been considered; 'on / off', where the asset will only operate when

required, i.e. reacting to demand or forecast demand, and 'minimum flow', where a minimum flow will continuously operate, reducing the requirement on other water sources during non-drought periods. Further detail regarding the operating need is provided in Section 2.1 Annex 8.1 Network Technical Reports: Desalination.

Desalination infrastructure would be operated alongside the existing distribution network. Initial modelling completed by SW and experience from other water companies indicates limiting the number of interfaces between desalinated water and the existing network to be best practice, as this reduces the risk of water discolouration due to chemical imbalance, which would severely impact water quality.

To control the "new network" a holistic real-time controls system is favoured, however due to cost and a wider breadth of monitoring benefits, such as reservoir turnover and water quality, can be complex to install on existing networks. This would install a consistent monitoring system across the new and existing infrastructure, which would be integrated together and controlled through the Regional Control Centre (RCC). This holistic approach also supports SW's calm pro-active network management ethos. Examples of the benefits of a more pro-active management approach include, predictive analytics of demand, lower pumping costs and more effective management of flows. Further detail of the controls and operating approach are provided in Section 2.2 Annex 8.1 Network Technical: Desalination.

4.1.4 Asset and Design Life

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

4.1.5 Cost and Benchmarking

Initial CAPEX, OPEX and WLC estimating 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, solutions A.1 and A.2

Component	CAPEX				Opex (£m) (60 years)	WLC (£m)
	Estimated CAPEX Cost (£m)	Estimate Benchmark Value (£m)	Equivalent Benchmark Value (£m)	Variance (%)		
Desalination Plant – 75 Ml/d	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Desalination Plant – 61 Ml/d	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Sea Intake / Waste Discharge – 75 Ml/d	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Sea Intake / Waste Discharge – 61 Ml/d	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Intake Pipeline	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Pipeline (desalination plant to Testwood – based on the Fawley site)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total – 75 Ml/d	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total – 61 Ml/d	[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 manhole, 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

Other items considered within the OPEX calculations include chemical usage, electric consumption, maintenance labour requirements and additional operational and maintenance requirements, but these are variable costs, so assumptions have been made around these.

4.1.6 Water Resource Benefit

SW is focused on delivering the Preferred Strategy in WRMP19, which sets out a programme of solutions that bridge the supply-deficit during a 1-in-200-year drought. 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 desalination option (where possible) is optimised across the region.

Aware of future water supply resilience requirements, desalination could be designed to include redundancy to allow expansion capacity for the future. Option A.1 provides the greatest resilience through offering greater redundancy of supply, due to the larger capacity of the plant and supporting infrastructure. Further detail is provided in Section 3.1.1 Annex 17 Alignment with Southern Water Resilience Plan.

As noted in Section 2.1, assuming that appropriate measures are considered during design, desalination has the potential to be expanded in line with customer demand and resilience. Albeit, this would require additional capital investment in relevant infrastructure and appropriate programme extensions, however the complexity should not be under-estimated, for example, a 20 Ml/d increase in deployable output would require, an approximate, 60 Ml/d abstraction increase. Further detail is provided in Section 3.3 Annex 4 Desalination: Technical Report.

Conjunctive use benefits have not been explored in detail at this point, however initial analysis indicates such benefits are limited. Further analysis will be completed post Gate 1, as part of cost-benefit analysis. The ability to support neighbouring water companies' events where there is a surplus in the desalinated water supply (during drought scenarios and other scenarios) has yet to be explored but has the potential to support strategic water use across the region.

4.2 Option D.1

The feasibility of Option D.1 was explored as a potential alternative to a large-scale desalination plant, its viability is reliant on close cooperation with a large coastal industrial facility and another water company.

4.2.1 Option Configuration: Option D.1

As detailed in Table 1, Option D.1 is a combination option, including desalination and water recycling components. For the desalination component, the process overview, site selection, operations / maintenance, and water resource benefits outlined in Section 4.1.1 are applicable. To avoid duplication, only variances from those are highlighted in Section 4.1.1 as well as considerations that relate directly to the water recycling component.

Desalination was identified as being a suitable method to supply industrial water for the large coastal industrial facility, due to the reduced treatment requirements and associated regulatory approval requirements, as detailed further in Section 5.4

The remaining water supply deficit in this option would be bridged by water recycling, which is detailed in Annex 4 Water Recycling: Technical Report. As detailed in the Section 4.1.2 of this document, SW is considering the existing and potential alternative locations to understand if any constitute a material change in circumstances since WRMP19 and to ensure technical, environmental and planning considerations are understood and addressed as part of the site selection process.

4.2.2 Process Flow

The high-level process flows for the desalination (for industrial water use) and water recycling (for drinking water use) are illustrated in Figure 4. As a result of the desalinated water from Option D.1 being used in industrial applications, there is a variance in the way in which water is treated for drinking in Option D.1 when compared to Options A.1 and A.2, with increased reverse osmosis in the treatment process. This is detailed in sections 4 and 6 Annex 4 Desalination: Technical Report.

