STRATEGIC REGIONAL WATER RESOURCE SOLUTIONS:

Cheddar 2 Source and Transfer

Standard Gate Two Submission

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Submitted to: RAPID

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1 Executive Summary

1.1 Introduction

This Gate 2 submission sets out the options appraisal and scope, costs and benefits of the preferred solution for the Cheddar source and transfer SRO. The scheme was originally promoted as a potential solution to Southern Water's need in Hampshire as the reservoir had already been granted planning permission. The scheme has not been selected by Southern Water and does not feature in the WRSE emerging plan and subsequent investment runs,

However, following further analyses and in light of the current drought it has been identified as having potential benefit in the West Country Water Resources Group's (WCWRG) emerging plan. Using the source in-region greatly reduces the length of transfer main and is therefore a more efficient use of the source, with lower capital, operating and carbon costs and construction impacts when compared to transferring the water to Southern Water. It has been agreed with RAPID that the scheme progresses with a concept design of a best value solution to use the water in-region.

The scheme will involve construction of a second reservoir at Cheddar, that was previously granted planning permission which has since lapsed, and to fill it from Cheddar springs and the river Axe, under Bristol Water's (BRL) existing licences. As an option to support Wessex Water (WSX) for evaluation in its Water Resources Management Plan (WRMP) water would then be treated at a new works before being transferred via a 55km pipeline to a strategic service reservoir in Wessex Water's groundwater area in the east of their region. This can then be used to boost resilience across the whole south west region, including considering whether the 2022 drought has demonstrated the need for more water for Devon and Cornwall and will require Cheddar two reservoir to be delivered earlier.

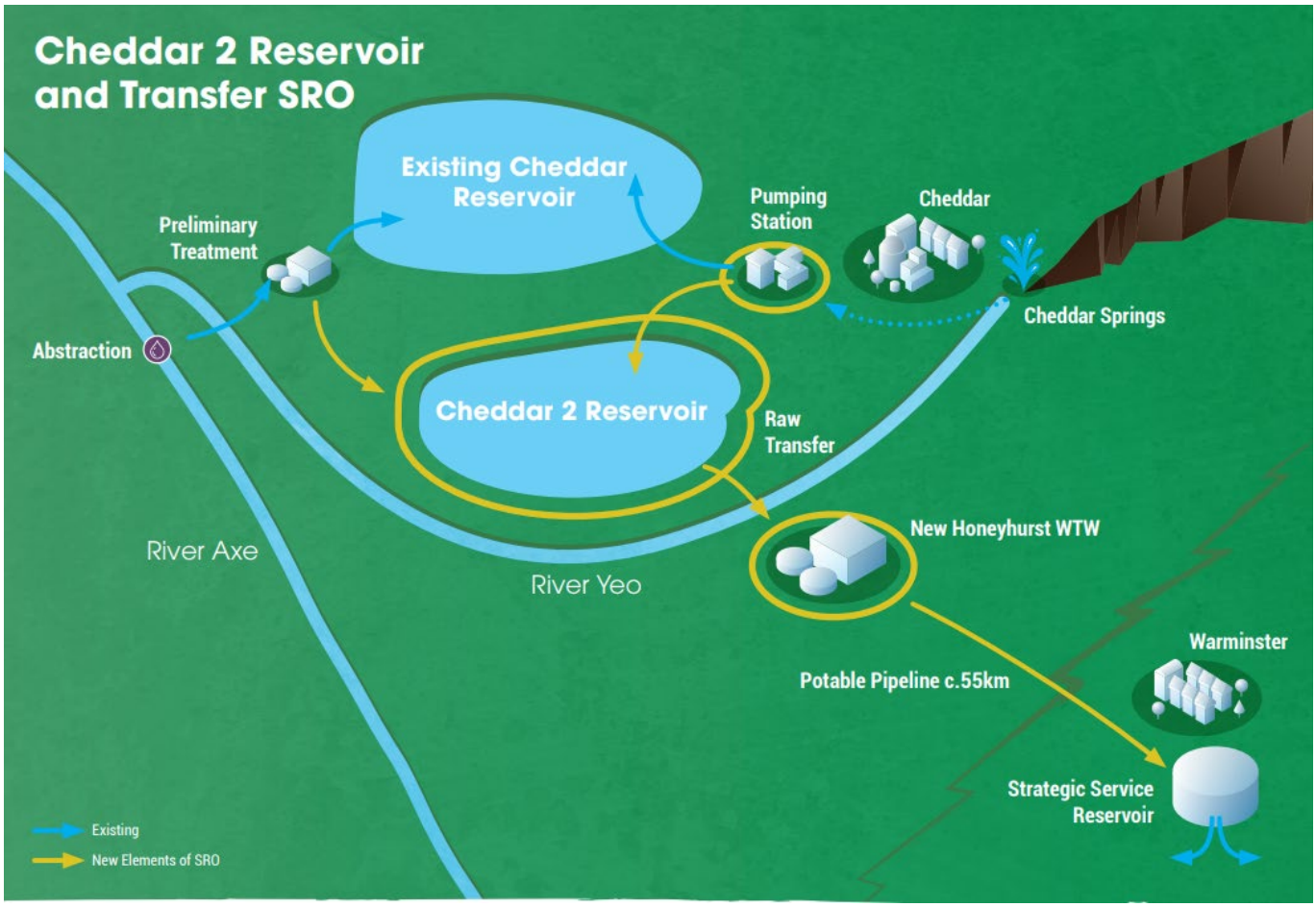


Figure 1 Scheme overview

1.2 Gate 2 Key Activities

To make best use of the limited Gate 2 funding available for the SRO, work has focussed on addressing the key uncertainties remaining from Gate 1 regarding the scheme's feasibility, determining the best value scope and producing and appraising an updated concept design. The partner companies consider that the Cheddar 2 reservoir could be of potential value, however, its further development as a water supply scheme should be done efficiently and in consideration of where the source could deliver greatest value. Designing multiple options was not affordable within the budget and was not appropriate in the light of the original proposal not being selected as part of the WRSE emerging regional plan and therefore an initial gate 2 phase of work determined the best use of the source and the second phase developed and appraised options for the associated scheme components.

Key aspects of the gate 2 work have included;

- Water resources modelling of the Cheddar springs and river Axe to determine the deployable output of the new reservoir alongside BRL's ongoing operation of the existing reservoir
- Fully appraise the potential for a raw water transfer or a cascade transfer to Southern Water
- Develop and appraise the concept design of an in-region option.

1.3 Options Appraisal

For Gate 2, options have been appraised to determine the reliable source availability and how it can be best deployed. This has resulted in the concept design of a core scheme for which the costs and benefits have been estimated to enable it to be considered in regional and company water resource management plans.

Cheddar 2 reservoir was originally identified as a potential source for a transfer to Southern Water, however as part of the gate 1 study, the long distance transfer was found to be very expensive with operational challenges to maintaining water quality.

The benefits of the alternative uses have been determined from the regional plans, reflecting the needs to which they could contribute. The determination of the most appropriate option to take forward to Gate 2 has therefore been made by considering the following:

- Which of the emerging regional plans does the scheme feature in, when and under what scenarios?
- What is the net benefit of incorporating the scheme in the regional plan, relative to the next best alternative?
- Comparison of the options costs, carbon and environmental impacts.
- The potential water resource benefit.

The Phase 2 appraisal then determined the most appropriate location and scope of the best value scheme components.

The overall aim of Gate 2 is to reach a position where a decision can be made on whether to progress the scheme so that it is construction ready in the period 2025-2030, which was one of the main drivers for the gated process in response to the National Infrastructure Commission's report in 2018.

RAPID's guidance for Gate 2 includes three overarching objectives:

- The solution design at Gate 2 should aim to eliminate sub-optimal options and only carry forward viable options
- Proposals should be aligned with any available strategic water resources plans (e.g. the emerging regional plans)
- Solutions should meet criteria that test the need for accelerated development and regulatory oversight and support.

We take each of these objectives in turn below.

1.3.1 Only taking forward viable options

At this stage, both the SRO option to take the water to Southern Water's Testwood site and the in-region option are considered to be viable.

1.3.2 Alignment with available strategic water resources plans

As described above the emerging regional water resources plans confirm that the scheme is:

- not required in the WRSE region. The scheme was offered in to WRSE's investment modelling. The outcome was that it does not feature in their emerging plan to 2040, nor in the adaptive plan to 2060. Stress testing of their plan does not change this result. Further development of WRSE's plan to a 'best value' plan continues to exclude the use of this scheme.
- of benefit to the WCWRG region. The WCWRG emerging plan indicates that, due the potential scale of the environmental destination reductions and increasing risks to supplies from climate change and population growth, there is a need to continue to develop all the strategic options such that the best options can be deployed if they are required. The plan is that this option development continues in parallel with work to reduce the uncertainty regarding abstraction reductions during the period 2025 to 2030.

1.3.3 The need for accelerated development and regulatory oversight and support

The scheme should continue as a strategic resource option, overseen by RAPID, due to multi-company involvement and ongoing engagement requirements with regulators and stakeholders regarding anew reservoir and to assist in obtaining the various consents required to construct and operate the scheme. Our responses to RAPID's eight criteria to be considered before schemes progress to the next gate are set out in Annex 1: Options Appraisal.

We have worked closely with the Environment Agency, DWI, Natural England and RAPID throughout this phase of work and we have not received any feedback to indicate that they perceive there to be any potential showstoppers.

Natural England's position is that the SROs in the West Country should be used to solve environmental needs in the region, which is effectively a showstopper for an inter-regional scheme.

1.3.4 Preferred option

Based on the Gate 2 Phase 1 work and the emerging regional plans, this scheme is potentially required in-region to address the future supply demand deficit, that was not envisaged when the SRO transfer to Hampshire was originally promoted.

It was therefore recommended that the scheme is considered as an in-region option only. The Gate two submission has scoped and appraised a scheme to use the reservoir in support of both SWW's and WSX's likely deficits in their areas. The recommendation that the scheme progressed to gate 2, as an in-region option only, as part of a best value, WCWR regional plan was agreed by RAPID in a letter[1] on the 27th May 2022.

1.4 Scheme Concept

The scheme is to fill a new, Cheddar 2 reservoir, alongside the existing reservoir from Cheddar Springs and the river Axe, under the constraints of Bristol Water's (BRL) existing abstraction licences. Water resources modelling has determined that the new reservoir could provide an annual average output of 14Ml/d and a summer, critical period output of 36Ml/d in a 1 in 500 year drought.

Water would be transferred to a new water treatment works from where a potable water main and associated pumping would take the water to a strategic service reservoir in WSX's system south of Warminster to mitigate the loss of local groundwater sources. Potentially it could provide more water to Devon and Cornwall and allow consideration of the future balance of utilisation of sources used by SWW and WSX.

The following table summarises all the key information about the SRO.

Table 1 SRO key information

Scheme type	Reservoir, treatment and transfer
Key components	9,000Ml reservoir Water treatment works 6km raw and 49km potable transfer mains
Annual average deployable output	14Ml/d

[1] WCWR-Interim-letter-response-27-May-2022.pdf (ofwat.gov.uk)

Summer peak demand deployable output	36Ml/d
Requirement being met	As an option to support WSX's groundwater area and/or to enhance drought resilience in WSX and SWW.
What plans does it feature in	WCWR emerging regional plan
When is it required	2035
AIC	537p/m^3
Carbon impact	631 $KgCo_2e$/Ml
Duration to operational use	12 years
Should the scheme progress within the RAPID gated process and proposed Gate 3 submission date	Yes, gate three in September 2025 , to be confirmed in final WRMP

1.5 Conclusions and recommendations

The conclusions and recommendations are agreed by all the scheme partners.

The initial phase of the gate 2 work, which has already been agreed with RAPID, concluded that the best value use of the water resource was as an in-region option only.

Based on the gate 2 studies, which are described in more detail below and in the accompanying annexes, we conclude that the scheme:

- is technically feasible and deliverable
- has minimal environmental impact
- would provide a drought resilient water resource, using existing abstraction licences, with an annual average of 14Ml/d and a peak of 36Ml/d if used to meet critical peak requirements in WSX's and SWW's areas
- can be construction ready by 2030
- needs continued development to resolve the remaining risks and uncertainties.

The status of the scheme in the companies' dWRMP24 is as follows:

- Bristol Water's draft WRMP central scenario assumes deep reductions in demand in line with government guidelines and does not select Cheddar two for implementation over the planning horizon to 2080. However it is recognised that there is considerable uncertainty about the deliverability of demand reductions. Cheddar two reservoir could provide resilience to both WSX and SWW regions in the future, especially in light of this year's current drought. The draft WRMP is subject to consultation with stakeholders and regulators in early 2023. The regional plan will be consulted on over the same timescales.
- Wessex Water's draft WRMP does not select the Cheddar two reservoir and transfer scheme in any scenario. Similarly it relies on significant demand reductions to achieve an acceptable supply-demand balance and deliver environmental improvements over the long term. However, the plan also includes some supply-side interventions and it selects the other strategic resource options, Poole and Mendips, in preference to Cheddar two reservoir.
- The position will be revisited between draft and final WRMPs, and in future rounds of regional planning when an integrated regional water resource system model is expected to be available.
- SWW's dWRMP makes reference to the need to review the Cheddar two SRO in light of the current drought and need to boost resilience in Devon and Cornwall, for example through supplementing resources for WSX which can then release currently shared resources.

Therefore, pending the conclusions of the consultation on the draft WRMPs and regional plan in 2023, it is recommended that the Cheddar scheme continues on the gated process through to gate three.

2 Background and Objectives

2.1 National Framework and Regional Planning

The Environment Agency's (EA) National Framework (Meeting our Future Water Needs: A National Framework for Water Resources[2]) was published in March 2020 and it explores England's strategic long-term water needs across all key sectors up to and beyond 2050, emphasising that if action is not taken many areas of England will face water shortages. The National Framework recognises that an increasing population, demand from agriculture and industry and improving our resilience to drought will all put significant pressures on our water resources, and that climate change will further increase these pressures.

If no action is taken, the National Framework identifies that the West Country may require an additional 227Ml/d by 2050 to meet future pressures on public water supply and that this could double by 2100.

The WCWR emerging plan[3] has identified that a new, strategic regional resource may be required in the next 20 years to maintain water supply resilience in the face of the above pressures. The plan shows that the region faces deficits across the range of forecast scenarios that will require supply side solutions in addition to ambitious demand and leakage savings. The need for this solution within the regional plan is summarised in section 3.1.2 below.

2.2 Water Company Plans

Bristol Water (part of the Pennon Group) will publish their draft WRMP for consultation in autumn 2022. Their best value plan is predicated on meeting government policy targets for per capita consumption and leakage reduction. However, the executive summary highlights the potential need for a second reservoir at Cheddar to improve regional resilience should their ambitious leakage and demand management plans not entirely deliver the envisaged reductions. Copied below is the executive summary of BRL's dWRMP24 from the company's CEO Susan Davy, which summarises their position.

We are determined to make the South West resilient to the increased risks of drought, to support sustainable economic and tourism growth, and to protect our environment, whilst reducing our carbon footprint.

Our work to date sets out the need to transform the way we all use water, as we adopt new ways of working, focus on sustainable operations and decarbonisation, think innovatively, and empower customers to make informed decisions around water use.

This means investing in new reservoirs, and for the first time ever - working with other water companies to share resources. For example, in the Mendip Hills there are quarries and pits that are well suited to be used for raw water storage. Cheddar is also a well-established site for a second reservoir that could now be used to increase resilience of water resources across the entire region. And with increased interconnections and reduced leakage, we can make sure that we share this water around the region, with customers and businesses protected from changing weather patterns and growth.

There are other supply options in the long-run that could see us invest in water recycling. Today, most of the water we all use, along with rainwater that lands our roofs and driveways, all ends up going down the drain and into the sea. We could introduce recycling schemes that will retain and recycle this water that would otherwise flow into the sea.

We will do our bit to make homes fit for the challenge, to support government targets to reduce leakage by 50% and reduce consumption by a quarter by 2050. Homes need to be able to recycle water, using more water butts and rainwater harvesting systems. Smart meters for all will help homes to manage water use and will identify the leakage on customer properties -which currently accounts for over one third of all leaks. This will ensure homes are smarter and healthier in the future. Our draft plan focuses on reducing water demand as the first approach, but depending on the consultation on this plan and other plans across the region, we will revisit the option to include new supply schemes, such as a second reservoir at Cheddar and water recycling schemes.

[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources
[3] WCWRG Initial regional draft plan Jan

Overall, we want to make sure that this draft water resources plan delivers for everyone, and it is one that future generations can be proud of. Please do take this opportunity to respond to this draft version, and have your say.

SWW, also part of Pennon Group, includes the same introduction from the group's CEO in its dWRMP24.. The south west of England has been particularly affected by the current year's drought, and the SWW dWRMP needs to reflect on the impact of the drought on resources needed across the region.

Wessex Water's dWRMP24 presents an affordable plan supported by customers, to deliver a positive supply demand balance and therefore a secure supply of water to 2079-80, which meets a 1 in 500 level of service for emergency drought orders by 2040, and also delivers important abstraction licence reductions to help protect Chalk streams in 2035 and 2050. The baseline supply-demand balance position shows that the planning period starts with a surplus which gradually declines throughout the planning period primarily as a result of a growing demand forecast into a deficit by 2079-80. On top of this long-term trend, further declines in available water occur due to licence losses in 2035 and 2050, resulting in overall planning deficits of 93 Ml/d by 2079/80 under the dry year critical period (DYCP) scenario.

The options appraisal and decision making within WSX's dWRMP did not select the Cheddar scheme in any scenario, although the baseline for the scenarios assumed the same use of existing resources as currently. WSX had identified that abstractions from groundwater sources in the east of their region would need to reduce in the future and as part of the regional planning process this need was identified as the most appropriate deployment of the new Cheddar 2 reservoir. The SRO has therefore been developed into a solution for this need to enable it to be compared alongside other supply and demand options within the programme appraisal of WSX's dWRMP. The SRO has been considered in the company's plans as two sub-options; the full 36Ml/d capacity and a half capacity, 18Ml/d option. Within the investment modelling, neither option was selected under any of the adaptive pathways.

3 Solution design, options and sub-options

3.1 Options Appraisal

The Gate 2 options appraisal for this SRO has been undertaken in two phases in line with the evolution of information following the Gate 1 submission. In Phase 1, we considered the potential to use the Cheddar 2 reservoir source as either an inter-regional transfer, as originally envisaged and also as an in-region option, to meet more local needs. The Phase 1 options appraisal also addressed the requirements of RAPID's Gate 1 final determination to assess sending water to Southern Water as either a raw water transfer, a direct potable transfer and via a cascade, using existing infrastructure. Following agreement with RAPID that the SRO should progress as an in-region option, the Phase 2 options appraisal focussed on the options for each component of the scheme required to use the source in-region.

This report sets out the methods and results for appraising the options, leading to the currently preferred solution that has been taken forward for concept design development for the Gate 2 submission.

3.1.1 Phase 1 Options Appraisal

A key consideration in determining which option should be progressed, was which was likely to feature in regional and company plans. Both the West Country and South East planning groups have issued emerging regional plans for consultation, setting out their range of long term needs and possible solutions. The regions are adopting adaptive planning approaches to deal with the large uncertainties in the drivers of the supply and demand forecasts. They will also apply a range of best value criteria in selecting solutions which do not just minimise cost but deliver wider societal and environmental benefits and support carbon neutrality and operational resilience.

West Country Water Resources Group (WCWRG)

The region's published emerging plan shows that the region faces deficits across the range of forecast scenarios that will require supply side solutions in addition to ambitious demand and leakage savings. Table 2**Error! Reference source not found.** below presents the selection of strategic supply options under the region's range of environmental and demand management scenarios. This shows that Cheddar source may be required in the more severe scenarios by 2050 and as such forms part of the WCWRG emerging regional plan. The adaptive plan means that it should continue to be developed in parallel to reducing the uncertainties regarding the future environmental destination and delivering the leakage and water efficiency programmes.

Table 2 WCWRG Emerging Plan Supply Deficits

	Base DYAA supply demand balance (Ml/d)	Supply-side options				Planning DYAA supply demand balance (Ml/d)
		Mendip quarry	Roadford pumped storage	Poole effluent reuse	Cheddar Two reservoir	
		90 Ml/d	30 Ml/d	30 Ml/d	16 Ml/d	
Policy Future	-42	√				48
Higher demand future	-125	√	√		√	11
Bad future	-186	√	√	√	√	-20
Stretching future	-277	√	√	√	√	-111
Alternative future	-132	√	√	√		18

In discussion with the WCWR companies, it was identified that the scheme could provide most benefit by mitigating the potential reduction in deployable output from WSX's groundwater sources in the east of its region. It could also provide resilience across Devon and Cornwall in the SWW region.

Water Resources South East (WRSE)

WRSE have similarly published an emerging regional plan, reflecting the range of potential future supply demand deficits that may be generated by future environmental destination, population growth and climate change scenarios. The West Country SROs (Poole effluent recycling and Cheddar two) were options within the regional investment model for consideration in producing the emerging plan. Neither scheme was selected under the range of future needs. **Error! Reference source not found.** below shows the schemes selected to 2040 in the WRSE emerging plan. After 2040 the plan considers three different scenarios to 2060 which each then further split to give nine possible futures beyond this time.

The WRSE plan continues to be refined and following consultation on the emerging plan, some currently selected schemes may be removed, requiring alternative solutions. However, it is considered that there are other schemes that would be implemented ahead of the Cheddar source and transfer, in such an event, due to its relatively high cost, low resource benefit and high carbon and environmental impacts, arising from the long transfer.

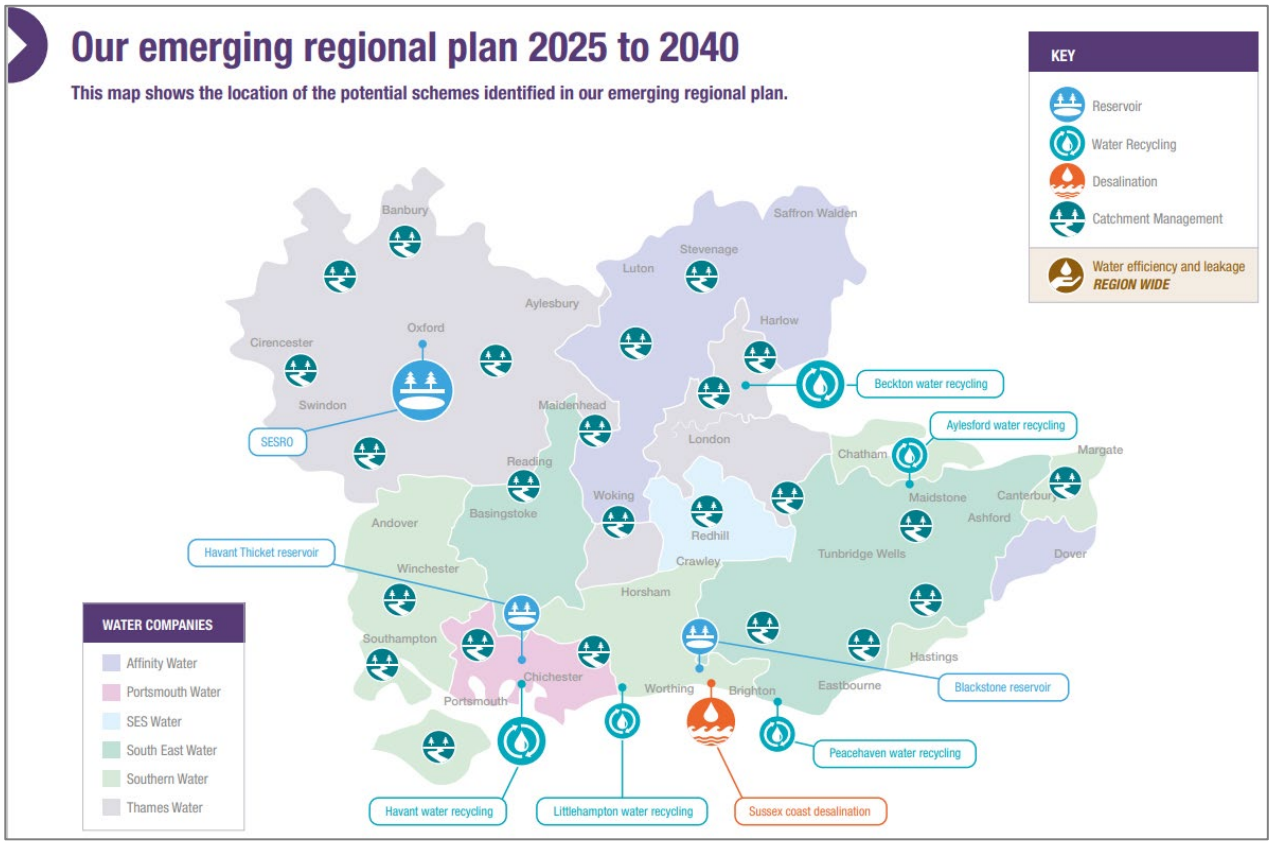


Figure 2 WRSE Emerging Plan

Regional plan conclusions

This scheme is not selected as part of the WRSE emerging regional plan and is highly unlikely to be selected as part of the region's best value plan given the length of transfer and small water resource benefit. However, the WCWRG plan now forecasts a significant deficit for which supply side schemes will be required and the reservoir could form part of this region's plan. As the WCWRG develops its understanding of the regional needs, the potential to integrate a second Cheddar reservoir with the existing system could generate a greater resource benefit than currently assessed as a standalone scheme and be deployed with less new infrastructure by enabling displacements and using existing inter-company connections to optimise the combined use of the region's resources.

It is therefore recommended that the scheme is considered as an in-region option only from this point forward. The Gate two submission should scope and appraise a scheme to use the reservoir in support of WSX's likely deficit in its eastern area. This will provide the cost and other information required for the scheme to be considered in WRMPs and the regional plan such that the need and timing for its further development can be established and decisions as to how it should proceed.

The recommendation that the scheme progressed from this point, as an in-region option only and that the Gate 2 submission and subsequent programme reflect what is required to meet the local needs as part of a best value, WCWR regional plan was agreed by RAPID in a letter[4] on the 27th May 2022.

[4] WCWR-Interim-letter-response-27-May-2022.pdf (ofwat.gov.uk)

Gate 1 transfer options to Testwood

Raw water transfer

At gate 1 a large, raw water transfer and a cascade transfer option were considered as options to support Southern Water's needs in Hampshire. Subsequently further work has been undertaken as part of the West Country South sources & transfers SRO Gate 1 study, along with a separate assessment of the feasibility of using Testwood lakes for storage.

The Gate 1 submission determined that a 65Ml/d capacity, raw water transfer was not feasible as it would require a 25Ml/d continuous, sweetening flow to mitigate the water quality risks. This meant that during sustained drought periods, when there would be no inflow to the reservoir, it would be drained by the sweetening flow alone.

To mitigate this risk, whilst still providing sufficient water to meet Southern Water's Hampshire needs, the use of Testwood lake to manage the peaks in demand was considered. The modelling of a 37Ml/d transfer in to Testwood lake and the lake having 400Ml of useable storage volume was undertaken. This showed that the much lower sweetening flow required for the smaller transfer pipe did not drain Cheddar 2 and that its peak transfer of 37Ml/d in combination with the lake storage could meet SRN's design events for the required SRO.

An action from Gate 1 was to investigate further the available information about the lakes at Testwood and to determine the current storage capacity and whether it would be feasible to increase it to facilitate the raw transfer from Cheddar Reservoir. Our investigation has concluded that the maximum feasible balancing storage that can be realised at Testwood Lakes is 230 Ml. This is circa 50% of the target storage that was mentioned in the West Country North SRO Gate 1 report and therefore the previously proposed transfer would not meet the immediate need and would have even less benefit in supporting wider regional needs.

The option of a raw water transfer has been shown not to be feasible.

Cascade transfer

A key requirement identified as part of Gate 1, for Gate 2, was to identify and assess in more detail the opportunities to use existing assets to convey the resource south-eastwards to Southern Water's Hampshire Area.

The existing network was reviewed as part of the West Country South SROs Gate 1 study to consider whether water could be displaced by using the new source to initiate a chain of offsetting of demands from existing sources and also by considering if existing assets had spare capacity. Very limited opportunities for integration of the new transmission requirement into BRL and/or WSX network were found due to a number of factors summarised below.

At Gate 1 it was estimated that a 16 Ml/d potable transfer could be provided from Cheddar 2 and that this would require a 450mm diameter pipeline. The current trunk main systems in BRL/WSX range from 200mm to 700mm diameter and therefore the network does not have sufficient surplus capacity to accommodate the additional flow, having been designed to current operation and with any headroom reserved for current resilience/ operational scenarios.

The BRL system supplies the majority of water from Cheddar towards Bristol area and there is limited operational flexibility to send any additional water along the route towards WSX and SRN, linked to the asset sizing point above.

The WSX strategic system generally operates in a west to east direction as the larger surface water sources in the west support the smaller groundwater sources in the east. There are no sources en-route providing water westwards which the new SRO source could replace, enabling the existing source water to be sent eastwards, as a displacement strategy. This scenario is the same for the small area of overlap within BRL region.

Consequently, it has been concluded that a potable, cascade transfer of the required size is not feasible.

3.1.2 Phase 2 options appraisal

Having determined that the source could potentially be best utilised to support WSX's groundwater region, options to achieve this were appraised. To systematically identify, develop and appraise the most efficient and cost-effective options, the project was split into the following components and the screening methodology detailed below applied to each:

- Cheddar Springs Source Abstraction –Options associated with Cheddar Springs source offtake
- Cheddar Springs to New Cheddar 2 Transmission – Options for connecting Cheddar Springs abstraction to new Cheddar 2 Reservoir (Pipelines/Pumps)

- New Cheddar 2 Reservoir – The original planning submission design (by Arup) was reviewed and considered to be appropriate for gate 2 feasibility assessment
- New Cheddar 2 Reservoir to New Honeyhurst WTW Raw Transmission (Pipelines/Pumps)
- New Honeyhurst WTW Site Selection
- New Honeyhurst WTW to a WSX strategic reservoir Potable Transmission (Pipelines/Pumps/Storage)

The screening process for the unconstrained SRO options was undertaken using two stages, where the level of scrutiny increased from Level 1, high level assessment using key parameters to a Level 2 screening which delved into a greater level of detail.

Level 1 screening removed all the options from the list that have major technical, planning or environmental constraints that are considered showstoppers to their feasibility. The outcome is a simple pass or fail with supporting reasoning.

Level 2 used a RAG system (red/amber/green) across the screening criteria with supporting commentary to enable a comparison of the remaining options and selection of a best value solution to be taken forward for concept design development.

The screening concluded that the existing raw water infrastructure from both the springs and the river Axe should be used and then transfer system follows a route that is of relatively low length, whilst avoiding environmentally sensitive areas and minimising construction in the flood plain. Most of the route is in fields, reducing traffic disruption and lowering cost.

Details of the options appraisal methodology and results can be found in Annex 1: Options Appraisal.

3.2 Concept design

The concept design of the selected components has been undertaken in accordance with:

- RAPID's "2022 Strategic regional water resource solutions guidance for gate two", with cognisance of the quality assessment criteria of robustness, consistency and uncertainty.
- The ACWG Design Principles as set out in the completed audit trail tables provided in Appendix A of Annex 2: Concept design report, meeting the guidance criteria for Climate, People, Place and Value.

The selection of system components and their materials has been made by also considering their contribution and impacts across the range of social, environmental and economic best value criteria. In particular, we have developed the overall solution scope to maximise environmental benefits and sought opportunities to minimise the whole life carbon emissions.

3.2.1 Summary of scheme components

The options appraisal task identified one feasible option across all the main components to be taken forward for concept design. Table 3 below summarises the key transfer and treatment components of the scheme.

Table 3 Scheme Components

Description	Water Type	Max Ml/d	Pipe Dia	Pipe Material	Distance (m)	No Pump Stations	No Storage
Lower Pond Intake Refurbishment	Raw	36					1
Lower Pond Intake to Cheddar WTW – Existing Raw Transmission & New Booster Station			54in splitting to 48in & 33in	CI	390 1,040 1,430	1	
Cheddar WTW to Cheddar 2 Reservoir New Raw Water Main			1400mm	ST	417		
River Axe Raw Main Extension to Cheddar 2 Reservoir			500mm	DI	425		
Cheddar 2 Reservoir							1 (9,000Ml)
Cheddar 2 Reservoir to Honeyhurst WTW – Raw Transfer and High Lift Pumps			600mm	DI	6,320	1	
Honeyhurst WTW (1MLD Losses)						1	2

Description	Water Type	Max Ml/d	Pipe Dia	Pipe Material	Distance (m)	No Pump Stations	No Storage
Honeyhurst WTW to Summerslade Service Reservoir – Potable Transmission	Potable	35	600mm	DI	48,968		

3.2.2 Sources and transfers to reservoir

Cheddar Springs currently gravitates to the existing reservoir through a large diameter pipe system from the Lower Pond intake. To achieve sufficient flows to fill both reservoirs, a pumping station would be constructed in the vicinity of Cheddar WTW. It will intercept water flowing through the existing transfer mains, and pump it to the existing reservoir and Cheddar Reservoir 2; the latter through a new connecting main.

At the location of the existing Cheddar WTW, the existing pipelines would be intercepted by a new pumping station. Valves would provide a bypass, allowing, when reservoir water levels permit, flows to gravitate on to the two reservoirs. Previous modelling of a free discharge at Cheddar WTW shows that the existing raw water mains have a limiting capacity of 3,593l/s (310Ml/d) which is well above the 250Ml/d abstraction licence limit and therefore, the pumps will only need to operate when the gravity head from Lower Pond is insufficient to transfer the desired flows to the reservoirs.

The preferred transfer option will require installation of a new large diameter main from Cheddar WTW booster to the inlet of the reservoir. It is envisaged that this will require a 412m length of 1400mm diameter main, sized to allow gravity transfers from Cheddar Springs when levels in the reservoir permit.

As with the existing Cheddar Reservoir, the River Axe abstraction at Brinscombe will provide Cheddar Reservoir Two with an additional source of water.

It is not proposed to seek any variation of the River Axe abstraction licence and all the modelling carried out has been in accordance with the existing licence constraints.

There are no works proposed at the Brinscombe Intake and Pumping Station as these are already sized to meet the licence maximum flow rate.

However, to allow the River Axe water to get into Cheddar 2 Reservoir, a branch connection will be required to link the existing River Axe mains, such that the existing Axbridge pre-treatment is maintained and can supply the full licence capacity of 30Ml/d to the reservoir.

It is anticipated that the new connection will be a 500mm diameter DI pipe with a length of approximately 425m.

3.2.3 Cheddar 2 Reservoir

The site of Cheddar Reservoir Two, immediately to the south of the existing Cheddar Reservoir, was identified during the site selection process as part of the original planning submission.

The site slopes gently from east to west, with existing ground levels that range from approx. 13.5mAOD in the east to 5.5mAOD in the west. It is relatively constrained in all directions and this poses limitations on the shape and size of the new reservoir, as explained below:

- To the north lies the existing reservoir and a number of mature trees and well established hedgerows;
- To the east lies the village of Cheddar, with recent house building encroaching westwards. There is also the proposed Sainsbury's development on Steart Farm;
- Also, to the east is Wessex Water's Sewage Treatment Works (STW). Relocation of the STW was considered, but would be complicated as the new site would have to be located outside of the flood plain, yet be in a location where it could receive the pumped sewage flows from Axbridge, and the gravity sewage flows from Cheddar. Such relocation is not proposed under this scheme, and the reservoir is designed to avoid the STW, which will stay where it currently is;
- To the south lies the River Cheddar Yeo. To the south-west lies the duck decoy, which is a Scheduled Monument of National Importance. The restoration of the duck decoy is to be included as part of the reservoir scheme; and
- To the north-west lies the Cheddar Clay Pits Biodiversity Action Plan (BAP) habitat, currently used for private angling lakes. Although only formed when the original reservoir was constructed (1930s), this area provides rich habitat and some visual screening of the proposed reservoir.

A detailed design was produced as part of the successful, previous planning application for the reservoir that fulfils the Gate 2 concept design requirement and therefore the design has been reviewed and adopted at this stage.

The design criteria for the capacity of the emergency bottom outlet, which is one area where guidelines have changed recently, was reviewed and found to be adequate.

It was identified that the key changes required for the intended transfer to WSX are related to downstream infrastructure and not the reservoir design.

The plan at Gate 3 will be to undertake a thorough review and update of the design of the reservoir, taking account of all current regulatory, non-regulatory, third party and customer requirements to provide a design that is suitable for a new planning submission during Gate 4.

Figure 8 below shows the Cheddar 2 Layout produced as part of the planning submission and provides an insight to the design and its interaction with the upstream and downstream works along with other compensatory construction requirements.

The key changes are to the downstream infrastructure from the draw down pump and the main feeding back to Axbridge Pre-treatment site to meet with Bristol Waters existing infrastructure and then pumped onwards to Cheddar WTW. This has now been replaced by a new Raw Water High Lift Pumping Station and transfer main to Honeyhurst WTW to the Southeast of Cheddar Town.

3.2.4 Honeyhurst water treatment works

Water will be transferred to the new WTW via a 6.3km raw transmission system consisting of:

- a connection to the Cheddar 2 reservoir outlet main, designed as part of the planning submission reservoir design with a new 600mm DI Main,
- a new high lift pumping station sited on the site previously identified for the draw off pumping station on the west side of Cheddar 2 reservoir, delivering 36Ml/d Peak and 9Ml/d turnover flowrate through a combination of pump sets
- a new 6.3km, 600mm DI main from the pumping station to the WTW

3.2.5 Potable water transfer

This 49km potable transmission system consists of:

- A new high lift pumping station sited on Honeyhurst WTW delivering 35Ml/d Peak and 8.75Ml/d turnover flowrate through a combination of pump sets. Note an assumed 1Ml/d treatment loss.
- New 600mm DI main connection from the high lift pumping station to the Summerslade WSR in Wessex supply area with intermediate pumping and storage.
    - A361 Pilton Booster Station & Break Pressure Tank, Milton Clevedon Booster Station & Break Pressure Tank, Copplesbury Lane Booster Station & Break Pressure Tank, Brixton Deverill Booster Station.

Honeyhurst WTW has been sized to treat up to 36 Ml/d of raw water during peak summer months. It is proposed that there is a minimum continuous sweetening flow of 9 Ml/d, to ensure pipe routes and water treatment processes are available to operate when the supply is needed.

The WTW process has been developed to address the range of water quality risks that could arise in the water from the reservoir, based on the Cheddar springs and river Axe sources. The key process units and their sizes are summarised in the table below.

Table 4 Honeyhurst WTW process units

Process	Sizing metric 1	Sizing metric 1 description	Sizing metric 2	Sizing metric 2 description	Sizing metric 3	Sizing metric 3 description	Commentary
Balancing tank	4 hours	Residence time	6000 m^3	Volume			Buffer for incoming flows to Honeyhurst WTW.
Clarification - DAF	8No	No. DAF	612 m^3	Total flocculation volume	204 m^2	Total flotation surface area	Higher footprint than Actiflo. Appropriate for treatment of algae.