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

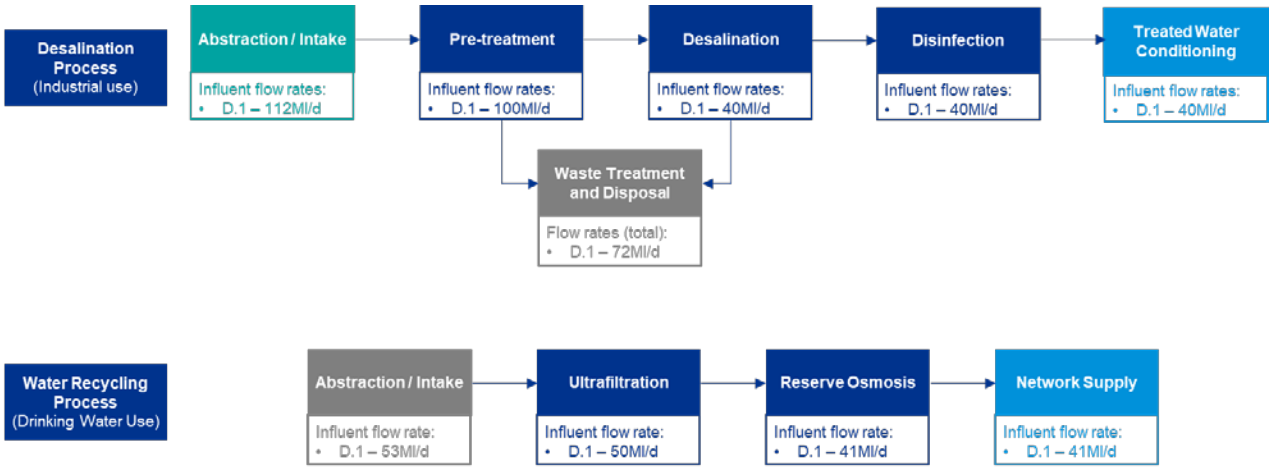

Figure 4 - High level water recycling treatment process

SW modelling undertaken to date indicates the dry weather flow of Budds Farm Wastewater Treatment Plant (WTP) in 2030 will be 96 Ml/d, indicating that Budds Farm should have sufficient flow to support anticipated customer demand in a 1-in-200-year drought scenario, due to it being sufficiently above the required 53 Ml/d influent flow rate, as illustrated in Figure 5. The intake flow requirements for the desalination component are illustrated in Figure 2.

4.2.3 Site selection

Site selection work, as detailed in Section 4.1.2, is ongoing and this is also applicable to Option D.1. For the water recycling component, a similar five-step site selection methodology is currently in progress and is detailed in Section 2 Annex 9.2 Site Selection Report: Water Recycling. At this stage, Budds Farm WTP has been identified as providing sufficient flow to support customer demand requirements. The site selection process utilised, and the factors considered in selecting the location of the proposed WRP, is consistent with all water recycling-based Options.

4.2.4 Operations and Maintenance considerations

4.2.4.1 Operating Need

As detailed in Section 4.1.3 the desalination component is required to operate constantly to meet industrial water use demands. The operating need of the water recycling component is common to the other water recycling Options, detailed in Annex 5 Water Recycling: Technical Report. Further detail of the operating need is detailed in Section 2.1 Annex 8.4 Network Technical Report: Additional Solution.

4.2.4.2 Operating approach

For Option D.1, the desalination plant is anticipated to operate constantly, in order to supply water to the industrial water user. The water recycling component of this option is expected to operate via either an ‘on / off’ or minimum flow approach, as detailed in Section 4.1.3. This is detailed further in Section 4.2.4.1 and Section 2.2 Annex 8.4 Network Technical Report: Additional Solution.

4.2.5 Asset and Design Life

Consistent asset and design life assumptions have been made across the desalination and water recycling components of Option D.1, which are further detailed in Section 4.1.5.

4.2.6 Costs and Benchmarking

Initial CAPEX, OPEX and WLC estimates broken down into key engineering components, as well as CAPEX benchmarking is detailed in Table 9. Further detail is included in Annex 12 Cost Report.

Table 9 - Option D.1: Capital Costs and Benchmarking

Solution / Option	CAPEX				OPEX (£m) (60 years	) WLC (£m)
	Estimated Construction Cost (£m)	Estimate Benchmark Value (£m)	Equivalent Benchmark Value (£m	Variance (%)		
Desalination Plant – 40M/d	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Sea Intake / Waste Discharge	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WRP (41 Ml/d)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Budds Farm to WRP	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WRP to Otterborune WSW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

4.2.7 Water Resource Benefits

The resilience benefit provided by desalination, as detailed in Section 4.1.6, is not valid for Option D.1 as, by design, its purpose is to supply a fixed quantity of industrial water only, with no provision for potable use. However, the water recycling component has resilience headroom as only 41 Ml/d is required to satisfy the forecast demand deficit against a maximum production volume of 79 Ml/d leaving theoretical 'headroom' that could be exploited at a later date. As with desalination any additional production volume would need to be designed in and would attract additional CAPEX.

Conjunctive use benefits have not been explored in detail at this point, however initial analysis indicates such benefits are limited. Further analysis will be completed post Gate 1, as part of cost-benefit analysis. The ability to support neighbouring water companies' events where there is a surplus in the desalinated water supply (during drought scenarios and other scenarios) has yet to be explored, however has the potential to support strategic water use across the region.

5 Environmental and Drinking Water Considerations

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

As detailed in Section 4.1.2, site selection work for the desalination plant and associated infrastructure is ongoing and is a key dependency for completing environmental appraisals. In the absence of a short-list of potential sites for all desalination Options, appraisals to date have been conducted as desktop exercises, with more detailed analysis planned post Gate 1, as detailed in Annex 20 Gate 2 Activity Plan.

5.1.1 SEA and HRA appraisals – Stage 1

The initial environmental appraisal undertaken included an assessment of the solutions following the principles of HRA, SEA, WFD and Natural Capital Assessment (NCA), as described in Table 10. 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 in Section 3 Annex 10.1 Environmental Appraisal: Desalination.