Filtration - RGFs	5No	No. RGFs	48 m^2	Surface area per RGF	1.2 m	Depth	Assumed dual media sand / anthracite
Filtration – clean backwash tank	444 m^3	Volume	2.2	Backwash volumes			
Filtration – dirty backwash tank	864 m^3	Volume	2.5	Backwash and run to waste volumes			
GAC adsorbers	6No	Number of GAC adsorbers	20 mins	EBCT			
Disinfection - chlorine contact	2282 m^3	Contact tank volume	15 mg.min/l	Target ECt			Split into 2 equal cells. Assumed 60% hydraulic efficiency.
Disinfection - UV irradiation	4	Log *Cryptosporidium* removal	22 mJ/cm^2	Validated Dose	85%	UVT	Initial design based on D/S Xylem Spectron 4000e UV irradiation systems.
Washwater balance tank	403 m^3	Volume	161 m^2	Surface area			
Lamella settler	117 m^2	Lamella surface area					
WRc type thickener	11.4 m^2	Surface area					
Sludge press	2No	Number of presses required	4412 l	Thickened sludge capacity per press	3	Presses / day / Press	Micronics 1500sq filter press used for initial design

Due to the presence of algae within Cheddar 2 reservoir, likely to be greater than that within Cheddar 1 reservoir as a result of an increased use of the River Axe, there is the need to mitigate against algal taste and odour (T&O) compounds such as geosmin or 2-methylisoborneol. Additionally, mitigation against the observed concentrations of pesticides such as metaldehyde is required. Three options were considered for this:

1. Powdered Activated Carbon (PAC) dosing before the clarifiers
2. Granular Activated Carbon (GAC) adsorber
3. Ozone

GAC adsorbers have been selected at this stage as GAC adsorbers offer significant reduction in T&O compounds as well as pesticide removal. PAC, while offering good removal, was not chosen as it would be needed year-round due to the presence of pesticides within the River Axe year-round, and so would likely have a higher whole life cost than GAC adsorbers. Ozone was not selected as ozone alone did not appear capable of reducing T&O compounds to a suitable concentration. One other thing to note is that both PAC and ozone require dose optimisation as opposed to GAC which is a barrier approach and therefore does not need any optimisation making commissioning and operation easier.

4 Water resource assessment

4.1 Utilisation

Following the review of the west country and south east regional plans and the decision that the Cheddar source should be progressed as an in-region option, to support WSX's groundwater region, its potential utilisation was considered within the developing WRMP. WSX had identified that the scheme could best help preserve groundwater sources and meet customer demands by being used as a peak, summer period resource.

With a reservoir source, the deployable output is very dependent upon how the stored volume is utilised. Taking water over a two month period means that it can produce far more than as an everyday, baseload source. In order to determine how much water could be provided over a peak, two-month period the filling and operation of the new reservoir was modelled alongside the ongoing operation of BRL's existing reservoir.

Operation of the overall system will need to ensure that enough water is available for the existing and forecast demand on Cheddar Reservoir before allowing any remaining resource to be used to fill the new reservoir.

4.2 Water resource benefit

The concept design in this submission is for a standalone scheme that provides a potable water supply benefit to the identified need area. The solution has been sized on the basis of the intended utilization described above. Water resources modelling has been undertaken to understand the potential supply benefit the underlying sources and new reservoir can yield, alongside BRL's ongoing operation of the existing reservoir. The solution components have been sized based on the amount of water Cheddar 2 reservoir can provide for the peak, two-month period in up to a 1 in 500 year drought. The model used a 4,800 year stochastic flow sequence of the springs and river Axe, along with their abstraction licence conditions to determine how much water would be available to fill the new reservoir once the ongoing operation of the existing reservoir has been achieved. Demands on the new reservoir (in line with the intended utilisation) were then ramped up in the model until the reservoir was depleted in a 1 in 500 year. Full details of the modelling approach and results can be found in Annex 2: Water Resources.

As shown in Figure 3 below, the modelling has estimated that Cheddar 2 reservoir will be able to provide up to 36Ml/d during the peak two months and 25% (9Ml/d) throughout the rest of the year, every year up to a 1 in 500 year drought.

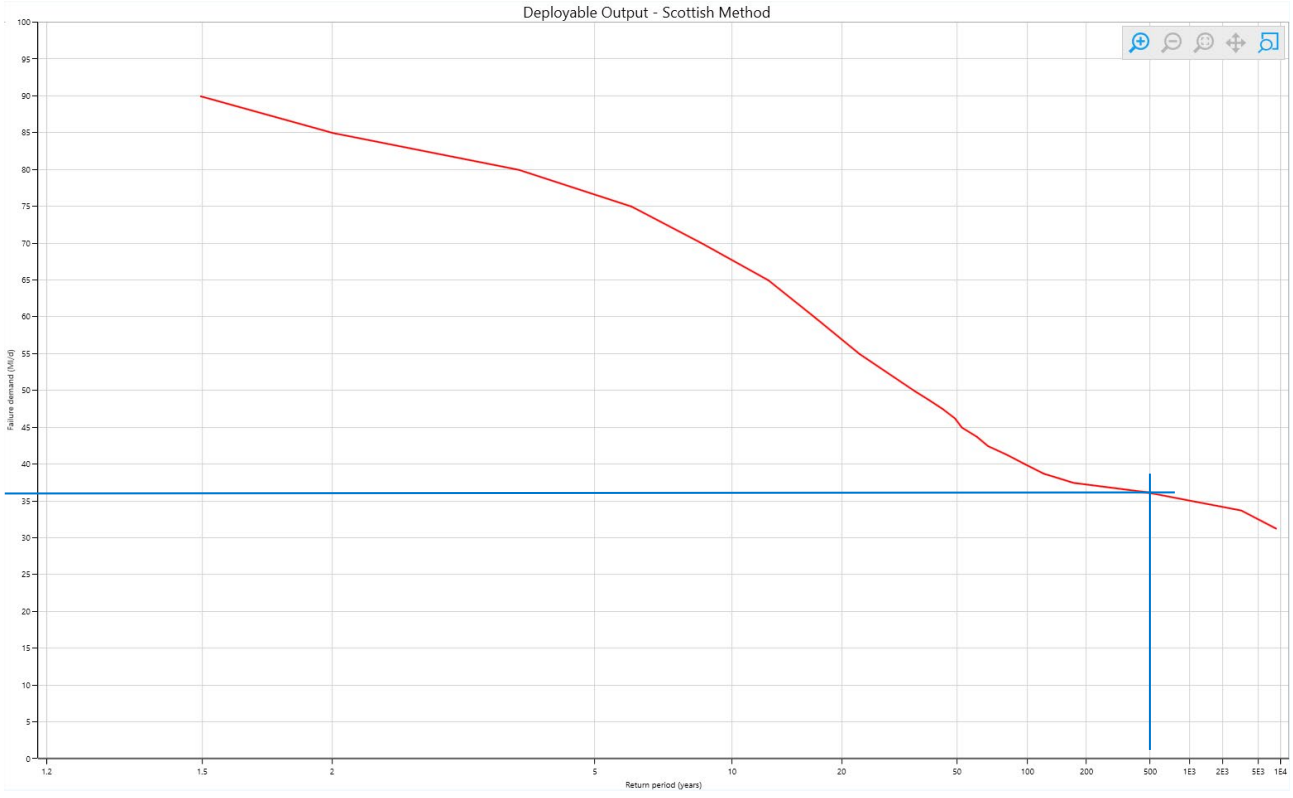


Figure 3 Reservoir yield under intended utilisation

5 Drinking water quality considerations

The drinking water quality risks arising from the sources and their blending and storage in the new reservoir have been assessed and an appropriate treatment process designed. The risks of transferring the treated water approximately 50km and blending with other sources in a service reservoir and onward distribution have also been considered and mitigated as required through additional treatment processes.

5.1 Source water quality and treatment

Cheddar 2 reservoir will be fed by the River Axe and the Cheddar Springs, an average blend of 23% River Axe and 77% Cheddar Springs, with a maximum River Axe input of 61%. For the purposes of this study, it was assumed that the water quality would be a blend of the River Axe and Cheddar Springs. This is likely not realistic, for example Cheddar 1 reservoir experiences a large drop in alkalinity compared to the source waters which has not been accounted for in Cheddar 2 reservoir. It is recommended detailed water quality modelling of Cheddar 2 reservoir is undertaken. It is expected there to be a greater algae risk in Cheddar 2 reservoir compared to Cheddar 1 reservoir. This risk of algal blooms is likely increased for Cheddar 2 reservoir when compared to Cheddar 1 reservoir due to the higher usage of the River Axe. The inclusion of the River Axe also means pesticides will likely be more of a concern in comparison to Cheddar 1 reservoir.

As part of the SRO project an “All Company Working Group” (ACWG) risk assessment has been developed. The ACWG spreadsheet is a tool to assess the risk of various hazards across the water system, from catchment through treatment and on to distribution. Using the sheet, it is possible to display the uncontrolled and controlled risk scores for each hazard at each point of the water system, noting whereby the risk originates from or how it is mitigated.

Using the water quality risks quantified within the ACWG spreadsheet the following treatment process for Honeyhurst WTW is proposed:

- A reservoir for settling and balancing flows allowing for maintenance on the raw water pipeline
- DAF clarification to combat the algae risk
- RGF primary filtration
- GAC adsorbers to mitigate algal taste and odour (T&O) risks and pesticides.
- Ultraviolet (UV) irradiation for Cryptosporidium inactivation
- Chlorine disinfection
- Final water conditioning including phosphate dosing to match the receiving water at Summerslade SR.
- Wastewater treatment stream consisting of balancing, settlement, thickening and a sludge press would also be required

An initial assessment of the treated water quality risks indicates the largest residual risk is that of the algal T&O compounds such as Geosmin and also pesticides.

5.2 Potable transfer and blending

36 Ml/d of water produced at Honeyhurst WTW will be transferred approximately 50 km to Summerslade SR, an existing 8.23 Ml service reservoir within Wessex Water’s water network. At full flow, the fluid velocity in the pipe is expected to be 1 m/s, giving a transfer residence time of 14 hours. It is currently assumed that as this is a relatively short transfer time, booster chlorination will not be needed.

The composition of pipes within Summerslade SR network are largely plastic however there is a large percentage of iron pipes that might be susceptible to corrosion and associated discolouration. Historically, Wessex Water have assigned discolouration within the network as a medium risk within the DWSP. Assessing the Summerslade SR DWSP suggests parts of the distribution system are in a ‘high risk lead zone’, the lead risk originates from customer pipes as opposed to Wessex Water mains. The inclusion of orthophosphate dosing at Honeyhurst WTW will help to mitigate this risk.

Water chemistry modelling of the transferred and receiving water was completed using Water!Pro, the modelling shows that the water chemistry of the proposed Honeyhurst WTW appears to be similar to the receiving water at Summerslade SR. This is indicated by corrosion indices such as the ‘aggressive index’ and ‘Langelier saturation index’ being similar. There does appear to be a higher Calcium Carbonate Precipitation Potential (CCPP) in the transferred water compared to Summerslade SR, which could lead to greater scale formation and hence customer complaints. Final water conditioning setpoints at Honeyhurst WTW were set to match the receiving water at Summerslade SR, it may be that a different pH target is optimum for reducing the CCPP however the risk does

appear to be low. There is also the potential for high THM concentrations due to the transfer time to Summerslade SR, further steps are required to fully understand this risk.

5.3 Recommendations and next steps

The following are the key recommendations should this project progress past Gate 2:

- Detailed water quality reservoir modelling to confirm the water quality expected from Cheddar 2 reservoir
- Sampling for additional parameters such as emerging contaminants in line with the ACWG spreadsheet outputs
- More detailed optioneering and WTW design including jar tests to optimise chemical dosing
- Development of drinking water safety plans
- Pilot trials for whether GAC adsorbers can reduce Geosmin, 2-MIB and Nitrite concentrations to an acceptable concentration.
- Chlorine decay testing in the Honeyhurst WTW to Summerslade SR transfer main to understand whether booster chlorination will be required, especially at the minimum continuous flow.
- Disinfection by-products (DBP) formation test work to understand the DBP risk within the transfer main and whether chloramination might be required.

6 Environmental assessment

As a major infrastructure project involving the construction of a new reservoir at Cheddar, a new WTW at Honeyhurst and the associated pipework for the transmission of potable water from Honeyhurst WTW to a strategic service reservoir at Summerslade in Wiltshire, the construction and operation of the Cheddar 2 Source and Transfer scheme (and constituent components) has the potential to generate a wide range of effects on a wide range of environmental, social and economic receptors. To address this during Gate 2, the following technical environmental assessments have been undertaken in Annex 5 - Technical Appendices 5.1 – 5.5.

- Appendix 5.1 Habitats Regulations Assessment (HRA)
- Appendix 5.2 WFD Compliance Assessment
- Appendix 5.3 Natural Capital and Biodiversity Net Gain Assessment
- Appendix 5.4 Carbon Assessment
- Appendix 5.5 INNS Risk Assessment

Below summarises the details of the regulatory and non-regulatory technical environmental assessments carried out for the Cheddar 2 Source and Transfer scheme.

6.1 Habitats Regulations Assessment (HRA)

The Habitats Regulations Assessment (HRA) report aims to establish whether the Cheddar 2 Source and Transfer scheme is likely to have a significant effect on European sites, either alone or in-combination through *informal* Stage 1 Screening. This is judged in terms of the implications of the scheme on the site's conservation objectives, which relate to its 'qualifying features'. Where the Cheddar 2 Source and Transfer scheme has been screened in, an *informal* Stage 2 Appropriate Assessment has been completed.

A total of 15 European sites were screened in based on proximity (within 10 km) and hydrological connectivity to the proposed Cheddar 2 Source and Transfer scheme. Likely significant effects at *informal* Stage 1 Screening were identified on 12 European sites during construction works. Severn Estuary SAC, SPA and Ramsar site, Mendip Limestone Grasslands SAC, Mendip Woodlands SAC, North Somerset and Mendip Bats SAC, River Avon SAC, Chew Valley Lake SPA, Chilmark Quarries SAC, Mells Valley SAC and Somerset Levels SPA and Ramsar.

Likely significant effects were also identified at *informal* Stage 1 Screening for 10 European sites during operation of the proposed Cheddar 2 Source and Transfer SRO; Severn Estuary SAC, SPA and Ramsar site, Mendip Limestone Grasslands SAC, North Somerset and Mendip Bats SAC, Chew Valley Lake SPA, Chilmark Quarries SAC, Mells Valley SAC, Somerset Levels and Moors SPA and Ramsar.

Where uncertainty was identified, this uncertainty indicated that a confident conclusion of no risk of LSE is not yet possible, in most cases due to the very early stage of option development (meaning specific design and location information may not be available to allow a full appraisal of the risk of likely effects). Where uncertainty remained, an *informal* Stage 2 Appropriate Assessment was undertaken to either confirm a risk of adverse effects on European site integrity related to a scheme or to confirm that no adverse effects are expected. The scope of the *informal* Stage 2 Appropriate Assessments is summarised in Table 4.1.

The Stage 2 Appropriate Assessments considered the need for additional mitigation measures to avoid an adverse effect on site integrity, such as measures to limit the impact from air and dust emissions and anthropogenic disturbance. However due to uncertainties regarding construction programme, number of heavy goods vehicles, anthropogenic noise and functioning role of habitat directly within the scheme footprint, adverse effects cannot be ruled out at this stage on all sites considered at Stage 2 Appropriate Assessment as a result of direct habitat loss, deterioration (rhyne/ ditch network), air emissions and noise disturbance.

In addition, due to uncertainties regarding the impact of reduced flows in the River Axe and Yeo on adjacent rhyne/ ditch network (potential supporting, functionally linked habitat), pass forward flows into the Severn Estuary and dissolved oxygen sags, adverse effects cannot be ruled out at this stage for all European sites taken through to Stage 2 Appropriate Assessment.

Therefore, the appropriate assessments will need to be reviewed and updated once more detailed information becomes available.

Table 5 Scope of the informal Stage 2 Appropriate Assessments

Relevant European site(s)	Phase	Scope of the *informal* Appropriate Assessment
Bats: • Chilmark Quarries SAC • Mells Valley SAC • Mendip Limestone Grasslands SAC • North Somerset and Mendip Bats SAC	Construction	• Loss of functionally linked offsite habitat through construction of reservoir and pipeline (ditch network, hedgerow habitats). • Disturbance (noise, light) to functionally linked offsite foraging habitats.
	Operation	• Change in flows/volumes within ditch network resulting in deterioration to offsite functionally linked habitat, causing a change in foraging availability.
Birds: • Severn Estuary SPA and Ramsar • Somerset Levels and Moors SPA and Ramsar • Chew Valley SPA	Construction	• Loss of functionally linked offsite habitat through construction of reservoir and pipeline (ditch network, floodplain habitats). • Disturbance (noise, light, air quality issues) to functionally linked offsite foraging
	Operation	• Change in flows/volumes within ditch network resulting in deterioration to offsite functionally linked habitat, causing a change in foraging availability during overwintering period.
Fish: • Severn Estuary SAC and Ramsar	Construction	• Loss of functionally linked offsite habitat through removal of ditch network within footprint of Cheddar 2 reservoir. • Potential degradation from the introduction of invasive non-native species (INNS), sedimentation and vibration caused by construction upstream of the Severn Estuary. • Potential use of wider ditch network by migratory fish species being crossed by pipeline, causing impedance to movement.
	Operation	• Changes to flows within the River Yeo and River Axe causing degradation to spawning and juvenile habitats. • Changes to flows and velocities changing the passability of existing barriers and reducing connectivity across the system.
Habitat degradation: • Mendip Limestone Grasslands SAC • Mendip Woodlands SAC • North Somerset and Mendip Bats SAC • Severn Estuary SAC and Ramsar • Somerset Levels and Moors SPA and Ramsar • River Avon SAC	Construction	• Potential air quality impacts for the habitat qualifying features of Mendip Limestone Grasslands SAC, North Somerset and Mendip Bats SAC and Mendip Woodlands SAC, as a result of construction. • Potential degradation from the introduction of INNS, sedimentation and vibration caused by construction upstream of the Severn Estuary. • Potential degradation from the introduction of INNS, sedimentation, pollution incidents, air quality and vibration issues when crossing the River Wylye, a tributary of the River Avon SAC.
	Operation	• Changes in pass-forward volume of freshwater into the Severn Estuary.

6.2 Water Framework Directive (WFD)

The WFD Compliance report sets out the Water Framework Directive Regulations (WFD) Compliance Assessment for the Cheddar 2 Source and Transfer scheme at Gate 2. The study area for the WFD Regulations Compliance Assessment for the Cheddar 2 Source and Transfer scheme at Gate 2 relates to effects on surface waters, and is limited to specific reaches potentially impacted by construction and/ or operation of the scheme.

Based on the current understanding of the scheme, there could be a reduction in moderate/high surface water flows downstream of the Cheddar Ponds, associated with increased abstraction from the Cheddar Springs, and

downstream of the Brinscombe River Axe intake, associated with increased abstraction from the Brinscombe River Axe intake.

For the purpose of illustrating the hydrological impacts the study area has been divided into hydrological reaches, based on stretches with similar hydrological characteristics. These reaches are as follows:

- River Yeo - Lower Pond outflow to Cheddar WRC
- River Yeo - Cheddar WRC to River Axe confluence
- River Axe – Brinscombe intake to River Yeo confluence
- River Axe - River Yeo confluence to tidal limit at Brean Cross Sluice.

The Gate 1 WFD screening process also identified that there could be an impact on the quantitative water balance test associated with changes in quantity and patterns of leakage from surface water to groundwater. There could also be a reduction in groundwater infiltration through the surface where Cheddar 2 Reservoir will be constructed. As such, the surrounding groundwater bodies, Wells (GB40902G804700) and Mendips (GB40901G804600), have been considered in the Gate 2 assessment.

A Level 1 screening was completed for all in-river construction works and the combined operating effects of the Cheddar 2 Source and Transfer scheme for the WFD Gate 1 assessment using the ACWG spreadsheet and agreed methodology. The full list of water bodies passed forward for a detailed assessment, along with associated ACWG listed activities is provided in Table 6. Table 7 provides a summary of compliance at Gate 2 for these water bodies. The remaining surface water bodies have been screened as compliant, and therefore not subject to Level 2 screening.