Table 10 – Initial option level environmental appraisal considerations: Desalination

Environment Appraisal	Appraisal consideration
Strategic Environmental Assessment (SEA) Further detail of the appraisal considerations are included in Section 6 of Annex 10.1 Environmental Appraisal: Desalination	• Biodiversity, flora and fauna • Population and human health • Material assets and resource use • Water; Soil, geology; and land use • Air and climate

Environment Appraisal	Appraisal consideration
	• 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 10.1 Environmental Appraisal: Desalination	• 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 10.1 Environmental Appraisal: Desalination	• 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 Section 6.4 of Annex 10.1 Environmental Appraisal: Desalination	• Environmental benefits • Environmental disbenefits • Opportunities for achieving net gain and improving environmental resilience

5.2 Options A.1 and A.2

5.2.1 Appraisal results – Stage 1

The high-level environmental screening was assessed against a structured rating scale detailed in Table 11. The results of the stage 1 screening completed are detailed in Table 12.

Table 11 - 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 12 - Summary of environmental screening results for key components for desalination options

Criteria	Abstraction pump station and pipeline to plant	Desalination plant	Desalination waste outfall pipeline	Pipeline to Testwood WSW		
				Route 1	Route 2	Route 3
Water resources and water quality						
Biodiversity, flora and fauna						
Archaeology and cultural heritage assets						
Landscape and visual amenity						
Other environmental considerations						
WFD						

A high-level cumulative effects assessment has been undertaken with other relevant plans, programmes and projects, including other water companies WRMPs, Drought Plan and other development plans in the area. The initial results are detailed in Table 13. Further assessment will be undertaken as part of the Gate 2 activities, as detailed in Annex 20 Gate 2 Delivery Plan.

Table 13 – Cumulative environmental effects: Desalination options

Stakeholder Group	Project / Programme / Region	Effects
SW	Central and Eastern Zones	No impacts expected
	Drought Plans	Unable to complete at this stage. Greater clarity over potential desalination plant site will enable this analysis to be completed.
Neighbouring Water Companies	Affinity Water	Not expected, but greater clarity expected once the site selection process has progressed
	South West Water	
	Bournemouth Water	
	Thames Water	
	Wessex Water	
	Cholderton and District Water Company	
	Sutton and East Surrey	
	South East Water	
	Portsmouth Water	
Other industries and developments	Fawley Waterside development	Noise and traffic impacts during construction. Development construction planned from 2021 to 2030. Traffic also likely to be re-routed to A326 during construction, which the pipeline from desalination plant to Testwood WSW may need to cross. Further clarity once at latter stages of site selection process.
	A326 Junction developments	No impacts expected. Project to be completed prior to commencing desalination solution construction

5.2.2 Other Appraisal Results

5.2.2.1 Contribution to environmental net gain

At this stage high level potential opportunities for environmental net gain have been identified for desalination. 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
- Habitat restoration within the New Forest National Park 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.

5.2.2.2 Carbon considerations

An initial carbon impact appraisal has been prepared, which models the anticipated carbon emissions from 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 14.

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

Table 14 - Carbon appraisal results: Desalination

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)
A.1	72,200	383,000	456,000	6,070
A.2	68,000	379,000	447,000	7,330
D.1	82,400	912,000	995,000	16,300

The results detailed in Table 14 are based on a full flow operating regime, which is the maximum flow and causes the greatest carbon impact, representing a worst case scenario. This carbon assessment will be refined once the preferred operating regime 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 desalination plant into, or out of, service is energy intensive, leading to higher net energy consumption per unit of water.

The three desalination-based Options are expected to generate the highest volumes (in comparison to other technologies and solutions considered) of carbon over their operating lifespan. Desalination is energy intensive, which is in part due to the power consumption of the plant during operation being approximately 40MW, which is approximately equivalent to power requirements of 80,000 homes. To put this into context, at the point of submission, the Isle of Wight has a total of approximately 70,000 homes. Further detail of the approach utilised to conduct this appraisal and the results are provided in Annex 10.1 Environmental Appraisal: Desalination.

Multiple components of the desalination plant construction and operation will result in carbon output. 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.

5.2.2.3 Resilience Considerations

The primary benefit of desalination is the provision of resilience of water supply to customers during drought scenarios (up to 1-in-200-year). Both Options A.1 and A.2 have a same level of resilience in terms of the volume of supply, as the ocean source water is able to meet requirements, irrespective of customer demand. The key constraint is the capacity of the desalination plant and associated infrastructure.

5.2.2.4 Social and Environmental Benefit

There is limited opportunity to provide environmental or social benefit in delivery of Options A.1 and A.2. The desalination plant is expected to provide a net neutral visual impact in terms of general area aesthetic, fitting with the surrounding area. During the design process additional benefits will be built into the final solution as required to satisfy consenting requirements.

5.2.2.5 Value for Customers

As detailed in Section 5.2.1, the primary benefit to customers is the provision of a secure water source for the Hampshire region during severe drought. Options A.1 and A.2 are expected to provide neutral visual and amenity impacts, high financial cost (detailed in Table 8) and (without appropriate mitigation) expected net negative environmental contribution, as detailed in 5.2.1, which all further limit the value of these options for customers.

5.3 Option D.1

5.3.1 Appraisal Results – Stage 1

The results of the high-level environmental appraisal for Option D.1 are detailed in Table 15.

Table 15 - Summary of environmental screening results for option D.1

Criteria	Budds Farm to WRP	Water Recycling Plant	Waste stream via Eastney LSO	Blending tank at Otterbourne WSW	WRP to Lake Otterbourne	Desalination plant with intake on marine terminal	Waste stream, offshore outfall, brine reception tank
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							
WFD							
Natural capital							
HRA Stage 1 Screening							

5.3.2 Other appraisal results

5.3.2.1 Carbon Considerations and contribution to environmental net gain

As indicated in Table 14, Option D.1 is expected to result in higher volumes of carbon emissions relative to other options. This is due to both the desalination and water recycling treatment processes having a high energy consumption, as detailed in 5.2.2.2. Similar to options A.1 and A.2. Opportunities to offset carbon emissions are limited.