Table 6 WFD Compliance assessment summary – Water bodies passed forward to Level 2

WFD Water Body	Water Body ID	ACWG Listed Activity
Cheddar Yeo - source to conf Stubbingham Rhyne	GB109052021540	New or increased surface water abstraction constrained by HOF Presence of new reservoir or modified existing reservoir
Axe - Cocklake to Brean Cross Sluice	GB109052021570	New or increased surface water abstraction constrained by HOF

Table 7 Summary of WFD compliance at Gate 2 for the Cheddar 2 Source and Transfer scheme against the three core WFD Assessment Objectives

WFD Assessment Objective	Cheddar Yeo - source to conf Stubbingham Rhyne (GB109052021540)		Axe - Cocklake to Brean Cross Sluice (GB109052021570)	
	Assessment outcome	Justification	Assessment outcome	Justification
1. To prevent deterioration of any WFD element of any water body	Non-compliant (medium confidence)	Potential for deterioration in the following status element: • Fish (low confidence) • Macrophytes and phytobenthos (medium confidence) • Macroinvertebrates (medium confidence)	Non-compliant (low confidence)	Potential for deterioration in phosphate status (low confidence)
2. To prevent the introduction of impediments to the attainment of 'Good' WFD status or potential for any water body	Non-compliant (high confidence)	Potential for impediment to Good status in the following status element: • Macrophytes and phytobenthos (medium confidence) • Phosphate (high confidence)	Compliant (medium confidence)	Potential for impediment to Good status in phosphate status (medium confidence)
3. To ensure that the planned programme of water body measures in RBMP2, to protect and enhance the status of waterbodies, are not compromised.	Compliant (high confidence)	There are no RBMP to water body measures for this water body and, therefore, no risk of compromise.	Compliant (high confidence)	There are no RBMP2 water body measures for this water body and, therefore, no risk of compromise.

Based on the WFD compliance assessment, it has been concluded that the Cheddar 2 Source and Transfer scheme at Gate 2 is potentially non-compliant against the WFD regulations.

The Gate 2 WFD compliance assessment provides suggestions for mitigation measures that could potentially reduce the relevant impact pathways and remove WFD compliance issues associated with the Cheddar 2 Source and Transfer scheme. It is worth noting that the efficacy of these mitigation measures would have to be justified to ensure that they would sufficiently address the pathway and reduce or remove the WFD compliance risk. Further details are provided in Appendix 5.2.

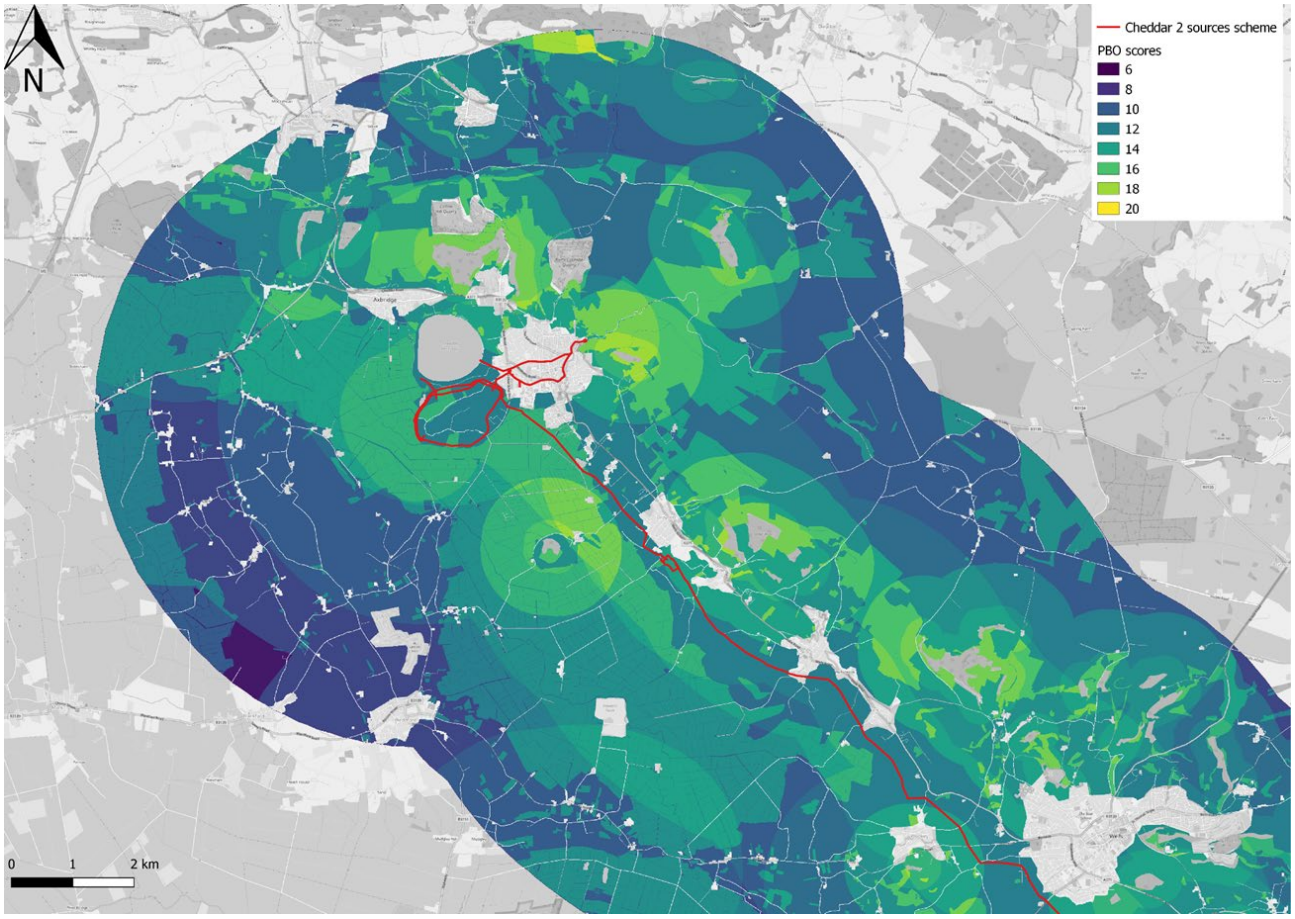
6.3 Biodiversity Net Gain/ Natural Capital (BNG/ NC)

The Biodiversity Net Gain (BNG) and Natural Capital (NC) assessment completed at Gate 2 has informed the site selection work and provides a preliminary assessment of BNG and NC losses and benefits of the Cheddar 2 Source and Transfer scheme. The Gate 2 work has included an assessment of habitat loss (both temporary and permanent loss) and a high-level assessment of the habitat reinstatement required on-site. Where necessary it has also considered additional off-site mitigation to offset any habitat loss. An assessment of 'uplift' necessary to achieve a minimum of 10% net gain has also been included. An associated NC assessment has been undertaken that accounts for temporary and permanent losses and additional benefits related to on-site and off-site mitigation required to obtain a minimum of 10% net gain.

The results of the Biodiversity Net Gain calculations are split for temporary impacts (e.g. pipeline construction corridor) and areas where there will be permanent change to habitats which includes construction of above ground infrastructure and the reservoir.

A total of 210.75 ha of temporary habitat loss and 10.23 km of temporary hedgerow loss was calculated for the whole Cheddar 2 Source Scheme due to the construction of pipelines and construction compounds. In the absence of off-site mitigation this would result in a net change of -21.32% BNG area units and -16.32% of hedgerow units.

A total of 6.995 ha of permanent habitat loss and 1.011 km of permanent hedgerow loss is calculated for the above ground infrastructure for the Cheddar 2 Source and Transfer scheme, in the absence of off-site mitigation, which would result in a net change of -100% BNG area and hedgerow units. The creation of the Cheddar 2 reservoir would result in the permanent loss of 99.72 ha of habitats and 14.85 km of hedgerows, creation of the reservoir would result in the addition of 99.72 ha of reservoir habitat, in the absence of off-site mitigation this would result in a net change of -17.18% BNG and -100% of hedgerow units. Areas of land which may be suitable for mitigation have been identified using scoring criteria with the highest scoring sites potentially offering more effective, functioning mitigation. Potential biodiversity opportunities within 5 km of the Cheddar 2 Source and Transfer scheme are shown in Figure 4.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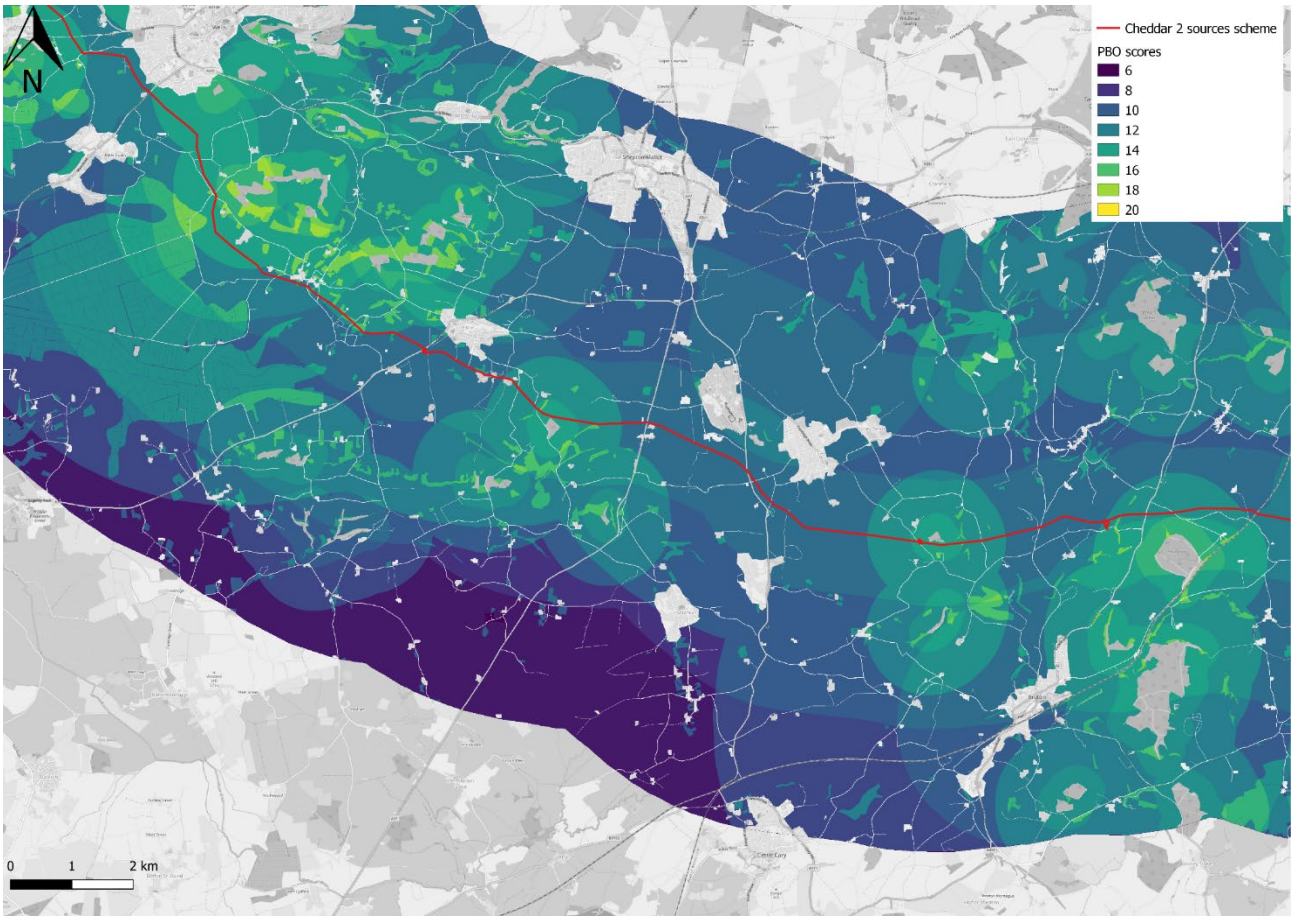
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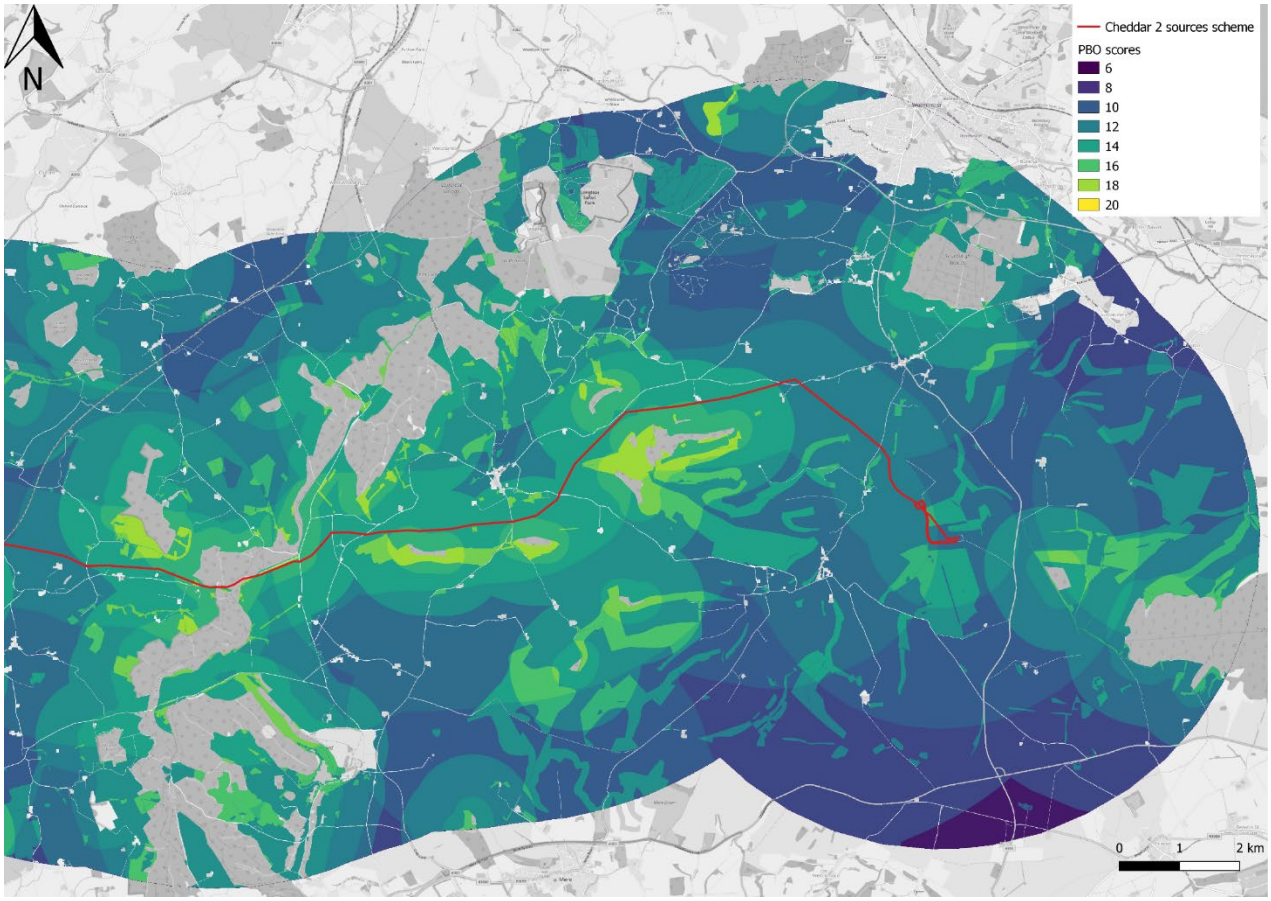


Figure 4 Potential biodiversity opportunities within 5 km of the Cheddar 2 Source and Transfer scheme. 1) West section; 2) Central section; 3) East section.

The overall environmental benefits in relation to climate regulation, natural hazard regulation and agriculture ecosystem services over the 80-year lifespan of the scheme equate to £1,329,023. The Natural Capital methodology does not take into account the monetary cost of land acquisition and management for the required mitigation. The current buffer for the assessed components extends to just the assumed construction zones. Whilst acceptable for a high-level approach, greater detail will be necessary following stakeholder engagement, refinement of design, and surveys to determine current habitat conditions as part of further scheme development. In addition the reservoir construction will include compensatory flood provision which will also act as a nature reserve and provide a further ecosystems benefit not currently accounted for; this will be revisited during gate three.

The assessments were undertaken based on open-source data, as no UK habitat classification, MoRPh, or BNG condition assessments have been undertaken for the habitats associated with the Cheddar 2 Source and Transfer scheme. River MoRPh and UKHab surveys would be required to ground truth the metrics to provide a complete baseline for Gate 3. This will inform the BNG metric calculations and reduce the assumptions required to determine the impacts and off-site mitigation requirements. The identification of PBOs was undertaken using opensource data and no ground truthing has been undertaken through surveys to confirm the habitats present or the suitability for the required enhancements as part of the Gate 2 assessments. There are known data but these are mostly at the local scale and should be obtained as part of Gate 3 and beyond. A large uncertainty is related to land ownership for the PBOs identified. To date, we have not had access to Cheddar 2 Source and Transfer scheme-related water company land assets or knowledge of individual water company's BNG ambitions on their land holdings. This has been identified as a gap in knowledge and will need to be addressed to support opportunities areas in the future.

6.4 Carbon Assessment

The carbon assessment presents the whole life carbon projection of the scheme, how carbon has been considered in best value planning decision making and identifies possible opportunities to further reduce emissions. The assessment includes the embodied and operational carbon impact of all scheme components and estimates the whole life carbon impact of the proposed scheme.

The whole life carbon calculated across the 60 year design life of the scheme is 186,659tCO_2e. 84% of the total GHG emissions are associated with the construction phase of the scheme with respect to the embodied carbon of

the materials used. The remaining emissions are associated with the operation of the scheme; electricity use and maintenance and replacement accounting for 10% and 6%, respectively. The majority of the construction carbon emissions are associated with the embodied materials used during the construction of the reservoir. This makes up 84% of the construction phase carbon emissions, and 70% of the whole life carbon emissions. The summary results are presented below.

Table 8 Carbon assessment summary

Project Phase	Reporting Boundary	Reservoir	Transmission	Treatment	Whole life Carbon (tCO_2e), assuming 60 years
Construction carbon	Embodied carbon of materials	130,948	23,208	2,663	156,820
Operational carbon	Maintenance replacement	10,626			10,626
	Electricity use	19,212			19,212
Total					**186,658**

6.5 Invasive Non-Native Species

The Invasive Non-Native Species (INNS) assessment conducted at Gate 2 provides an updated, detailed assessment of the INNS risk associated with construction and operation of the Cheddar 2 Source and Transfer scheme in light of the latest scheme understanding and methodologies.

A total of 41 INNS of interest were recorded during the baseline period within the NBN atlas across the whole River Axe catchment. The most frequently recorded species within this area is the aquatic plant species Nuttall's Waterweed (*Elodea nuttallii)*, with other frequently recorded species being the aquatic invertebrate species New Zealand Mudsnail (*Potamopyrgus antipodarum)* and aquatic plant species Himalayan Balsam (*Impatiens glandulifera) and Canadian Pondweed (Elodea canadensis).*

A heatmap representation of available data (see Figure 5) indicates a generally low density from INNS records across the catchment as a whole. The north-west area of the catchment around Weston-super-Mare has a higher concentration of records compared to other areas of the catchment. There are 37 areas with a recorded density >5 records within 500m, across the catchment, again with many of these located in the north-west surrounding Western-super-Mare. There are also three recorded densities of >5 records within 500m, within close proximity to the scheme, with those being directly south-east of Cheddar reservoir.

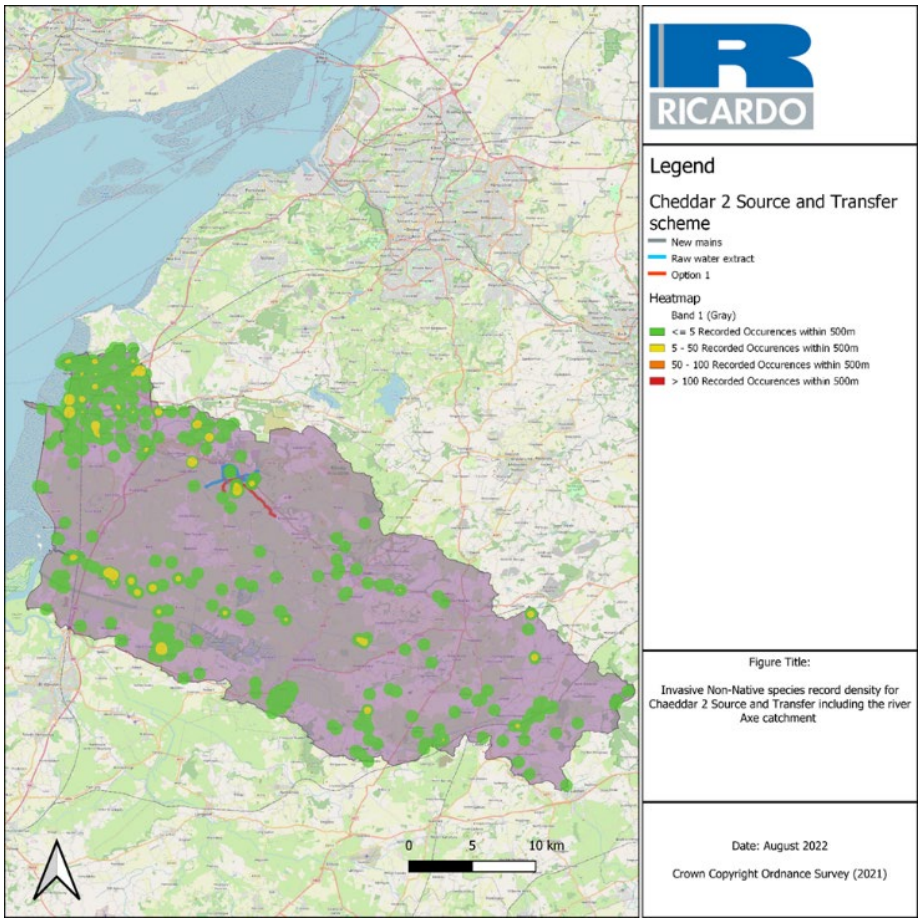


Figure 5 Heatmap representing the available INNS occurrences data within the River Axe operational catchment.

An assessment of the raw water transfer and assets was also undertaken using the Environment Agency's SAI-RAT tool. The tool assigns a risk value based on the characteristics of the asset or transfer option. The output scores produced by SAI-RAT are provided in Table 9 and Table 10 below.

Table 9 Risk scores produced for the Cheddar 2 Source and Transfer raw water transfer components using the SAI-RAT RWT risk assessment tool.

Scheme Component	SAI-RAT RWT Risk Score
(Cheddar Springs to Cheddar 2 transfer)	37.13
(Axbridge WTW to Cheddar 2 transfer)	27.48
(Cheddar 2 to Honeyhurst WTW transfer)	35.85

Table 10 Risk scores produced for the Cheddar 2 reservoir using the SAI-RAT Asset risk assessment tool.

Scheme Component	SAI-RAT Asset Risk Score
Cheddar 2 Reservoir	72.54

At present detailed construction methodologies are not available, however, it is expected that the transport of plant equipment, personnel, soils, and aggregates to and from the site will occur during construction and that these activities are likely to represent INNS distribution pathways. A number of species which may present a risk are

located in close proximity to the scheme infrastructure and within the wider catchment. Several terrestrial invasive plant species have been recorded in proximity to the pipeline route which may be distributed through seeds, vegetation fragments, bulbs and rhizomes.

Our understanding of the current INNS present in proximity to the Cheddar 2 Source and Transfer pipelines and infrastructure is limited by the availability of occurrence records. It should be borne in mind that the majority of data available within open-source datasets has not been captured as a result of INNS-specific surveys. Therefore, a survey of the construction areas should be completed in the growing season prior to the commencement of work. This survey will provide the necessary information required to provide targeted mitigation advice which can be applied to most effectively curtail the risk of INNS transfer during construction. The risk of transfer of the species recorded and offsite species which are not captured within the baseline dataset or targeted survey can be reduced through the application of mitigation measures during construction which align with best practice.

The assessment of the operation of the scheme was split into three distinct raw water transfer components to facilitate the assessment using the SAI-RAT RWT risk assessment. Additionally, Cheddar 2 Reservoir was assessed as an asset using the SAI-RAT Asset risk assessment:

- The abstraction of water from Cheddar Springs is perceived to be a low risk (37.13%) as the abstraction source has a limited potential to facilitate the entrainment of INNS due to the source being spring fed and the abstraction point being relatively close to the source of the spring.
- The discharge of raw water abstracted from the River Axe to Cheddar 2 has a low (27.48%) potential for INNS transfer as water will be treated at Axbridge WTW prior to discharge to Cheddar 2. It is assumed based on the current understanding of the treatment process at Axbridge WTW that the treatment is sufficient to remove INNS and therefore eliminate the risk of transfer to Cheddar 2.
- Onward transmission from Cheddar 2 to Honeyhurst WTW has a high potential to entrain and transport INNS from Cheddar 2. However, the transfer destination is likely to limit onward transmission during normal operation. The SAI-RAT RWT tool scores the abstraction and onward transmission of raw water from Cheddar 2 to Honeyhurst WTW at 35.85% based upon the variables inputted to the tool.
- Cheddar 2 Reservoir once in operation has a high potential to facilitate the transport of INNS, the reservoir is likely to represent a recreational facility which may include angling, water sports and boat users and will require site visitation and maintenance from operatives. The SAI-RAT Asset risk assessment tool scores the Cheddar 2 reservoir at 72.54% based upon the variables inputted to the tool.

Mitigation to reduce the INNS transfer risk during the operation of the scheme should focus on several key aspects:

- Prevention of transfer of INNS during RWT from Cheddar Springs to Cheddar 2.
- Prevention of transfer of INNS from the Axbridge WTW to Cheddar 2 Reservoir.
- Prevention of discharge of INNS during raw water transfer from Cheddar 2 Reservoir to Honeyhurst WTW.
- Prevention of transfer of INNS through operational activities such as site maintenance works, waste management and treatment sludge disposal.
- Prevention of transfer of INNS through secondary pathways such as angling, walking and water sports at Cheddar 2 Reservoir.

If INNS are transferred to Cheddar 2 Reservoir the waterbody will likely constitute a potential INNS propagule source which may facilitate the distribution of INNS into the surrounding habitats. To prevent the distribution of INNS to Cheddar 2 Reservoir the raw water sources would if necessary need to be treated sufficiently to remove INNS propagules prior to transfer and discharge into the reservoir itself in line with the EA's recent position statement. The abstraction from the River Axe is currently treated at Axbridge treatment works to a standard which is sufficient to remove INNS. Additionally, mitigation should aim to reduce the risk of secondary pathways particularly recreational activities such as water sports and angling from distributing INNS to and from the reservoir.

Operations at the various infrastructure sites as part of the scheme including pumping stations and abstraction intakes may present a risk, assuming for example that site operatives will be required to attend the site periodically and treatment waste materials will likely be transported to off-site disposal facilities. At this stage information on the specific site operations is not known but mitigation will be covered by company-wide biosecurity protocols and standard operating procedures to ensure that operations are tied into biosecurity practices.

6.6 Risk Assessment

A number of moderate risks have been identified in association with both construction and operation of the scheme. The availability of construction details is limited at this stage of scheme development, and as such there is insufficient detail to conclude no adverse effects on several European sites and SSSIs. Following further development of the scheme design and investigations/surveys (e.g. additional ecological surveys and air quality assessment), it is likely that sufficient mitigation measures could be identified to reduce impacts on these sites.

With identified mitigation measures for the potential impacts of habitat loss and anthropogenic disturbance on bat populations during construction and operation, no adverse effects on site integrity of the North Somerset and Mendip Bats SAC, Chilmark Quarries SAC, Mells Valley SAC and Mendip Limestone Grasslands SAC are anticipated. However, due to evidence gaps, it is uncertain what mitigation measures (if needed) could be put in place to ensure that there are no adverse effects on the qualifying features of these SACs due to potential changes in flows/volumes within the ditch network during operation. These changes could potentially result in deterioration of offsite functionally linked bat habitat and further detailed study is therefore required at Gate 3.

Further investigations will also be required to inform scheme design and confirm adequate mitigation measures are available to reduce potential contamination risk during construction in relation to the Druley Hill historic landfill site.

Potential effects during operation have been identified on the Cheddar Yeo and River Axe and associated aquatic ecology receptors (e.g. fish and macrophytes) and designated sites. Key effects relate to a potential loss of functional flows, however there is uncertainty around the ecological function of high flows in the impacted reaches as well as a requirement to further develop the operational regime to allow for a refined assessment. Water quality impacts are also possible and further data collection is required to better understand possible impacts in relation to possible dissolved oxygen sags and increased phosphate concentrations. Full details of the assessment of risks across each of the topics is provided in Annex 5 and its supporting appendices.

6.7 Next Steps and monitoring at Gate 3

The next steps for environmental assessment work at Gate 3 are summarised in Table 11 below. The table identifies the key data gaps and uncertainties remaining at Gate 2 and the work proposed at Gate 3 to address those.

Table 11 Environmental appraisal next steps for gate 3

Topic/Receptor	Data gaps/uncertainties	Proposed work at Gate 3
Biodiversity, flora and fauna		
North Somerset & Mendip Bats SAC / Mendip Woodlands SAC / Mendip Limestone Grasslands / Cheddar Wood SSSI / Rodney Stoke SSSI and NNR / Twinhills Woods and Meadows SSSI / Long Knoll SSSI / Brimsdown Hills SSSI / The Perch SSSI	How significant would air quality issues be during construction Lack of information on the number of heavy goods vehicles required, access routes and construction methodology.	Desk based air quality assessment is recommended for NOx and nitrogen deposition to determine if critical levels/ loads will further be exceeded during the construction of Cheddar 2 Source and Transfer as a result of construction traffic and non-road mobile machinery, generators and combustion plants. Review pipeline routing and construction methods near designated sites
Somerset Levels and Moors SPA and Ramsar / Chew Valley Lake SPA and SSSI/ Severn Estuary SPA and Ramsar	Uncertainty suitability/use of impacted habitat (Cheddar 2 reservoir footprint) for designated bird species No protected species records from Somerset Environmental Records Centre were available on request at time of writing. Limited understanding of the hydrological connectivity between the River Axe/ Yeo and the adjacent rhyne/ ditch network, plus the flood regime during autumn and winter.	Somerset Environmental Records Centre protected species records for within 2 km of the proposed scheme footprint to provide baseline data on species presence and absence. Wintering bird surveys within the footprint of the works directly impacting on coastal and floodplain grazing marsh priority habitat, with a 500 m buffer in order to determine presence and absence of qualifying birds to determine if the area is used as functionally linked, supporting non-breeding habitat, plus flight paths in and out of the survey area. Improve the accuracy of hydrological modelling through the utilisation of the upgraded water resources modelling and the consideration of a more accurate operational regime. This will aid understanding of the potential impacts of the scheme during autumn/ winter conditions and potential impacts should be considered on the adjacent rhyne/ ditch network.

Topic/Receptor	Data gaps/uncertainties	Proposed work at Gate 3
Severn Estuary SAC and SSSI	Lack of data on fish presence in the impacted rhynes/ ditches Uncertainty suitability of impacted habitat for designated fish species Insufficient data to be able to provide insight into the location, timing and magnitude of potential dissolved oxygen sag events. Uncertainty around operation of the Brean Cross sluice and likely extent of increased ponding under scheme operation The hydrological assessment to date is based on a fixed operational regime, which is likely to be unrepresentative of the actual operational regime of the Cheddar 2 Source and Transfer.	River Condition Assessments (River MoRPh) and river habitat surveys specifically for identifying suitable spawning and nursery fish habitat is recommended in order to inform the assessment of functionally linked habitat present in the River Axe and River Yeo for qualifying fish of the Severn Estuary SAC and Ramsar Continuous monitoring of dissolved oxygen saturation is recommended in the River Axe and River Yeo in order to understand baseline conditions and better inform a scenario based assessment of changes in dissolved oxygen and sags that could impact on the suitability of the habitat to support qualifying fish species, particularly brown/ sea trout, Atlantic salmon and European eel. Additional modelling to further understand flows into the Severn Estuary during baseline conditions and during the operation of the scheme. Further study to understand arrangements at Brean Cross sluice and likely impacts under scheme operation.
North Brewham Meadows SSSI	Is there potential for the pipeline to cause localised drying of wetland habitats/change in preferential flow pathways	Establish whether there is any hydrological connectivity with pipeline working area
North Somerset and Mendip Bats SAC, Chilmark Quarries SAC, Mells Valley SAC and Mendip Limestone Grasslands SAC	Due to evidence gaps, it is uncertain what mitigation measures (if needed) could be put in place to ensure that there are no adverse effects on the qualifying features of these SACs due to potential changes in flows/volumes within the ditch network during operation. These changes could potentially result in deterioration of offsite functionally linked bat habitat.	• Further study to determine the nature of any potential changes in flows/volumes within the ditch network during operation. Based on this, an assessment to be made of potential changes to the condition of offsite functionally linked foraging habitat and any resulting changes in prey availability for foraging bats. • Development of a mitigation strategy for habitat loss, anthropogenic disturbance and potential changes in flows/volumes within the ditch network during operation.
Ancient woodland	• Uncertainty regarding loss/disturbance of ancient woodland during construction phase	Tree and woodland surveys following further route optimisation. Desk based assessment with ground truthing of acceptable crossing points of the watercourses (where there is existing infrastructure, no wetland habitat) to identify common crossing points to be used by all pipelines where possible. Commence habitat mapping, UKHab surveys and identification of Tree Protection Orders/trees of value.
Priority habitats	• Uncertainty regarding loss of priority habitats; not currently quantified. • Multiple crossings of river and streams priority habitat; cumulative effect. • Data not publicly available for linear features e.g. hedgerows and arable field margins.	Obtain relevant biological record centre data to aid pipeline route optimisation. Desk based assessment with ground truthing of acceptable crossing points of the watercourses. Commence habitat mapping, UKHab surveys and identification of Tree Protection Orders/trees of value. Coastal floodplain grazing marsh – hydroecological assessment at pipeline crossings to ensure no localised drying of priority habitats.
Priority species	• Currently only considered in relation to designated sites. • Baseline datasets from NBN Atlas were not deemed sufficient in this	It is recommended that protected species records are sought from relevant Local Environmental Records Centres within the operational and construction footprint of the scheme

Topic/Receptor	Data gaps/uncertainties	Proposed work at Gate 3
	instance with limited protected species returns within 100 m of potentially affected watercourses.	Obtain relevant protected species information and commence targeted survey work.
Fisheries / Aquatic	• Baseline monitoring gaps	Macrophyte, macroinvertebrate and fish surveys in impacted reaches.
INNS	• Limited confidence in SAI-RAT assessment tool	Review SAI-RAT tool and update before Gate 3 assessments to account for wider comments from other users following implementation during Gate 2
Arboriculture	• No existing data/evidence	Mapping of veteran trees Mapping of TPOs (if readily available from LPAs websites) Tree surveys at key sites
Local designations	• Lack of understanding as to effect on local sites.	Obtain data for Sites of Importance for Nature Conservation.
Soil and Geology	• Proximity of construction Druley Hill historic landfill site and other nearby sites – uncertainty over whether this could result in land contamination	Establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate. Carry out site investigations and Envirocheck review where pipeline cannot be re-routed to avoid areas.
	• Unknowns around contaminated land/ground conditions	Review of local plan allocations Desk based assessment (conceptual site models), review of historical mapping, British Geological Survey data, UXO screening.
	• Soils condition and type have not been considered in terms of potential habitat loss and related natural capital and BNG benefits and potential losses	Assessment of soils condition and type for e peat core samples to be taken to understand extent (depth) and condition.
Landuse	• Potential to disrupt agricultural practices, existing drainage networks, and adversely affect Grade 2 and 3 land. • The extent of temporary severance during construction for each individual landholding is unknown at present.	Review pipeline routing within individual field boundaries (arable) to establish whether existing paths/boundaries could be followed to minimise severance and temporary exclusion/sterilisation of areas. Engage with land agents at earliest opportunity to establish landowner requirements (e.g. crop rotation/removal, drainage, and likely compensation package).
Water environment		
Water	The hydrological assessment to date is based on a fixed operational regime, which is likely to be unrepresentative of the actual operational regime of the Cheddar 2 Source and Transfer. Limited understanding of connectivity with ditch and rhyne system There is little current understanding if the magnitude and timing of high flows provide an ecological function. Uncertainty around operation of the Brean Cross sluice and likely extent of increased ponding under scheme operation Insufficient data to be able to provide insight into the location, timing and magnitude of potential dissolved oxygen sag events. There is the potential for increased phosphate loads entering the Cheddar WRC as a result of. There is insufficient data to understand how increase usage of the Axebridge Treatment	Assessment should be updated based on a more realistic representation of the demand profile as this may significantly alter the regularity of hydrological impacts. A better understanding of the interactions between the River Yeo, River Axe and the surrounding drainage systems is required to build a more realistic understanding of flows and flow management in the system. Improve understanding of high flow events via habitat surveys and velocity/depth surveys using ADCP under both moderate and high flow conditions to establish the impact as a result of more high flows being reduced to the HOF constrained values. Though not likely to be a significant impact to the aquatic ecology, there is the potential for. A better understanding of the operation of the Brean Cross Sluice is required to fully understand this potential for increased ponding behind the sluice.

Topic/Receptor	Data gaps/uncertainties	Proposed work at Gate 3
	Works associated with the WCN Scheme may impact phosphate concentrations discharged into the River Yeo from Cheddar WRC.	Continuous data collection is advised at representative locations in order to fully understand any potential dissolved oxygen sag events as a result of the SRO and the potential pathway to impacts of the aquatic ecology. It may also be useful to investigate the composition of the algae within the study area, perhaps, using remote sensing technology. Wessex Water has recently revised the permit conditions at Cheddar WRC for phosphate to Best Available Technology so more baseline data should be collected to understand how this impacts phosphate concentrations in the study area. This should include the reinstatement of the routine monitoring at the Cheddar Yeo Blw Hyth (SW-E7070500) sampling point.
Flood Risk	• Requirement for permanent infrastructure within Flood Zone 2 and 3 uncertain (e.g. pumping stations).	Obtain Environment Agency Product 4 data (detailed flow rates, flood levels and flood extents) for Flood Risk Assessment. Site visits and liaison with Lead Local Flood Advisor(s)
Air quality	• Uncertainty over routes for construction-related traffic in relation to residential receptors and designate biodiversity sites • No quantification of impacts to residential receptors.	Desk based air quality assessment with identification of key receptors and likely impacts. Indicative modelling at other locations. Targeted AQ surveys at key construction sites/receptors – human and ecological.
Climate change	• Uncertainty around GHG emissions	Identify GHG emission sources and establish baseline
Landscape and visual amenity	• Impacts to visual amenity uncertain as final designs of key infrastructure sites unconfirmed	Desk based assessment (policy review, local designations, key issues) Early consultation with LPA/AONB about mitigation requirements Initial desk based Landscape and Visual Impact Assessment Site visits Photographs late summer/winter for photomontages Professional assessment of whether proposed development will impact AONB Review siting and overall design specifications of pumping stations to avoid visual impacts
Historic environment	• Proximity of pipeline route to scheduled monument – uncertainty over how the site and setting may be impacted • Potential for unknown archaeology along pipeline routes • Uncertainty of whether the setting of other heritage features e.g. listed buildings could be impacted during construction phase	Early desk based study / initial walkovers will determine sensitivity of the site and help identify if there is a need for any geophysical surveys or intrusive investigations or if pipeline routes need to be altered Desk based assessment of local designations (GLAAS data, HE data, Local Authority data) Site visits to key sites Identification of areas for targeted geo-physical surveys – through consultation with local authorities / archaeological trusts Local archaeological designations to be considered.
Population and human health		
Health	1 Uncertainty over range of impacts to human health	HUDU (Rapid Risk Assessment) / Health Impact Assessment? Desk based air quality assessment Desk based noise assessment

Topic/Receptor	Data gaps/uncertainties	Proposed work at Gate 3
Recreation and Tourism	2 Uncertainty over range of impacts to recreational resources during construction.	Desk based assessment of recreational impacts Surveys at key locations (visitor counts e.g. car parks/recreational facilities that will be closed, PRoW)
Socio-economics	3 Uncertainty over number of construction-related jobs	Data review of Index of multiple deprivation and ONS statistics Desk based study

7 Programme and planning

7.1 Project Plan

Figure 6 below provide a summary schedule for the key activities and timescales based on the detailed programme for the potable and raw water components of the scheme. Full programme details can be found in Annex 9.