5.3.2.2 Resilience Considerations

Further to the resilience considerations noted in Section 5.2.2.3, related to Options A.1 and A.2, which are applicable to the desalination component of Option D.1, the water recycling component of Option D.1 provides additional resilience benefits. Recycling will provide SW with redundancy of supply options in an event where the deficit required to be bridged is less than the full capacity of the asset, as this option contains a storage component. Optimising the use of the plants has yet to be explored in detail at this stage and will be conducted at a later-stages to understand impacts in greater detail.

5.3.2.3 Social and Environmental Benefit

As with Options A.1 and A.2, there is limited scope for social and environmental benefits associated with D.1. Social and environmental benefits from the desalination component are those detailed in Section 5.2.2.4 and the water recycling component includes the development of an engineered storage lake, which is not expected to be accessible for public use, nor will it be designed to specifically include components that support biota . During the design process additional benefits will be built into the final solution as required to satisfy consenting requirements.

5.3.2.4 Value to customers

As per Options A.1 and A.2, the benefit to customers of Option D.1 is the provision of a secure water source for the Hampshire region during severe drought. Option D.1 has the additional benefit of a lake that could be used by the community providing amenity value.

At this stage in the design process, the wider benefits for customers have not yet been identified, this will happen as options are further developed after Gate 1.

5.4 Water Quality Considerations

5.4.1 Source Water Considerations

Water Quality testing has been carried out at Fawley Harbour, Sandown Coast and Christchurch Bay to understand influent (seawater) quality characteristics, to inform process design requirements. Parameters tested include salinity, turbidity, pathogenic bacteria, pathogenic protozoa, viral pathogens, cyanotoxins, algae, boron, sodium, sulphate, chloride, chlorate, bromide, pH level, trihalomethanes, Total Dissolved Solids (TDS), Total Organic Carbon (TOC) and petroleum. Parameters with relative' high' results; TDS, turbidity, TOC and boron, indicate the requirement for a specific pre-treatment stage for the desalination process. Further detail of source water quality is detailed through Section 2.1 Annex 4 Desalination: Technical Report.

5.4.2 Condition Requirements

5.4.2.1 Options A.1 & A.2

A key stage of the desalination process for preparing water for human consumption is re-mineralising (conditioning) treated water. SW must conform to the requirements of Regulation 31 of the Water Supply (Water Quality) Regulations 2018 to demonstrate that desalinated water meets wholesomeness requirements. Wholesomeness relates to the public acceptance of water supplied, which in turn relates to ensuring water meets both aesthetic and chemical profile requirements.

The re-mineralisation process changes the chemical profile of the water and needs to be closely managed. This will be undertaken through a corrosion control strategy, which is detailed in Section 2.2.2 Annex 4 Desalination: Technical Report. Failure to appropriately manage the re-mineralisation process can lead to the water having a corrosive effect on the distribution network, impacting taste and causing discolouration.

The desalinated water will need to align chemically with, and be of a similar profile to, existing water at Testwood WSW. The profile of water supply at Testwood WSW between April 2015 and April 2020 is detailed in Table 16. Further detail is provided in Section 2.2.4 Annex 4 Desalination: Technical Report.

Table 16 - Testwood WSW water quality sampling

Parameter	Units	Min	Average	Max
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				
[redacted]				

5.4.2.2 Option D.1

For Option D.1, re-mineralisation is not required as desalinated water is to be used for industrial use only. Drinking water from the water recycling component of the Option is subject to Regulation 4 within the Water Supply (Water Quality) Regulations 2018. Customer acceptance is key, as re-mineralisation and blending of the water must be carefully considered, so that water taste and composition is not significantly changed.

Similar to the detail in section 5.4.2.1, to control the impact of using recycled water as a source its chemical profile will need to align with that of existing water sources. The profile of treated surface water at Otterbourne WSW, which recycled water needs to compliment (as evidenced from testing completed between April 2015 and April 2020) is detailed in Table 17. Further detail is provided in Section 2.2.4 Annex 4 Desalination: Technical Report.

Table 17 – Otterbourne Surface Water WSW treated water quality sampling

Parameter	Units	Min	Average	Max
[redacted]				

5.4.3 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. This process is detailed further in Section 2.3 of Annex 4 Desalination: 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 (WQRA) prior to Gate 2. To inform this process, sampling, similar to that detailed in Section 5.4.1, will take place following a structured sampling plan, with hazards to be included in the DWSP database. This sampling plan will form the basis for the risk identification, assessment and verification stage of the DWSP development process. The key elements of the sampling process for desalination are detailed in Table 18.

Table 18 - Source water sampling stages

Phase	Expected timing and Status	Description
Phase 1	Ongoing until September 2020	Initial testing conducted along the Fawley coastline, with samples collected from seven locations on seven consecutive days, under various tidal conditions.
Phase 2	October 2020 – March 2021	Continuation of Phase 1 sampling, with sampling areas extended to twenty locations across the Isle of Wight, West Sussex and Sandown Coast areas
Phase 3	March 2021 – September 2021	Further targeted sampling in terms of location and parameters sampled for as potential desalination plant sites become further refined
Phase 4	Post desalination site identification	Resumption of the 'business as usual' monitoring regime to the preferred site selected for the desalination solution

5.4.4 Regulatory Barriers

SW has engaged with multiple regulators, including DWI, throughout the Gated process, and will continue to do so throughout the Programme lifecycle. A key purpose of this engagement is to ensure that the DWSP meets DWI requirements and provides appropriate detail on how SW will manage and ensure water safety, once operational. This includes ensuring that water is acceptable to customers and meets 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 will require approval under Regulation 31 of the Water Supply (Water Quality) Regulations 2018 as it will be new technology / material for use in the England and Wales. This regulation represents a significant challenge for desalination, however, will be required to meet the Regulation 4 test of wholesomeness. For the indirect recycling options, Regulation 31 approval is not required for the reverse osmosis 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 desalination as an Option by focussing on the Base Case (Option A1) as it is deemed to be representative of all procurement activities for the desalination-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 Table 19, which also includes the assessment results.

Table 19 - 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 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 the Desalination A.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 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 Desalination A.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,	Deemed suitable based on currently developed information
Quantitative VfM Test Section 4.2.3 Annex 11 Commercial Strategy	• The solutions 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

Option A.1 appears 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 further development of the project specification, specific risk mitigation plans as feasibility information matures and additional market engagement. There are four core tender models (very early, early, late and split), which can be used, dependant on which entity is best placed to manage the risk and delivery of the design, planning & consenting and pre-construction 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.

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

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 is that a bespoke later DPC model, delivered with urgency to suit the overall delivery requirements is deemed appropriate, 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 contracting 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 desalination solution in the PR19 Final Determination to be delivered through DPC and therefore ownership of the asset in all desalination 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. The asset 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 20 details the forecast production requirements of the desalination plant, in terms of days and total water volume expected to be transferred in various drought scenarios.

Table 20 - Asset Utilisation

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. 8 Ml/d, which is equivalent to up to 1104 Ml of volume transferred during a 1 in 200-year drought event

As detailed in sections 4.1.3 and 4.2.4.2, two operating scenarios for the plant have been considered, 'on / off' and 'minimum flow', both of which allow for increases in supply, to meet customer demand. A detailed analysis of the impacts of these operating scenarios will be completed post Gate 1. Table 20, details utilisation in against forecast supply deficit, which aligns with the 'on / off' operating situation

considered. 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. Further detail is provided in sections 2.1 and 2.2 Annex 8.1 Network Technical: Desalination.

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 3.1.1 Annex 17 Alignment with Southern Water Resilience Plan. There is limited storage capacity provided by desalination, which limits flexibility reducing the capacity of the options to react and manage emergencies, in comparison to other solution types considered.

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 and TCPA consenting options are summarised in Table 21. Further detailed explanation of the risks and opportunities are detailed in Section 2.1 Annex 13 Planning Strategy.

Table 21 - DCO consenting approach 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 reduce 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 to the transfer of water resources;
- The construction or alteration of a desalination plant; and
- The construction or alteration of a reservoir or dam.

Under these criteria, each desalination option would not automatically pass this threshold and would require a request for a section 35 Direction to be made to the Secretary of State, for the project to be classified as an NSIP, and therefore eligible to utilise the DCO consent route. The key steps in the DCO planning approach process, including the request for a Section 35 Direction, are illustrated in Figure 5.

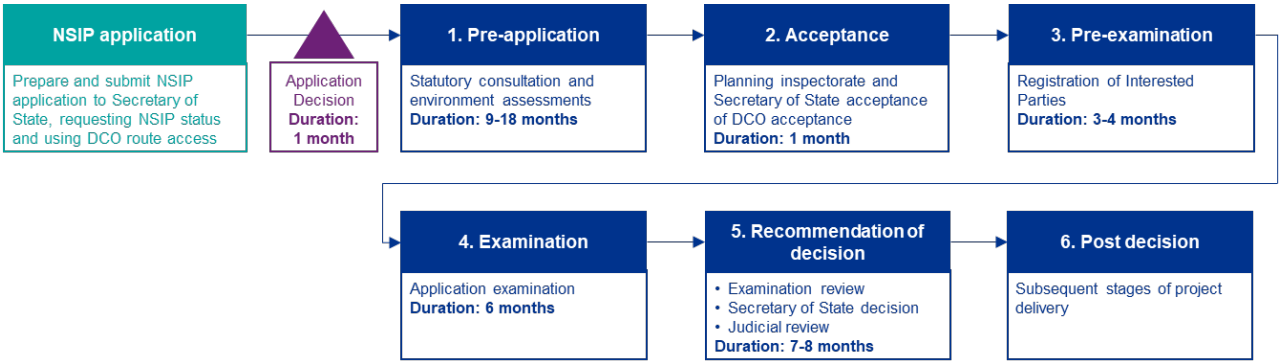

Figure 5 - DCO process

The key steps in the DCO planning process are illustrated in Figure 5, including the initial request to the Secretary of State for a Direction under section 35 of the Planning Act 2008 that the development be treated as a NSIP and the timeline for the DCO process. This includes statutory timeframes that will drive the overall project schedule through this part of the programme. This is detailed further in Section 3.

In the event that the request for a s.35 Direction to the Secretary of State is unsuccessful, the TCPA planning route would be consenting regime for the scheme.

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 WfLH programme. Customer and stakeholder perceptions have the power to shape Programme delivery, irrespective of Option selected. Detail of the approach and process utilised by SW to engage with, and understand the views of, customers and stakeholders is provided in Annex 15 Stakeholder and Customer Report.

Desalination is a complex Solution, which was initially viewed positively during engagement activities associated with WRMP19. A wide range of views are held across the customers and stakeholders involved with the WfLH programme – many of which directly conflict one another. Desalination is a relatively new technology for the UK and therefore opinion is likely to outweigh factual understanding.

SW is engaging with a wide range of groups across the W4LH programme, these are broadly grouped as detailed in Table 22. Evidence of the specific engagement activities are detailed in Annex 15 Stakeholder and Customer Report.

Table 22 - Customer and stakeholder groups

	Customer and Stakeholder groups engaged	Customer or Stakeholder Definitions included in Section 1 Annex 15 Stakeholder and Customer Report.
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,*
2	Customer Action Group	
3	Businesses	
4	Hampshire Chamber of Commerce	

	Customer and Stakeholder groups engaged	Customer or Stakeholder Definitions included in Section 1 Annex 15 Stakeholder and Customer Report.
5	Community groups	*non-household), diverse cultures, future, those in vulnerable circumstances, stakeholders and different customer segments."*
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, MMO)	
8	Consumer Council for Water	
9	Government organisations (e.g. councils)	
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 four-stage engagement process, are detailed in Table 23.