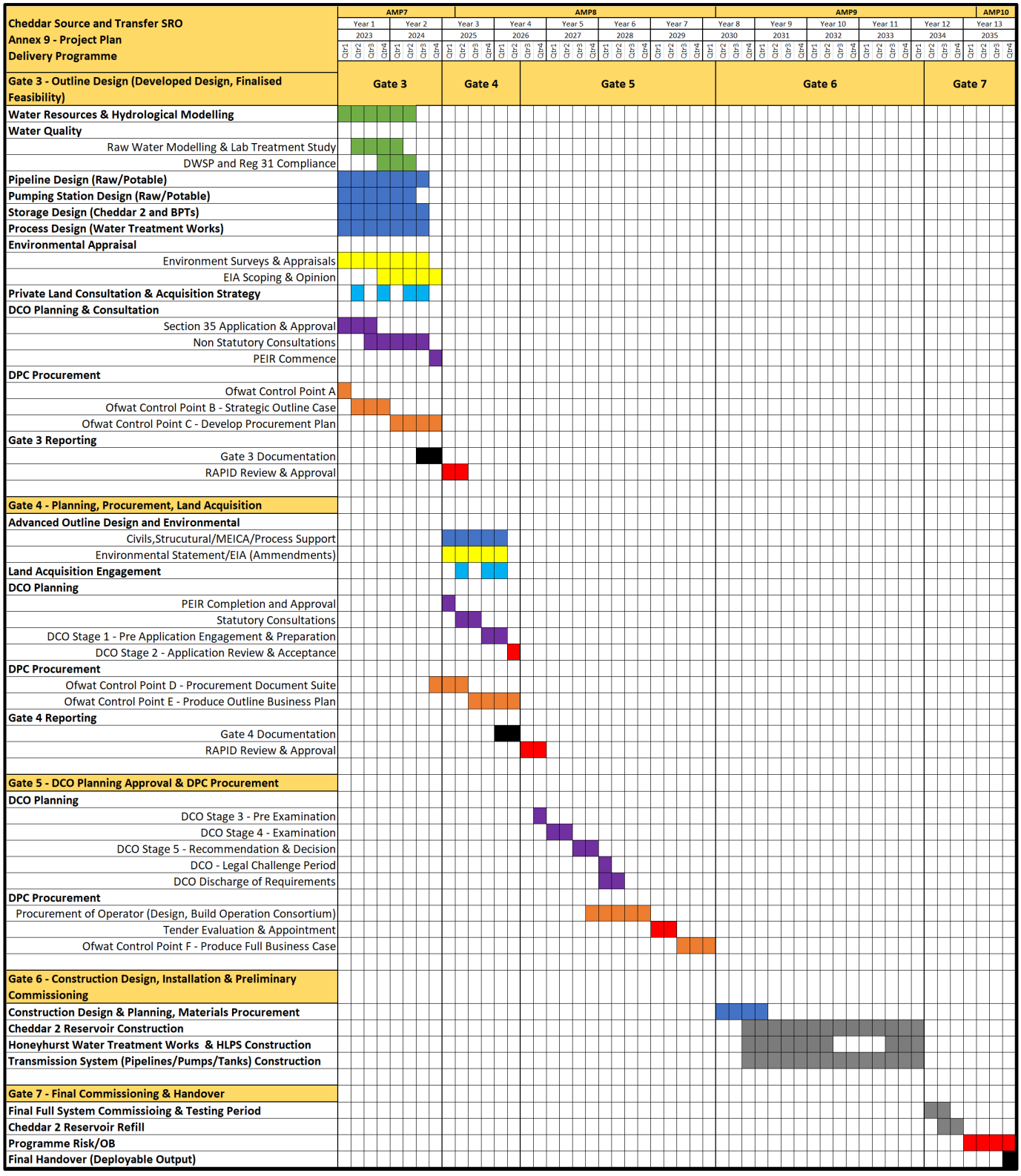


Figure 6 High level programme

The plan assumes work on the SRO will continue and gate 3 activities will start in January 2023 with submission in March 2025.

Following the scheme development and additional knowledge acquired at Gate 2 and reassessment of risks, the plan includes one year for risks. Thus, the central estimate for the overall future project duration is 12 years with beneficial use from 2035.

All the prompts detailed within the Gate 2 guidance document have been considered, as summarised below:

- The programme is the current estimate of best achievable timescale for delivering the scheme rather than to meet a specific need.
- A total of 64 assumptions have been used to inform the programme including:
    - The scheme will proceed based on the gate 2 concept design
    - DPC has been chosen as the preferred procurement method for the reservoir onwards, due to scale and minimal interconnectivity with the existing BRL and WSX networks.
    - Planning approval will be achieved via a Section 35 DCO.
- To ensure sufficient level of detail is available for the submission and remove the risk of potential changes post approval, design will be progressed to outline design level, designing to limits of deviation to allow for minor changes following consent. Any minor changes will be incorporated as part of the DPC procurement, where the tenderers will be required to undertake detailed design as part of their submission.
- Enabling works and mobilisation will start in summer 2030, with main construction later that year.
- With the project reverting to an in-region option and not required to meet the Southern Water's Section 20 date, the programme is on track.
- Gate 4 planning submission activities will overlap with some updates/amendments likely, following further statutory consultations. DCO Pre application, Application and Regulatory acceptance as well as DPC Control Points D and E are planned for the end of Gate 4 in Summer 2026.
- Gate 5 will consist of the DPC procurement control point F – full business case and procurement of the DPC Consortium as well as awaiting DCO approval with completion end of 2029.
- Due to the scale of the works involved we believe the funding currently allowed will not be sufficient to complete all the activities required for planning, environmental assessment, including detail design and procurement.
- Missing information – Section 7.5 below, provides a detailed description of the Gate 3 activities which identifies investigation and survey activities across all disciplines to address unknowns and confirm assumptions.

7.2 Planning and consenting route

BRL have previously gained planning approval for the construction of the new reservoir under the Town and Country Planning Act (TCPA) 1990 however that has lapsed. A review of land ownership and planning applications covering the reservoir site and has concluded that the original location is still available and consentable. As the SRO includes a new water treatment works and a long distance pipeline, a review of consenting options has been undertaken and a preferred approach recommended.

In broad terms there are two options for obtaining consent for the proposed scheme, namely:

- Town and Country Planning Act (TCPA) 1990;
- Reliance upon Permitted Development Rights (PDR) for relevant components in combination with planning applications under TCPA 1990 for all other infrastructure not benefitting from PDR.
- Outline planning permission followed by discharge of reserved matters
- Detailed planning permission
- Hybrid planning permission (combination of 2b and 2c relating to different elements of a scheme)
- Planning Act 2008 (PA 2008) by means of a Development Consent Order (if qualifying or through a Section 35 Direction by the Secretary of State (SoS))

The Gate 1 Planning section did not recommend a consenting option, and instead provided the risks and merits of each option and determined that there was insufficient information to recommend a single consenting option. As the Scheme has advanced to the point of a chosen route with preliminary technical aspects known, a recommended consenting strategy can be given. However, as the Scheme is still being developed, any changes would require the recommended strategy to be reviewed and amended accordingly.

The recommended consenting strategy has been formulated through the analysis of the risks and merits of seeking consent through the PA2008 and TCPA when taking into consideration the need for the Scheme and the scale, scope, and complexity of the Scheme.

7.2.1 Recommended Consenting Strategy

It is recommended that the Scheme should seek consent as a DCO through the PA 2008.

Scale and Complexity of the Scheme

The Scale of the Scheme means it extends through the administrative areas of Sedgemoor District Council (SDC), Mendip District Council (MDC), and Wiltshire Unitary Authority (WUA) and necessitates the submission of identical planning applications to each planning authority. This route has inherent risk as each of the authority areas would have to approve the scheme, or their part of it. Due to the complexity of the scheme, the burden on resources with each authority could result in severe delays, and / or the application could be 'called in' by the SoS which would add significant delay.

Numerous supporting consents for non-planning matters (such as CPO) would be needed to be submitted to each authority. Again, if one of the authorities refuses a non-planning consent, this could also result in a lengthy appeal process.

Using the DCO route would result in one application which includes all planning and non-planning consents being submitted and determined by the SoS. The DCO timescales are statutory and once the application is submitted (and accepted), any delays or suspensions would have to be agreed with the Applicant.

Need for the Scheme

The Scheme is required to address the national issue of water resilience and to future proof water supply and availability. These needs are of national importance and provide limited benefits to the local communities and populations.

Furthermore, the need for the Scheme is not particularly well supported by Local Plans, but has greater support from national policy such as the draft National Policy Statement (dNPS), and governmental targets and strategies produced by Ofwat and the National Infrastructure Commission (NIC).

The need for the Scheme has potential to be a key planning issue, especially in SDC, where the construction of Cheddar 2 will likely have numerous adverse environmental and social impacts to the town of Cheddar which is a key tourist destination in the region. On the other hand during the previous planning application the benefits were generally perceived by the community to outweigh the construction impact (especially in an area where quarry traffic is a normal part of life so people are used to the idea of heavy vehicles on the roads). Therefore, the national need for the Scheme would need to be assessed by SDC against the local adverse and beneficial impacts, which gives rise to the risk of a negative determination by SDC.

Although local planning policies are taken into consideration in the determination of a DCO, national policy and the relevant NPS are more heavily weighted in the determination process. This does not negate the planning issues around local benefits, but instead places them in perspective of the entire Scheme and the national significance of the Scheme. The risks of the NPS for Water Resources not being published is discussed below and how this may impact the DCO application (specifically the Section 35 request) is discussed below.

Section 35

The main risk for the Scheme to seek consent as a DCO is the Section 35 process. A Section 35 request would be required as the Scheme does not meet the threshold to be considered an NSIP.

To optimise a positive determination of the Section 35 request, the application should ensure the need for the Scheme is clearly justified and supported by the relevant paragraphs in Section 2 of the dNPS, and the government and Ofwat's policies, objectives, and strategies to improve national water resilience. The national significance of the Scheme should be emphasised by explaining that the national, social, environmental and economic benefits of the Scheme outweigh the localised impacts.

The request should also state all the required planning and non-planning consents and the quantum of different applications that would need to be submitted to the three different planning authorities to place a focus on the potential burden the consents and planning applications may have on the local planning authorities, and the need for consistency in decision making and timing of determinations.

7.3 Planning Risks and Risk Management Strategy

It is not possible to predict with certainty whether, or how, each of the identified issues would be considered in the determination of a DCO or planning application. This would be subject to the characteristics of the development proposed, the outcomes of the environmental assessment work, together with a range of other issues such as comments from stakeholders and other evidence submitted before and during the consenting / application process.

Table 12 below, provides an overview of the potential planning risks for the Scheme in its current form, having regard to relevant planning policy and the site-specific environmental constraints, or impacts. The identified risks are based on the information within this Strategy, professional opinion and those issues that have arisen in similar proposals elsewhere. The Table also outlines the steps that could be taken to manage such risks.

As the Scheme evolves and more assessment work is undertaken, the planning risk assessment and associated management strategies will become more detailed and specific (and so should be kept under review).

Table 12: Planning Risks and Management Recommendations

Planning Risk	Management Recommendations
S35 request refused meaning the inability to use the PA 2008 consenting route and associated benefits. Separate TCPA applications would be required.	Consultation with the Planning Inspectorate to seek guidance on the S35 request. It is essential to prepare a detailed and convincing argument for the project being of national significance, the S35 request should set out: • The national significance of the Scheme as supported by the draft NPS, government and Ofwat objectives/ strategies. • The geographic scale of the Scheme spanning over 50km, across three local planning authorities • The scale of environmental considerations, surveys and reports that would need to be produced • The complexity of the Scheme and requirement for multiple planning consents, and the subsequent resource and skill burden this may have on the local planning authorities. • Complicated and protracted land acquisition.
Habitats Regulation Assessment (HRA): derogation tests not met meaning scheme refusal and/or risk of legal challenge.	Continued engagement with Natural England and other relevant consultees to identify the potential impacts on the: • Chew Valley Lake Special Protection Area (SPA); • Chilmark Quarries Special Area of Conservation (SAC); • Mells Valley SAC • Mendip Limestone Grasslands SAC • Mendip Woodlands SAC • North Somerset and Mendip Bats SAC • River Avon SAC • Severn Estuary SAC, SPA, Ramsar • Somerset Levels SPA, Ramsar, Continue to undertake surveys and refine the Scheme to reduce the evidence gap and be able to complete more detailed informal HRA Screening and Appropriate Assessments and to considered whether the “derogation” tests under the Habitats Regulations can be passed (and therefore whether the Scheme can be consented). The tests are whether there are no alternative solutions to the proposals and if this is the case, then Imperative Reasons of Overriding Public Interest (IROPI) should be demonstrated, and suitable compensatory measures would need to be identified and secured.
Potential Impacts during construction of the Cheddar 2 reservoir and the water pipeline (e.g. on air quality, noise, and transport) resulting in numerous significant effects, refusal and/or risk of legal challenge to the	Further assessment work should be undertaken to identify and/or refine the characteristics of the potential impacts (e.g. type, extent, severity) resulting from the construction of Cheddar 2 and the water pipeline, which could cause significant disruption to local residents, business, and road users. The assessments are subject to the outcomes of any formal EIA scoping process (if required) and should be undertaken in consultation with relevant consultees. The outcome of such assessments should be used to inform the design of the Scheme and route of the water pipeline (including the measures required to avoid or minimise potential adverse effects) and how the construction process should be managed (e.g. timing and duration of working house, the phasing of construction or the technology used).

Planning Risk	Management Recommendations
assessments undertaken.	
Other potential environmental impacts from the construction of Cheddar 2 and the pipeline resulting in numerous significant effects, refusal and/or legal challenge to the assessments undertaken.	Undertake further environmental assessment work (including engagement with relevant consultees) in respect of the following potential environmental impacts, which will likely be important considerations in the determination of a planning application: • Direct and indirect ecological impacts to nearby international ad European designated sites (as listed above), Cheddar Reservoir SSSI, and ecological corridors. • Landscape and visual impacts on the Mendip Hills AONB and the Cranbourne Chase and West Wiltshire Downs AONB. • Permanent or temporary impacts to heritage and archaeological assets, including the assets associated with the Cheddar and the Roman settlement site Scheduled Ancient Monument and listed buildings within 500 metres of the pipeline, cheddar 2, and Honeyhurst Water Treatment Works. • Direct and indirect socio-economic impacts to the town of Cheddar and its tourist industry from the construction and operation of Cheddar 2. • Hydrological impacts associated with increased abstraction from the River Axe and Cheddar Springs, and any associated Water Framework Directive Assessment required. • Traffic and transport impacts associated with the construction of Cheddar 2 and associated emission of pollutants and noise from vehicle movements. The assessments are subject to the outcomes of any formal EIA scoping processes (if required) and should be undertaken in consultation with relevant consultees, such as Natural England, Historic England, Environment Agency, the Lead Local Flood Authority and other relevant local authorities and stakeholders. The outcomes of the assessments should inform the route and design of the Scheme (including the measures required to avoid or minimise potential adverse effects). Some of the impacts may be politically sensitive (e.g. in respect of discharge into the River Stour) and this may need to be reflected in the consultation strategy required.
Local objections resulting in scheme refusal and/or risk of legal challenge.	Early consultation with the Sedgemoor District Council, key stakeholders, and the public to: • Outline the need for the Scheme. • Set out the Scheme's positive and negative impacts. • Emphasise the temporary nature of the construction impacts. • Minimise residential impacts to nearby dwellings and set out / discuss potential mitigation measures. • Outline traffic and transport management measures.
Network Rail operational land restrictions prompt scheme refusal and/or risk of legal challenge.	Early engagement with Network Rail to discuss railway crossing options, potential impacts, and the required protective provisions.

7.4 Key risks and mitigation measures

Risks to the cost, delivery duration and potential benefits of the scheme have been tracked through the gate 2 scheme development. As the studies and assessments have removed uncertainties, risks have been removed or reduced. The yield of the second reservoir is highly dependent on its intended utilisation and water availability from the existing abstraction licences at Cheddar springs and Brinscombe on the river Axe. The water resources modelling, completed during gate 2, has shown that some of the high, winter flows downstream of the springs are lost. Discussions with the Environment Agency have not concluded whether this needs to be mitigated, as the link between the high flows and the ecology is unknown. Consequently, a further constraint may need to be applied to the licence, resulting in Cheddar 2 reservoir achieving lower levels of refill during some years and hence reducing its yield from the current estimate.

An updated quantitative risk assessment has been completed to inform the overall cost estimate for gate 2 and the key risks to cost and programme are presented in the tables below.

Table 13 Key cost risks

Category	Description	Consequence	Probability score	Cost score	Total Score
Design uncertainty / complexity	Archaeology	Archaeological finds at sites and along pipe routes. Potential realignment. Cost of investigations could be substantial	4	2	**8**
Environmental constraints	Failure of stakeholder approval leading to failure to obtain or delays in securing favourable abstraction and/or discharge licences. (WFD Issues)	Potential requirement for reduced abstraction and/or discharge below proposed levels (in volume or operating periods) would reduce effectiveness in meeting SRO objectives. Depending on the severity of any operating restrictions (for environmental reasons) this could also reduce financial viability. Delays due to potential need to re-design and re-assess, increase in infrastructure complexity (and cost) and delay to operation start date.	3	3	**9**
Stakeholder	Land Compensation	Additional costs due to higher than expected due to design constraints for location of sites, value of land or constraints with alignment make alternate route costly	3	3	**9**
Design uncertainty / complexity	Additional Major works required at the intake	Desktop assessment of requirements insufficient following additional surveys and inspections of intake structure	2	2	**8**

Table 14 Key programme risks

Category	Description	Consequence	Probability score	Schedule score	Total Score
Environmental constraints	Weather Delays to pipeline and reservoir construction	Delay to construction due to poor weather conditions. Working within the flood plains	3	4	**12**
Planning and approvals	Section 35 Direction not approved for proposed DCO consenting route	Extended timescale and cost for gaining TCPA approvals	3	4	**12**
Design uncertainty / complexity	Construction at Multiple Sites	Unable to construct at multiple sites in parallel. Some sites need to be done in sequence due to third party or construction constraints	3	4	**12**
Procurement	DPC not appropriate to the SRO due to interface with existing systems to maintain operability. DPC liability v Water Company Liability issues with provision of water	Delays to procurement process, causing programme and funding delays. Risk to Water Company if DPC progresses, understanding liabilities	3	3	**9**
Design uncertainty / complexity	Current assumption is that all major crossings can be undertaken using no dig solutions.	Risk that this assumption turns out to be incorrect, leading to realignment of the route in order to find a preferred alignment.	3	3	**9**

Category	Description	Consequence	Probability score	Schedule score	Total Score
Environmental Constraints	Current assumption is that the pipeline is routed to avoid all known significant constraints	An incorrect assumption could lead to project delay and/or re-alignment	3	3	**9**
Design uncertainty / complexity	Archaeology	Archaeological finds at sites and along pipe routes. Potential realignment.	4	2	**8**
Stakeholder	Risk of legal challenge to planning consent	Risk of delay	2	4	**8**
Financing	Exceeds budget	project delay/pause	2	4	**8**
Design uncertainty / complexity	Additional Major works required at the intake	Desktop assessment of requirements insufficient following additional surveys and inspections of intake structure	2	4	**8**

Table 15 ACWG Risk Scoring Guide

Description	Probability	Cost impact	Schedule Impact
1 - Very Low	Improbable (1-10%)	Minimal (<1%) effect on project cost	No delay to project delivery
2 - Low	Remote (11-30%)	Small (1-2%) effect on project cost	Minimal (1-2%) effect on project delivery
3 - Medium	Possible - Likely (31-50%)	Moderate (2.1-5%) increase in project cost	Small (2.1 - 5%) delay to project delivery
4 - High	Probable (51-70%)	Significant (5.1-15%) increase on project cost	Significant (5.1-15%) delay to project delivery
5 - Very High	Almost certain (71-99%)	Major (>15%) increase in project cost	Major (>15%) delays to project delivery

7.5 Proposed gate 3 activities and outcomes

Details of the gate 3 programme and activities are provided in Annex 9. The next steps for this scheme will be to address the key risks and uncertainties and progress the required consents, covering:

- resource availability
  - environmental investigations to confirm whether the proposed abstractions are acceptable
- water quality risks
  - sampling and analysis to determine risks of the range of blend of sources in the reservoir
  - development of treatment requirements
- customer and stakeholder engagement to identify any concerns regarding the development and operation of the scheme and how it may need to adapt
- review and updating of the reservoir design and site investigation plan
- development of infrastructure and treatment works outline designs
- environmental surveys and planning to EIA scoping report
- preparation of the Section 35 request for DCO consideration
- progression of the DPC process through to control point C, procurement plan.