Table 23 - Trends in customer, stakeholder 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 are taken in response to engagement with stakeholders

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

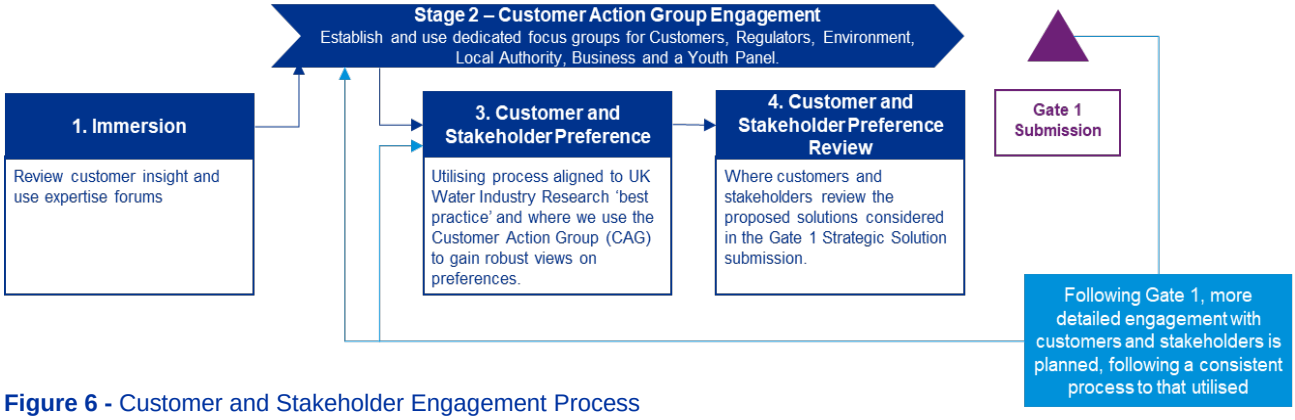

Figure 6 - Customer and Stakeholder Engagement Process

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 and 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 Assumptions, Risks and Opportunities

9.1 Options A.1 & A.2

A consistent approach to assumption, risk, issues and opportunity identification and management process has been developed and applied across all Solutions/Options, as detailed in Annex 14.0 Risk Report Guidance. Individual registers for assumptions, risks, issues and opportunities have been developed for each option. The key assumptions, risks and opportunities are detailed in Annex 14.1 Risk Report: Desalination, and consider the stability, sensitivity, validation / mitigation and provide an overall RAG status. Assumptions and risks rated as 'high' are detailed in Table 24 and 25. No opportunities have been identified as 'high'.

Table 24 - Key Option A.1 and Option A.2 assumptions

Assumption ID	Assumption description	Mitigation	Stability	Sensitivity
WfLH-A0079 (A.2 only)	It has been assumed that a S.35 Direction under the Planning Act 2008 will be made in relation to A.2 (and associated enabling Infrastructure) to enable it to be progressed through the DCO process.	The high-level delivery schedule makes provision for a request to be made for a Section.35 Direction. SW will keep the position under review as it moves through the gated process	D	C

Table 25 - Key Option A.1 and Option A.2 risks

Risk ID	Risk description	Technical category	Current Score	Mitigation Strategy	Residual Score
Desal-R32	Owing to the need to gain approval from a number of stakeholders (ABP Southampton, MMO and NE) and therefore the limitations on the number of viable locations, there is a risk that it is not feasible to physically locate the Intake and Outfall structures (incorporates all construction and operation approvals) within The Solent, leading to an alternative location having to be sought with increased costs and programme delays.	Stakeholders & Approvals	25	Initial engagement with ABP Southampton and MMO has been undertaken and a road show was held in June 2020. [redacted]	24
Prog-R22 (A.2 only)	Under the Planning Act 2008, the Desalination Plant is only a nationally significant infrastructure project that can be consented under the DCO consenting regime if it has a deployable output above 80 Ml/d. In this situation, SW would have to apply for a Section 35 direction to be made to enable the project to proceed under the DCO consenting regime. 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 & Consents	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
Desal-R45	Owing to the use of saline water to produce drinking water, even following a two stage Reverse Osmosis process, there is a risk that the water is not considered wholesome and acceptable to the end users, resulting in reputational damage to SW.	Stakeholders & Approvals	24	Remineralisation has been designed in order to ensure that the chemical composition of the water received from the Desalination Plant matches that of the current supply at Testwood. The remineralisation approach needs to be agreed with the DWI. SW are looking to use blending of water with other sources in order to reduce any issues over taste and odour.	18
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 & 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
Desal-R51	Currently, there are no SWRO 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	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

Risk ID	Risk description	Technical category	Current Score	Mitigation Strategy	Residual Score
	SWRO membrane is not achieved within the required timescales, leading to a delay to the delivery of the Base Case.			SW will liaise with Thames Water to understand the progress on their application for the membranes at the Gateway brackish water desalination plant at Beckton.	
Desal-R35	[redacted]	Ground & Environmental Conditions	21	[redacted]	21
Desal-R31	Owing to the number of environmental (proximity to the National Park) and spatial constraints (pipe route not able to be located in A326) affecting the pipeline corridor from Fawley to Testwood, there is a risk of formal objection to the route 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. SW will also undertake detailed land referencing work to identify landowners and engage with landowners and other stakeholders.	19
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 & 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

9.2 Option D.1

Assumptions, risks and opportunities for Option D.1 rated as 'high' are detailed in Table 26 and 27, utilising a consistent process utilised to identify risks detailed in Section 9.1 regarding options A.1 and A.2

Table 26 - Key Option D.1 assumptions

Assumption ID	Assumption description	Mitigation	Stability	Sensitivity
WfLH-A0079	As per Table 24	As per Table 24	D	C

Table 27 - Key Option D.1 risks

Risk ID	Risk description	Technical category	Current Score	Mitigation Strategy	Residual Score
Desal-R32	As per Table 25	Stakeholders & Approvals	25	As per Table 25	24
Prog-R22	As per Table 25	Planning & Consents	24	As per Table 25	24

Risk ID	Risk description	Technical category	Current Score	Mitigation Strategy	Residual Score
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	23	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. This would include collaborative working with other water companies for example Thames Water or Essex and Suffolk to allow data sharing to present a DWSP. Use of globally available data to support and validate the proposed design solution. Engage with DWI to agree such an approach to the use of data if required.	21
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
Prog-R50	As per Table 25	Commercial & Supply Chain	22	As per Table 25	22
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
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
Prog-R59	As per Table 25	Commercial & Supply Chain	19	As per Table 25	19

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. 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 solutions 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 Section 2.2 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 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 HM Treasury 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 28. CBA assessments will be undertaken post Gate 1.

Table 28 - Current indicative MCDA driven option hierarchy

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

The solution costs detailed in Table 28 have been developed in-line with relevant HM Treasury Green Book guidance, which 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 desalination-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 29.

Table 29 - Qualitative benefit and impact assessment

Benefit		A.1	A.2	D.1
1	**Resilience:** Provides greater resilience of water supply to the Hampshire region during drought scenarios			
		Commentary: Desalination is a resilient solution due to the source being reasonable unaffected by drought, plants can be expanded but this is expensive and requires this increase needs to be designed into the process and supporting infrastructure. Water recycling solutions are constrained by Dry Weather Flow (DWF) to WTWs. Option A.1 provides greater resilience, bias providing greater capacity, or redundancy, of supply.		
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: Desalination is a highly energy intensive process, causing high carbon emissions during operation (Annex 10.1 Environmental Appraisal: Desalination). Furthermore, these solutions will be difficult to offset from a carbon and environmental perspective and produce a hyper saline waste stream that is discharged back into the environment.		
4	**Amenity value:** Increased amenity provision for the local community(ies)			
		Commentary: Desalination plants provide little potential for creating amenity value as they are an industrial plant with associated marine and terrestrial infrastructure. Option D.1 contains an indirect water recycling component which will provide some amenity benefits, but this is offset but the amenity disbenefits provided by the desalination component for industrial water supply.		
5	**Customer and Stakeholder:** Preferential customer and stakeholder solution			
		Commentary: Option D.2 is favoured by stakeholders compared to all other options as, the thematic customer priorities, reflected in Section 8 including reducing the need for significant infrastructure and inclusion of assets which provide amenity value and / or environmental benefits, are included. Desalination options provide limited capacity for these benefits. Furthermore, Environmental regulators are sceptical of desalination options due to environmental impacts. Further detail is provided in Annex 15 Customer and Stakeholder.		
6	**Water Quality:** Enhanced water quality – for customers			
		Commentary: Desalination will produce a compliant water that once re-mineralised will be suitable for consumption, however, there is a risk that taste will be affected and therefore there is a risk of customer acceptability. Option D.1 is green as the desalinated water is straight to industry and there is a significant volume of potable water from SWW		
7	**Carbon Emissions:** Offsets carbon emissions and has potential for carbon net zero without need of external initiatives (e.g. tree planting)			
		Commentary: Desalination is highly power intensive and emits the greatest quantities of carbon, with negligible opportunity to offset any emissions. Indirect water recycling has the potential to offset carbon emissions, via the environmental buffer, while options [redacted] have the potential to off-set carbon impacts through the regeneration of flora and fauna D.1 has potential to be less impactful as it is a hybrid of new and existing technologies. Further detail is provided in Annex 10.1 Environmental: Desalination.		
8	**Deliverable and Operable:** Southern Water have experience delivering and operating the required technology and systems			
		Commentary: Desalination and water recycling would be new technologies for SW. Although both are used extensively internationally, there is limited experience delivering and operating these systems in the UK. Transfers and reservoir management are more closely aligned to water sourcing methods SW currently uses.		
9	**Futureproof:** Option capacity can be expanded to 1-in-500 year without significant capital investment required			
		Commentary: All options would require significant additional capacity to be designed into the solution prior to approval of consents and commencement of build to enable flexibility to a 1:500-year event. This would affect the schedule too having to assess additional environmental/ cost and customer impact.		
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 it is a risk that there is limited experience delivering and operating either desalination or water recycling in the UK, international support is likely to be required.		
11	**Affordability:** Aligns with Southern Water customer's willingness to pay			
		Commentary: Desalination and water recycling are costly to deliver and operate, which is expected to have a flow on impact to customer bills. At this stage this impact has yet to be determined. Option D.2 has the lowest expected WLC of the options considered and is expected to have a lesser impact on customer bills, relative to all other options. All options require significant capital and operation cost investment. Further detail is provided in Annex 12 Cost Report		

11 Impacts on Current Plan

11.1 Supply-demand Balance Impacts

The Preferred Strategy in WRMP19 includes a desalination plant of 75 Ml/d [redacted] (Option A.1 - Base Case) to bridge the supply demand deficit across the western area.

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 30 - 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)
75 Ml/d (A.1)	+21	+31	+31	+41
61 Ml/d (A.2 & D.1)	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 desalination options considered, as detailed in Table 1, and their alignment to the National Framework for Water Resources. The results of this assessment show that each of the desalination options align with the National Framework, as detailed in Table 31.