7.6 Procurement, ownership and operation

7.6.1 Assessment for DPC

At Gate 1, this scheme was proposed as a solution to meet Southern Water's demand deficit by transferring potable water to Testwood treatment works. Since then, the scheme has evolved to manage supply demand needs in the Wessex area. We note that further changes to the SRO are likely to be made as regional and individual

plans are developed and water resource requirements evolve. This will be reflected in future gates, impacting on the DPC assessments and potential financial and contractual arrangements.

In Gate 2, we have welcomed the opportunity to update the DPC analysis for the new scheme elements based on Ofwat's guidance[5] – including a revised 'size' and 'discreteness' tests and new 'value for money' test with the cost data now available. These tests have been run for the scheme as a whole and for an alternative option where the new pumping station from Cheddar Springs and raw water pipelines from the existing preliminary treatment plant sections of the scheme have been excluded from DPC.

The table below summarises the results of the assessment for DPC:

Table 16 Summary of Results of Assessment for DPC

Option	Size (£100m totex)	Discreteness	VfM	Overall recommendation
1. All DPC				Not suitable for DPC
2. As Option 1 but excluding pumping station & raw water pipelines				Suitable for DPC

The scheme as a whole passes both the size and value for money tests, but it is considered unsuitable for DPC based on the discreteness test. This finding is driven by the nature of the works required near, and directly impacting, Bristol Water's assets, i.e. a new pumping station from Cheddar Springs that may supply either the existing Cheddar reservoir or Cheddar 2, and the pipeline from the existing preliminary treatment plant.

Once these assets are excluded from DPC scope, the overall scheme can be considered suitable. An important consideration at future Gates will be potential development of the Honeyhurst site. Changes to the nature of the site would likely require a re-assessment of 'discreteness' and impact the conclusions below.

7.6.2 Delivery parties

Based on the results of the DPC assessment, we propose the following parties deliver each element of the scheme:

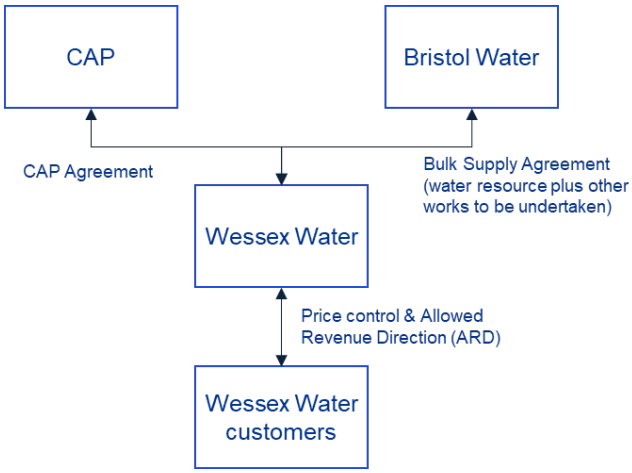
- **Bristol Water:** given the interface of the pumping station and raw water transfer pipelines with existing Bristol Water's assets, Bristol Water is considered to be the party best placed to deliver these elements of the works. It would seek to recover its costs incurred in delivering works from Wessex Water.
- **Competitively Appointed Provider (CAP):** is the appropriate party to deliver the remaining elements of the scheme, including Cheddar 2 reservoir, raw transfer pipeline to Honeyhurst, Honeyhurst water treatment works, and potable pipeline to a strategic service reservoir in the Warminster area. Wessex Water, as the Beneficiary, is considered to be the most appropriate contract counterparty. The CAP would seek to recover its costs from Wessex Water, however it will be reliant on Bristol Water, as the Provider, to complete the enabling works set out above.

[5] Ofwat, Delivering Water 2020: Our methodology for the 2019 price review, Appendix 9: Direct procurement for customers (December 2017)

7.6.3 Contractual and operational arrangements

Set out below is an indicative contractual arrangement based on the delivery parties identified above. The principal purpose of each contract would be:

- CAP Agreement: sets out the services the CAP will deliver and the basis on which they will be paid. The payment amount will be based on the bid during the competitive procurement process.
- Bulk Supply Agreements: any BSAs between Wessex Water and Bristol Water could be modified to include the provision of works required to be undertaken by Bristol Water and the payment for the water resource.
- Price Control and Allowed Revenue Direction: Wessex Water would be expected to recover the schemes costs from its customers, as appropriate.



7Illustrative contractual structure

Operation of the scheme as a whole may be through a number of alternative arrangements – for example bilateral communication between each party as required, or a System Operator relaying instructions to all parties.

While a system of bilateral communications may work in most eventualities, there is a concern as to how it would respond to disruptions in any part of the chain – for example Cheddar Spring pumping station would be unable to match Wessex Water's demand. Where instructions cannot be followed or need to be modified a central clearing house, or System Operator, may be required.

If, at futures gates, regional and individual plans identify additional beneficiaries of the SRO, the contractual arrangements and cost recovery mechanisms will have to be revisited.

7.6.4 DPC tender model

For the alternative option (all procured via DPC excluding the new pumping station and raw water pipelines from the existing preliminary treatment plant and pumping station), we have considered the appropriate tender model in appointing the CAP. Potential alternatives include:

- **Early model** – schemes will be tendered out once the preferred solutions have been identified by incumbent companies. The tender and handover of assets will be at the 'initial solution design' stage.
- **Late model** – schemes will be tendered out once after incumbent companies will obtain consent and initial design has been completed. The tender and handover of assets will be at the 'detailed design of assets' stage.
- **Split model** – scheme is tendered out in two separate tenders. one for the design and second for the construction and operation of the asset. Under this model, there will be two handover points, one at the 'initial solution design' stage and second at the 'detailed design of assets' stage.
- **Separation of construction and financing** – following the example of TTT, the separate procurement of the construction contractor and the project company that will finance and own the asset. This could be considered a bespoke version of the late model.

Based on a consideration of the examples where the alternative tender models have been applied or are in development (including Offshore Transmission Owners/ Competitively Appointed Transmission Owners/Private Finance Imitative/ Public Private Partnership/Thames Tideway Tunnel (TTT)) we consider the late model to be the most appropriate tender model.

An early model may mean significant cost uncertainty at the time of appointment and the split model could add significant lead times with two procurements. Separating the finance and construction may mean that bidders are unable to optimise the risk allocation between contractors and the CAP. The late model can be aligned to the DCO and TCPA planning application timelines as well as providing additional benefits to customers in the form of fixed prices for the contract duration.

Additional consideration on whether there is a case for applying the Specified Infrastructure Projects Regulations (SIPR) will be undertaken at gate three. At that point we will if there is a case for moving the third party into a separate licenced entity (as in the case of TTT) in order to manage the size and complexity of the scheme.

8 Solution costs

The capital and operating costs of the SRO have been updated from gate 1 to reflect the updated scope for the in-region use of the source, with a 36Ml/d capacity system and the reduced potable transfer pipeline.

The capital cost estimate, including key risks and optimism bias have been calculated in accordance with the All Company Working Group Cost Consistency Methodology (August 2020) and Update to Guidance on Optimism Bias (1 February 2021).

Average Incremental Cost (AIC) estimation has followed the process from the All Company Working Group to ensure consistency in the calculation of Net Present Value (NPV) and AIC across all SROs. The estimation method is consistent with that used in WRMP24.

Full details of the cost estimation can be found in Annex 7.

8.1 Capital costs

The capex estimates have been produced using ChandlerKBS' Cost Intelligence Database (CID). The CID is a system of integrated cost databases and costing tools that allows users to review and compare multiple cost models, project data and indices to normalise and derive industry average costs for a range of asset drivers.

The CID comprises data from thousands of capital projects delivered by UK water companies over the past 20 years, including Wessex Water, South West Water, Bristol Water, Thames Water, Welsh Water, Scottish Water and Northern Ireland Water.

The estimate for the new reservoir works was derived using the gate 1 scope, aligning ranges of contemporary unit cost rates for similar civil works and assessing the costs of items and supporting assets not identified in the gate 1 scope. The quantity of comparable major civil works in the UK is very low as no reservoirs have been built for 30 years. However, the confidence in the unit cost rates for the basic material items included in the reservoir scope is good.

The process for deriving a 'total cost to client' capex cost was based on two approaches. A top-down estimate was initially assessed using high level, total cost to client rates and cost models. Subsequently, a low-level refined cost estimate was produced comprising direct costs and indirect costs.

Direct costs consist of aggregated labour, plant and material costs to reflect the scope. Indirect costs, relevant to the asset type, are added as an uplift factor to account for contractor management, design, tender-to-outturn and client overheads. Due to the highly subjective nature of land acquisition and power supply costs, these have been estimated with provisional sum allowances, which are also reflected in the key risk allowances.

To adjust cost data to account for its age, a factor has been applied that represents the industry's variance in construction costs from the cost data's base date to the estimate base date of Q3 2021. The adjustment factors have come from the Civil Engineering cost index (reference 1191) published by Building Cost Information Services (BCIS). To adjust cost data for UK regional differences, a factor has been applied to adjust the cost data's base region to reflect the UK average. The factor is determined by an index of UK regions (Regional Index) which is published by BCIS.

8.1.1 Risk

The Quantitative Cost Risk Assessment (QCRA) was carried with reference to the Cost Consistency Methodology Technical Note and Methodology (Revision C), dated 28 August 2020.

A Risk Workshop was held with the project engineering and design team and the costing team to identify the known risks associated with each project. The key risks were recorded using the All Company Working Group (ACWG) QCRA Template and are summarised in Table 13 in Section 7.4 above.

As specified in the QCRA Template, the risk cost included in the SRO Capex Cost estimates is the P50 value, whereby it is anticipated that half of the potential outcomes are expected to be below the selected value.

8.1.2 Optimism Bias

The Optimism Bias for the scheme was derived in accordance with the Cost Consistency Methodology Technical Note and Methodology (Revision C), dated 28 August 2020, and the Update to Guidance on Optimism Bias, dated 1 February 2021.

The proportions of standard and non-standard civil engineering activities were attributed, based on the estimated capex values of assets. This allowed the upper bound of optimism bias to be calculated. A review was carried out by the project team which had technical and commercial knowledge of the project together with an understanding of the approach to costing. Each contributory factor was considered and the extent that mitigation factors have been applied to produce a scaled back optimism bias.

Following completion of the capex cost estimating and the QCRA, a review was carried out to consider whether there was any further adjustment required to the optimism bias. The optimism bias percentage for the SRO was further adjusted to mitigate risks identified in the costed risk register, to give a final value of 37.4% as shown in Table 17 below.

Table 17 Optimism Bias

Risk Category	Optimism Bias Upper Limit (%)	Scaled Back Optimism Bias (%)	Risk Register Adjusted Optimism Bias (%)
Procurement	7.9	7.4	4.4
Project specific	18.9	14.4	8.9
Client specific	20.7	17.7	16.5
Environment	5.2	4.2	3.4
External influences	8.2	6.5	4.3
Total	60.8	49.9	**37.4**

8.1.3 Benchmarking

The benchmarking focused on the most significant cost components of the scheme capex cost estimate, i.e., the reservoir, pipelaying, including crossings, treatment works and water storage tanks.

The difficulty in benchmarking the reservoir is that design scopes for similar civil engineering projects have significant variations in included assets, sizes and quantities. It is also evident that market conditions are currently having a significant impact on the cost of procuring large civil engineering contracts.

The benchmark for pipelines utilised project cost data from various sources in the South West region. Major pipe laying projects were analysed to assess their alignment with the base estimate. In addition to the project cost analysis, recent estimates and benchmarks of similar works were utilised to identify a range of anticipated costs.

Overall, the benchmark estimate was within 1.7% of the scheme capex estimate and at a programme level, a difference in price of 10% would generally be an acceptable indication that the estimate of costs is in line with the market.

8.2 Operating costs

The opex cost estimate was produced from combining ChandlerKBS' CID data and Wessex Water rates for power and chemical costs. The estimate is based on modelled historical data and assumptions that can be affected by many different factors including operating regimes and raw water quality. ChandlerKBS' CID opex utilisation rates have been normalised to 100% and adjusted to align with the utilisation rates required by the scope.

8.2.1 Fixed opex

The fixed opex costs were calculated for the annual operation and capital maintenance costs of the assets irrespective of flow through the assets. Fixed opex costs were derived on the following basis:

- A base rate of 3.0% of mechanical, electrical and ICA (MEICA) capex
- Labour costs as a proportion of the MEICA capex costs per annum.

A benchmark check of the fixed opex cost calculation utilising an alternative base rate method of 1.5% of MEICA capex and 0.5% of civil capex derived a variance of circa 3%. This indicates a high confidence in the fixed opex value.

8.2.2 Variable opex

The Variable Opex cost per megalitre was calculated utilising the capacity driver of the individual assets to derive costs for power, chemicals, labour, maintenance and other costs.

Supporting information provided by the project engineering and design team that identified the anticipated power and chemical usage for each asset based upon the maximum and minimum outputs. Unit rates from the CID were applied to the power and chemicals usage. This information was used to adjust the CID opex models to suit the forecast operating regime of each site. However it should be noted that power and chemical costs have changed a considerably from the historic baselines in the past year and there remains a risk of further volatility.

8.3 Cost estimates

The 80-year NPV of capital financing costs, opex and Water Available for Use (WAFU) have been calculated using the AIC MS Excel template produced by Mott MacDonald. The AIC tool calculates the NPV over an 80-year period from the beginning of the capital investment.

Maximum and minimum WAFU values are based on operating the scheme at its capacity of 36Ml/d and at its' 25% sweetening flow of 9Ml/d respectively.

The current proposal is that the scheme would operate at capacity for a peak, summer, two-month period and at the sweetening flow for the remaining ten months, every year. This gives an anticipated annual average utilisation of 13.5Ml/d.

The 80-year NPV summary outputs are presented below in Table 18.

Table 18 NPV cost summary

	Min utilisation	Max utilisation
NPV Finance	£469.9m	£469.9m
NPV opex	£80.7m	£109.7m
NPV WAFU (m^3)	107,998,130	107,998,130
AIC (p/m3)	510	537

9 Stakeholder and customer engagement

9.1 Stakeholder Engagement

Throughout Gate 2, an important element of the development of the preferred solution has been regular engagement with environmental and planning stakeholders. Consultation on the planning status of the reservoir location and the impacts of fully exploiting the existing abstraction licences at Cheddar Springs and River Axe have informed both the scope of investigations and the solution components. Regular reviews of emerging findings and proposals have enabled work to progress efficiently and a clear plan of monitoring and investigations for the next phase to be established. Our engagement has included:

- Site visits to the proposed development site with Regulators' Alliance for Progressing Infrastructure Development (RAPID), with the Environment Agency (EA) and Natural England (NE) for a site introduction;
- Regular progress meetings with the EA and NE to review concept design and environmental assessment work, discuss environmental issues associated with each scheme (e.g. implications of proposed abstractions) and agree assessment scope;
- Introductory meetings with external stakeholders to introduce the project, including the Drinking Water Inspectorate (DWI), the Land Drainage Authority, RAPID and local councils;
- Key milestone workshops with EA and NE to provide an update on the progress of the technical work undertaken and to enable discussions that guide further work that will be undertaken. During the workshops, local and regional specialists attended to provide further input and to make connections with our technical leads to take discussions offline;
- Topic specific meetings with EA and NE local specialists to enable an iterative procedure when completing the technical annexes/appendices and to ensure a comprehensive study is completed; and,
- Provision of draft environmental reporting to EA and NE for review, followed by meetings to discuss risks identified at component levels.

A schedule of all engagement activities undertaken is provided in **Table 19.Error! Reference source not found.Table 19. Schedule of Environmental and Planning Stakeholder Engagement**

Date	Engagement	Attendees	Agenda
11.11.2021	Biweekly progress meeting	EA & NE	Introductions and update on the evolving scheme design and environmental work to be carried out at Gate 2
25.11.2021	Biweekly progress meeting	EA & NE	Preparation for key milestone workshop, to present the findings of the Gate 2 Phase 1 work
06.12.2021	Key milestone workshop	EA & NE	Presentation outlining the key findings of the Gate 2 Phase 1 scheme design and environmental work followed by discussion
09.12.2021	Biweekly progress meeting	EA & NE	Follow up from workshop
23.12.2021	Biweekly progress meeting	EA & NE	Progress discussion, including regarding preparation of Gate 2 Phase 1 environmental technical reports
06.01.2022	Biweekly progress meeting	EA & NE	Progress discussion, including regarding preparation of Gate 2 Phase 1 environmental technical reports
20.01.2022	Biweekly progress meeting	EA & NE	Preparation for February site visit
02.02.2022	Cheddar springs and reservoir site visit	RAPID EA & NE	Project introduction and presentation on and discussion of key environmental issues.
05.04.2022	Hydrological assessment update	RAPID EA & NE	Presentation of updated hydrological assessment of scheme yield
21.04.2022	Monthly progress meeting	EA & NE	Recommencement of consultation Update of next steps
18.05.2022	WFD	EA	Environmental impacts of abstraction changes
19.05.2022	Monthly progress meeting	EA & NE	Monthly progress meeting Modelling of the wetland opportunity Put and take license agreement and discussion
16.06.2022	Monthly progress meeting	EA & NE	Update on the overall project work completed to date Modelling of the wetland opportunity Upcoming workshop set up and agenda

Date	Engagement	Attendees	Agenda
28.06.2022	Key milestone workshop	EA & NE (incl. local specialists)	Scheme level assessments emerging findings workshop Key questions for local specialists prepared and discussed
21.07.2022	Monthly progress meeting	EA & NE	Review of actions and progress updates from the June workshop
18.08.2022	Monthly progress meeting	EA & NE	Outstanding actions to be completed and programme review Clarity on the work being completed for emerging substances within water quality and WFD Availability of assurers and reviewers
07.09.2022	Introductory meeting	EA Area Director	Outline solution to EA area senior management
08.09.2022	Key milestone workshop	EA & NE (incl. local specialists)	Overview of preferred option and summary of environmental outputs from Gate 2 with further work outlined
13.09.2022	Draft Technical Appendices issued	EA & NE	Draft Technical Appendices issued to EA & NE for review: Annex 5 – Initial Environmental Appraisal Appendix 5.1 - HRA Appendix 5.2 - WFD Compliance Assessment Appendix 5.3 - Natural Capital and BNG Assessment Appendix 5.4 - INNS Risk Assessment
16.09.2022	Draft Technical Carbon Appendix issued	EA & NE	Appendix 5.5 – Carbon Assessment
20.10.2022	Monthly progress meeting	EA & NE	Update on the overall project work completed to date Discussion regarding comments provided on the Technical Appendices

In addition to the above, regular, quarterly check point meetings have been held with RAPID where progress and emerging issues have been presented. These have enabled feedback from the regulators on the solution development and provided guidance on expectations.

Table 20 below summarises the feedback received at Gate 1 and how this has been addressed.