Table 31 - National Framework alignment for desalination-based options

Option	Aligns to National Framework	Commentary
A.1 & A.2	✓	• Desalination and transfers are explicitly recognised in the National Framework as being amongst the range of options to increase supply • Increase SW's resilience to drought, and both increase overall supply and facilitate the movement of water • Incorporation of desalination, as a new method of supply, would broaden the types of supply available in normal or drought conditions • The National Framework supports the investigation and consideration of options that combine transfers and supply increases
D.1	✓	• Desalination, water reuse and transfers are amongst the range of options to increase water supply • The combined desalination, water re-use and transfer option will increase SW's resilience to drought, and both increase overall supply and facilitate the movement of water to where it is needed • Incorporation of both desalination and water reuse, as new methods of supply, would broaden the types of supply available in normal or drought conditions, increasing resilience overall • The investigation and consideration of options combine transfers and supply increases. • Projects increased demand for water supply to manufacturing and other industrial uses.

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 7.

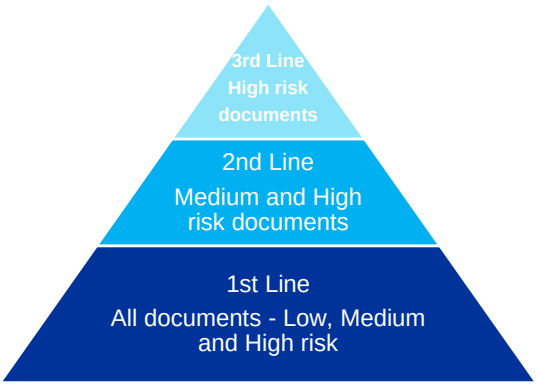

Figure 7 - 'Three lines of defence' framework

Key components of the assurance activities within each line of defence are included in Table 32, with further detail provided in Annex 1 Assurance Process.

Table 32 - 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. • Strategic assurance, completed by PwC, and technical Assurance, completed by Jacobs

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 A.1 and A.2

There is expected to be no direct engagement with other water companies in delivering either Options A.1 or A.2. SW is expecting to work independently in delivering these Options, should they be selected for capital delivery.

13.2 Option D.1

Option D.1 will require SW to engage with another water company to re-purpose and negotiate a bulk supply agreement [redacted] as this supply will no longer be required to serve the large coastal industrial facility. In addition, SW will need to engage and enter into complex commercial negotiations with a third party [redacted]

14 Efficient Spend of Gate Allowance

The spend breakdown to Gate 1 and the key activities completed are detailed in Table 33. [redacted] The final determination allowance to Gate 1 is £3.74m.

Table 33 – Activity spend preparing Gate 1 submission for Desalination-based options

Activity **Management Costs – shared costs with water recycling options** Portion of costs for Desalination Options shown only	Total Gate 1 Spend
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]

Activity	Total Gate 1 Spend
Management Costs – shared costs with water recycling options Portion of costs for Desalination Options shown only	
Management sub-total	[redacted]
Technical Costs – Desalination options only	
Engineering and technical	[redacted]
Environmental appraisals	[redacted]
Project Management	[redacted]
Technical Sub-total	[redacted]
Total (combined management and technical costs)	[redacted]

14.1 Forecast Spend to Gate 2

As detailed in Table 3, the estimated spend preparing the Gate 2 submission is [redacted] in line with 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 Option A.1

15.1.1 Design Activities

- Engagement of Reverse Osmosis (RO) membrane suppliers to validate the performance expectations for the RO membranes, making proprietary modelling platforms available to determine the likely effluent quality produced by their products, supporting validation of the identified customer acceptability and agricultural impact risks.
- Undertake a detailed feasibility study of the proposed pipeline routes from Fawley to the Testwood WSW site.

15.1.2 Pre-planning application

- Update of the existing Stage 2 HRA following site selection.
- Finalisation of site selection and route optimisation to confirm the Order Limit Boundary.
- Undertake a Constructability Review for the proposed options.
- 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 the deliverables and strategy for the confirmed consenting route.

15.1.3 Stakeholder Consultation

- Engagement with Environment Agency, Natural England and other key stakeholders to test and validate plans.
- Extensive consultation with Defra, MHCLG and PINS/local authorities.
- Continuing engagement with relevant stakeholders, e.g. RAPID etc.

15.1.4 Scheduling development

The current Gate 1 delivery schedule will be optimised as a result of the following outcomes:

- Constructability input secured for the key construction and commission activities;
- Land strategies, activities and scope will be greater defined following detailed site selection;
- Further development of the Option A.1 procurement schedule and SOC; and
- Improved clarity on the engineering and technical requirements following additional surveys and incorporation of specialist capabilities.

15.1.5 Procurement, Cost & Commercial

- Undertake DPC assessment to confirm procurement route.
- update to the cost and risk assessments to align with the maturity progression post Gate 1.

At Gate 2 a more detailed plan will be presented for those solutions that are proposed to continue beyond Gate 2.

15.2 Alternative option development

For the alternative Options, these will be progressed beyond Gate 1, to further assess and determine their feasibility between Gate 1 and Gate 2. It is possible that some of the alternatives may be determined not to 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.

At Gate 2 we propose that a recommendation should be made by RAPID as to which solution 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, we 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.

Alternatives proposed for consideration at Gate 2 will be further developed to a standard that aligns with the Gate 2 requirements. The primary activities, will include, but not be limited to, the following:

- Development of concept solution designs with reduced uncertainty in costs and benefits; and
- Re-testing in updating of the regional and company models (to support updated decision making and filtering of outputs including those that are mutually exclusive).
- Where appropriate i.e. Option D.1 further conversations will be had with 3rd parties to further assess feasibility or practicality of assumptions made re: bulk supplies, supply transition or collaboration

The supporting activities for each solution, include, but are not limited to, the following:

- site selection progression;
- development of Level 2 Fact Files that detail and summarise the technical aspects of the solutions. This level of detail is consistent with WRMP19;
- Stage 2 HRA / Outline SEA for the Feasible options;
- Refinement delivery schedule;
- Update to the risk register; and
- outline procurement strategy.

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