Table 20. Stakeholder Engagement action log

Date/ Consultee	Stakeholder feedback	How action has been addressed
Gate 1 - Ofwat	Provide more information about stakeholder engagement and the understanding of customer acceptability including: • for individual solutions and options; • on issues that could cause delay; and • how the views of vulnerable or harder to reach stakeholders and customers will be sought.	Within this Gate 2 submission, a stakeholder engagement log has been completed, along with an early engagement plan into Gate 3 and beyond.
Gate 1 - Ofwat	Undertake route corridor optioneering in consultation with the Environment Agency and Natural England, to meet gate two requirements and timescales.	Throughout Gate 2, EA and NE have been consulted on a monthly basis, along with key milestone workshops where progress updates on the scheme have been communicated and their feedback sought and incorporated into the design. Into Gate 3 and beyond, outline design will continue to liaise with the regulators to ensure the most efficient route is taken.

Regular engagement with environmental and planning stakeholders will continue and intensify at Gate 3 (and subsequent gates), with planned activities including:

- Early engagement with the EA and NE to agree the scope of the technical studies and associated surveys required in and around the Cheddar Reservoir. These studies will need to be completed in sufficient time to inform a refined options appraisal;

- Engagement with relevant landowners, statutory consultees, local planning authorities, MPs, local communities, businesses and relevant non-statutory consultees (e.g. environmental groups such as the Wildlife Trust);
- Monthly progress meetings with the EA and NE throughout Gate 3 to review design and environmental assessment work, discuss environmental issues associated with the scheme agree assessment scope;
- Follow-up technical workshops with the EA and NE (and other relevant stakeholders as appropriate) to review environmental monitoring findings, address specific risks and likely significant effects, and review mitigation options.
- Provision of draft environmental reporting for review, followed by meetings to discuss risks identified at component and scheme levels.

Tailored briefing notes issued to and meetings with Local Planning Authorities hosting major infrastructure components to outline the relevant scheme, discuss how planning and environmental issues are being addressed and to inform the development of detailed consenting strategies (building on Annex 6 – Consenting Strategy).

Further consultation with relevant environmental and other relevant stakeholders should continue and intensify as the Scheme progresses to future appraisal gates. This should include updates to any existing stakeholder engagement strategy.in terms of the type and scope of the environmental assessments required, its potential impacts and to identify and respond to issues raised regarding the delivery of the Scheme. This should continue to include the EA and NE, but also relevant landowners, statutory consultees, local planning authorities, MPs, local communities, businesses and relevant *on*-statutory consultees (e.g. environmental groups such as the Wildlife Trust).

9.2 Customer Engagement

Between June 2021 and March 2022, BRL used a combination of qualitative (deliberative groups and quantitative research (online survey) to develop their understanding of customer views in relation to the regional plan. The deliberative groups consisted of 66 household customers across eight groups meeting over two sessions. The online survey was with a regionally representative sample of 1,504 household and 304 non household customers. The WCWRG companies have already engaged with customers and stakeholders – through PR19 - and as part of their business-as-usual activities. This study builds on this existing insight to further develop customer and stakeholder evidence to inform the development of the regional water resource plan. The overall purpose is to support WCWRG in formulating the best value regional plan for the South West. The research is also pertinent to the development of this SRO and the WRMPs. Key findings were as follows:

- Drought resilience. Customers were aware of the future water supply challenges in the South West, although had limited understanding about the impacts of extreme drought. Severe water use restrictions like rota cuts were perceived as difficult to cope with and generally unacceptable.
- Environmental ambition. Customers see water in the environment as a precious resource and there was a strong preference for the plan to go beyond the minimum requirements for environmental protection to provide even greater benefit for nature and wildlife.
- Trade-offs. The majority of customers supported higher frequency of less severe restrictions such as hosepipe bans and the potential inconvenience it would cause, if this would contribute to keeping more water in the environment and protecting sensitive habitats. However, this research was completed before the dry weather experienced in summer 2022. Customer views on TUB restrictions will be re-tested between our draft and final WRMP24 as part of the public consultation process, to see if views have changed in response to the drought restrictions that were implemented across large areas of the south of England over the summer of 2022.
- Timing of investment. Customers favoured earlier investment in new supply options, even if this had increased risk that they may not be needed, or they could be wrong size. For customers the benefits or acting early and being prepared outweighed the potential benefit of waiting for more certainty in the future before acting.
- Option types. No supply and demand options for the plan were unacceptable to customers. However, supply options were seen as more reliable, because of the uncertainties associated with demand reductions and the reliance on sustained behaviour change by customers. Support was highest for reducing leakage, closely followed by new or extended reservoirs. Customers support reservoirs as a source of water. They like the certainty they provide, but also they see them as able to protect rivers from abstractions and low flows. They are also a source of habitats and recreation. The media attention this summer showed the support for reservoirs and the concern that not enough are being built at a time of climate change.
- Transfers. Customers were supportive of sharing water at both national and regional levels, particularly if this helped to better protect the environment in water scarce areas. However, the support was not unconditional – with maintaining aesthetic quality of water for “donors” along with leakage and water saving levels in “recipient” areas being critical considerations.

In addition the successful planning application process for the second reservoir at Cheddar in 2013 and 2014 showed that there is substantial customer support for the reservoir locally.

10 Board statement and assurance

Board statements

The Boards of each of the solution owners assure that they:

- support the recommendations for solution and/or option progression made in this submission
- are satisfied that progress on the solution is commensurate with the solution being "construction-ready" in the period 2025 to 2030
- are satisfied that the work carried out to date is of sufficient scope, detail and quality as would be expected of a large infrastructure scheme of this nature at this stage in its development
- are satisfied that expenditure has been incurred on activities that are appropriate for gate two and is efficient.

The Board statement (with signatures redacted) is included in Appendix 1.

The Bristol Water Board noted that they can assure the option progression, but the specific solution would need further consideration in light of the 2022 drought and the opportunity to supplement resources for WSX which can then release currently shared resources.

Assurance

The final determination and the report template provided by RAPID calls for external assurance of the quality and consistency of data and approaches used in preparation of the submission, as well as evidence of efficient cost expenditure (refer to section 11 below). Based on feedback and lessons learnt from the previous gate one submissions the assurance requirements have been revised so that they focus on the desired outcomes rather than being a check on how well the submission templates have been completed.

In addition to internal review and sign-off by the team responsible for each workstream, members of the wider programme team and internal experts from the companies have reviewed the key deliverables.

Mott MacDonald, as independent third party external assurers, have reviewed the gate two report and the key supporting annexes, data and information. Table 21 ***21*** summarises the assurance used to support the Board statement.

Table 21 21Board statement and supporting assurance

Board statement	Assurance
The Board support the recommendations for solution and/or option progression made in this submission.	• The recommendations about scheme progression have been agreed by all the scheme partners and discussed with RAPID in advance of submission. • The recommendations align with the West Country Water Resources Group regional plan and with the partner's WRMPs. • The Executive directors of each partner have been briefed on the conclusions and approved the recommendations. • The progress on the project has been reviewed and delegation of authority to finalise, approve and submit has been obtained from the partner companies' Boards. • Third party assurance by Mott MacDonald
The Board are satisfied that progress on the solution is commensurate with the solution being "construction-ready" in the period 2025 to 2030.	• The supporting information and analysis set outs the data used to carry out the assessment. • A detailed project plan has been prepared and reviewed. • Third party assurance by Mott MacDonald. • The Cheddar scheme could be construction ready by 2030. Its timeline will be revisited by Bristol Water between draft and final WRMP • This statement is not applicable to Southern Water
The Board are satisfied that the work carried out to date is of sufficient scope, detail and quality as would be expected of a large infrastructure scheme of this nature at this stage in its development.	• Preparation of initial concept design and feasibility assessment by industry leading engineering consultancy company with their own internal review. • Peer review of documents by representatives of the partner companies.

Board statement	Assurance
	• Third party assurance by Mott MacDonald.
The Board are satisfied that expenditure has been incurred on activities that are appropriate for gate one and is efficient.	• Evidence of efficient cost expenditure has been reviewed by Mott MacDonald. • This follows an approach consistent with the successful gate one submissions in 2020 and 2021. • Third party assurance by Mott MacDonald.

11 Efficiency of expenditure for gate two and forecast for future gates

This section sets out:

- The gate two allowances, that is the maximum expenditure that the regulator has allowed for the gate two activities
- The actual gate two costs, with a breakdown, as well as a comparison with the allowance and the partner share percentages
- The forecast for future gates along with the proposed gate allowances.

11.1 Gate two allowances

The maximum allowances based on the PR19 final determination and the subsequent changes and adjustments are set out in Table 2222 below.

Table 2222 Gate two allowances

	£m @ 2017/18 prices	
Gate two	0.74	Original PR19 FD allowances
Underspend from gate one carried forward	0.06	As agreed with RAPID
Maximum allowance for gate two	0.80	Total

11.2 Gate two costs

As mentioned above, we adopted a phased approach to the gate two studies in order to maximise efficiency and provide justification for focussing the work on an in-region solution only. The phases comprised:

- Phase 1 to March 2022, covering the main factors affecting scheme feasibility, such as water resources assessments, as well as
- Alignment with regional plans
- Elimination of unfeasible or sub-optimal solutions (in accordance with the second bullet of section 3.2 of the guidance of gate two)
- Phase 2 to November 2022 for the preferred in-region option only
- Concept design, environmental assessments and cost estimates.

This approach was endorsed by RAPID in May 2022, refer to our interim letter and RAPID's confirmation: interim letter relating to the West Country Water Resources solutions and the response from RAPID. As part of this review it was agreed with RAPID to change the name of solution to Cheddar two source and transfer.

Table 23 below provides a breakdown of the costs for gate two, in the format requested by RAPID, at 2017/18 prices. It is based on actual costs incurred at the time of writing and a forecast of costs to complete. Current costs have been deflated to a 2017/18 price base using the CPI-H index. Of the total gate two expenditure 30% was incurred in Phase 1 to 31 March 2022, with the balance in Phase 2.

Table 2323 Gate two efficiency of expenditure template

Category	Activity	Expenditure (£m @ 2017/18 prices)	% of Total Expenditure
Programme & Project Management	Programme management and partner costs	0.06	8%
	Technical assurance	0.03	4%
Feasibility Assessment and Concept Design		0.30	39%
Option benefits development and appraisal	Options development	0.10	13%
	Cost estimating	0.04	5%
Environmental Assessment		0.17	22%
Data Collection, Sampling, and Pilot Trials		0.00	0%
Procurement Strategy		0.02	2%
Planning Strategy		0.00	0%
Stakeholder Engagement	Environment Agency National appraisal unit and area costs (based on offer letters from EA)	0.04	6%
	Natural England Discretionary advice service costs	0.00	0%
	Stakeholder Engagement - other	0.00	0%
Legal		0.00	0%
Other		0.01	1%
Total		0.79	100%
Gate two allowance		0.80	
Gate Under / Overspend		-0.01	-1%

Expenditure on the gate two studies has been delivered efficiently, because:

- Work has only been undertaken on activities included in the list of gate activities in the PR19 final determination appendix for the specific solution
- The packages of technical work and environmental assessment have been awarded following competitive tenders or through framework agreements that were competitively tendered. Compensation events for additional work are based on the rates from the tenders. The packages are based on defined scopes of services, activity schedules, defined deliverables and key dates.
- Programme management and scheme partner in-house staff costs are based on actual and forecast staff time (hours) and rates, with defined scopes and budgets which are subject to regular reviews.
- Efficiencies have been realised by running the two standard gate two solutions (Cheddar two source and transfer & Poole effluent recycling and transfer) as a single programme with a single programme manager, combined governance and steering group meetings and combined checkpoint meetings etc.
- We agreed with RAPID to eliminate unfeasible options and sub-optimal inter-regional options early in the programme.

The change in solution scope agreed with RAPID in May 2022 gives rise to some changes in the solution partner arrangements. At PR19 there were three partners including Southern Water, who were originally intended to be the beneficiary. With the change in scope to a solution for in-region use only rather than an inter-regional transfer, it was not appropriate that Southern Water continued to fund the development. Therefore Southern Water have dropped out as a partner as from the end of Phase 1 on 31 March 2022. Their share of the project budget is reallocated to the remaining partners on a pro rata basis.

The revised solution partner shares are as shown in Table 2424 below.

Table 2424 Revised solution partner shares

SRO	SWB	WSX	SRN	BRL	Comments
Gate 2 original %s					
West Country North sources & transfers	0.0%	29.6%	29.6%	40.9%	As original %s
Gate 2 revised %s for April 2022 onwards					
Cheddar two source and transfer	0.0%	42.0%	0.0%	58.0%	SRN drop out, pro rata balance

Thus for example Southern Water's expenditure is 29.6% of the phase 1 expenditure, which was 30% of the total gate two expenditure (i.e. £0.79m x 29.6% x 30% = £0.07m).

11.3 Forecasts for future gates

No gate three activities have been advanced into the gate two period, and therefore Table 2424 above does not include expenditure for any gate three activities.

The proposed gate three activities and timelines are described in section 7 above. The aim of gate three is to demonstrate substantive progress in solution design, costs and benefit assessment, planning and consenting, procurement, environmental and drinking water quality assessments, such that the project can be implemented to the required timeline. The required timeline is driven by the need in the regional and company water resource plans and the lead-in time of the solution.

Table 25 25 below provides a preliminary estimate of the expenditure required for gate three and gate four. This is indicative and will need to be developed 'bottom up' once the timeline for the project is confirmed in final WRMPs.

Table 25 25 Preliminary gate three and four estimate

Category	Activity	Expenditure (£m @ 2017/18 prices)			% of total expenditure
		Gate three	Gate four	Total	
Programme & Project Management	Programme management and partner costs	0.7	0.4	1.1	11%
	Technical assurance	0.05	0.05	0.1	1%
Feasibility Assessment and Concept Design	Concept design	1.7	0.4	2.0	21%
Option benefits development and appraisal	Options appraisal	0.5	0.0	0.5	5%
	Cost estimating	0.1	0.1	0.2	2%
Environmental Assessment		0.4	0.4	0.8	8%
Data Collection, Sampling, and Pilot Trials	Data collection & sampling	0.6	0.6	1.2	12%
	Pilot Trials	0.0	0.0	0.0	0%
Procurement Strategy		0.4	0.4	0.7	7%
Planning Strategy	Including project plan	0.4	0.4	0.9	9%
Stakeholder Engagement	Environment Agency National appraisal unit and area costs	0.23	0.23	0.5	5%
	Natural England Discretionary advice service costs	0.05	0.05	0.09	1%
	Stakeholder engagement	0.1	0.1	0.3	3%
Legal	Land	0.4	0.4	0.7	7%
Other	Contingency	0.5	0.5	0.9	9%
Total		6.0	4.0	9.9	100%

Solution partner shares are as shown in Table 2626, based on carrying forward the revised percentages from gate two. We recognise that it would be best to base the percentage share of costs by partner on the final agreed shares of the deployable output of the scheme, but these will only be available once the final WRMPs are approved. Therefore we propose that the solution partner share percentages are revisited during the gate three period.

Table 2626 Gate three solution partner shares

SRO	SWB	WSX	SRN	BRL	Comments
Cheddar two source and transfer	0.0%	42.0%	0.0%	58.0%	As Gate 2 final

Although we have been able to achieve all of the key deliverables during gates one and two, the available funding allowances have been constraining. The original PR19 development allowances for all of the West Country strategic resource options were based on a capital cost derived from a notional £ per Ml/d. These capital cost estimates have been shown to be substantial underestimates.

For gates three and four the allowances would need to be reset as part of PR24. Based on the latest capital cost estimate we have calculated the total gate three and four allowances @ 2017/18 prices. The proposed timeline for the project now extends into AMP8 rather than being completed in AMP7 as per the original PR19 plan. We have

limited the gate three expenditure in AMP7 to no more than the remaining allowances allocated at PR19, with the balance of the new reset allowance in AMP8. The proposed allowances are set out in Table 2727 below, along with an indicative phasing. The actual/forecast expenditure in AMP7 will be reconciled with the PR19 allowances through a PR24 reconciliation model. Any underspend or overspend at each gate can be carried forward to the next gate.

The proposed allowances are set out in Table 2727 below, along with an indicative phasing.

Table 2727 Proposed gate three and four allowances

£m @ 2017/18 prices		AMP7/PR19		AMP8/PR24		Total
Original PR19 allowances		**G3**	**G4**	**G3**	**G4**	
		1.72	1.97	0.00	0.00	3.69
Proposed 'reset' allowances			**G3**	**G3 continued**	**G4**	
	'Reset' based on latest capex estimate - whole SRO scope incl transfer to WSX		3.7	8.1	13.5	25.3
	'Reset' based on latest capex estimate - Cheddar two reservoir & raw water pumping station only		3.7	3.5	8.2	15.4

For solutions that progress beyond gate two cost sharing is applied to the ring fenced development allowance as set in the PR19 final determination appendix, with 50% of underspend or overspend shared between customers and the water companies. Therefore it is essential that the allowance reflects the agreed scope and is based on an up to date capital cost estimate.

12 Conclusions and recommendations

The conclusions and recommendations are agreed by all the scheme partners.

The initial phase of the gate 2 work, which has already been agreed with RAPID, concluded that the best value use of the water resource was as an in-region option only.

Based on the gate 2 studies we conclude that the scheme:

- is technically feasible and deliverable
- has minimal environmental impact
- would provide a drought resilient water resource, using existing abstraction licences, with an annual average of 14Ml/d and a peak of 36Ml/d if used to meet critical peak requirements in WSX's groundwater area
- can be construction ready by 2030
- needs continued development to resolve the remaining risks and uncertainties.

The status of the scheme in the two companies' dWRMP24 is as follows:

- Bristol Water's draft WRMP central scenario assumes deep reductions in demand in line with government guidelines and does not select Cheddar two for implementation over the planning horizon to 2080. However it is recognised that there is considerable uncertainty about the deliverability of demand reductions. Cheddar two reservoir could provide resilience to both WSX and SWW regions in the future, especially in light of this year's current drought. The draft WRMP is subject to consultation with stakeholders and regulators in early 2023. The regional plan will be consulted on over the same timescales.
- Wessex Water's draft WRMP does not select the Cheddar two reservoir and transfer scheme in any scenario. Similarly it relies on significant demand reductions to achieve an acceptable supply-demand balance and deliver environmental improvements over the long term. However, the plan also includes some supply-side interventions and it selects the other strategic resource options, Poole and Mendips, in preference to Cheddar two reservoir.
- The position will be revisited between draft and final WRMPs, and in future rounds of regional planning when an integrated regional water resource system model is expected to be available.

Therefore, pending the conclusions of the consultation on the draft WRMPs and regional plan in 2023, it is recommended that the Cheddar scheme continues on the gated process through to gate three.

13 Supporting documentation

Details of the various work stream activities and their findings that have been undertaken during the gate 2 programme have been documented in the following supporting reports.

Reference	Document
Annex 1	Options Appraisal
Annex 2	Concept Design
Annex 3	Water Resources
Annex 4	Water Quality & Treatment
Annex 5	Initial Environmental Assessment
Appendix 5.1	HRA
Appendix 5.2	WFD
Appendix 5.3	BNG
Appendix 5.4	INNS
Appendix 5.5	Carbon
Annex 6	Planning
Annex 7	Cost Estimation
Annex 8	Procurement
Annex 9	Programme

14 Appendix 1: Board statement

CHEDDAR TWO RESERVOIR AND TRANSFER STRATEGIC RESOURCE OPTION

The Boards of each of the solution partners assure that they

- support the recommendations for solution and/ or option progression made in this submission
- are satisfied that progress on the solution is commensurate with the solution being "construction-ready" in the period 2025 to 2030.
- are satisfied that the work carried out to date is of sufficient scope, detail and quality as would be expected of a large infrastructure scheme of this nature at this stage in its development
- are satisfied that expenditure has been incurred on activities that are appropriate for gate two and is efficient.

Signed by

Andy Pymer

Director of Regulation and Finance

On behalf of

Wessex Water Services Ltd

Signed by

Dr Lisa Gahan

Group Director of Regulatory, Strategy and Asset Management

On behalf of

Bristol Water plc

Signed by

Malcolm Cooper

Non-Executive Director

On behalf of

Southern Water Services Ltd

With respect of the work completed prior to the change of scope on 31 March 2022 as agreed with RAPID and excluding the second bullet of the above statement.