Strategic Solution Gate One Submission:
Preliminary Feasibility Assessment

Fens Reservoir

5 July 2021

Contents

Acronyms

Acronym	Definition
A2AT	Anglian to Affinity Transfer
AA	Appropriate Assessment
ACWG	All Company Working Group
AIC	Average Incremental Cost
AMP	Asset Management Plan
AOD	Above Ordnance Datum
AWS	Anglian Water Services
BSA	Bulk Supply Agreement
CAP	Competitively Appointed Provider
CESMM4	Civil Engineering Standard Method of Measurement v.4
CW	Cambridge Water
DBFMO	Design, Build, Finance, Operate and Maintain
DCO	Development Consent Order
DO	Deployable Output
DPC	Direct Procurement for Customers
DWI	Drinking Water Inspectorate
EAR	Environmental Assessment Report
EBSD	Economics of Balancing Supply and Demand
EIA	Environmental Impact Assessment
FCRM	Flood and Coastal Risk Management
FSA	Flood Storage Area
FWP	Fens Water Partnership
GAC	Granular Activated Carbon
GRP	Glass Reinforced Plastic
HRA	Habitats Regulations Assessment
ICA	Instrumentation, Control and Automation
IDB	Internal Drainage Board
INNS	Invasive Non-Native Species
JV	Joint Venture

Acronym	Definition
M&E	Mechanical and Electrical
MCDA	Multi-Criteria Decision Analysis
MCM	Million Cubic Metres
MO-RDM	Multi-Objective Robust Decision Making
NPV	Net Present Value
NSIP	Nationally Significant Infrastructure Project
OB	Optimism Bias
PEI	Preliminary Environmental Information
PPA	Power Purchase Agreement
PSM	Participatory System Mapping
PSM	Particpatory System Mapping
PWS	Public Water Supply
REGO	Renewable Energy Guarantees of Origin
RSS	Regional System Simulator
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SLR	South Lincolnshire Reservoir
SPA	Special Protection Area
SRO	Strategic Resource Option
ToLS	Test of Likely Significance
UKTAG	UK Technical Advisory Group
WFD	Water Framework Directive
WQ	Water Quality
WQRA	Water Quality Risk Assessment
WRE	Water Resources East
WRMP	Water Resources Management Plan
WRSE	Water Resources South East
WTW	Water Treatment Works

1. Executive summary

Fens Reservoir was identified in Anglian Water's Water Resources Management Plan 2019 (WRMP19) as a potential strategic water resource option, to be developed to detailed design stage (equivalent of gate two) by the end of AMP7. Similar winter storage options were explored by Cambridge Water.

Given the challenges faced in the region, there is a need to accelerate the programme for Fens Reservoir to enable it to be 'construction ready' by AMP8. This submission is a joint proposal between Anglian Water and Cambridge Water to escalate the development of Fens Reservoir to the RAPID process.

Fens Reservoir

Solution summary

- Fens Reservoir is a strategic regional water resource solution that is being proposed in the Anglian Water region to support supply to both Anglian Water and Cambridge Water customers, with a possibility to also support Affinity Water via the Anglian to Affinity transfer solution.
- Water would be abstracted from the Ouse catchment when river flows allow and transferred to a newly constructed reservoir in the Fens.
- The initial concept design includes a bunded reservoir and piped transfers from four proposed abstraction points.
- The concept design will be fully developed for gate two, incorporating additional features to deliver multi-sector benefits.
- The water resource benefit estimated at this stage is 99Ml/d.
- Whole-life costs will be £1,973M.

Outline delivery plan

- The proposed programme allows for Fens Reservoir to be 'construction ready' in AMP8, although the required 'into supply' date is dependent upon the outcome of the regional modelling.
- The workstreams planned for gate two will ensure that there is a robust planning and market engagement process in place to help inform the preferred procurement model.
- The scheme is expected to be promoted as a Nationally Significant Infrastructure Project, requiring a Development Consent Order (DCO).

Water quality considerations

- Initial water quality risk assessments have not highlighted any significant issues.
- The output has been used to inform the proposed treatment requirements.

Key environmental outcomes

- Initial environmental assessments have not identified any unsurmountable issues.
- The abstraction licence arrangements will be discussed with the Environment Agency to ensure no adverse effects on designated sites, and a programme of monitoring has been agreed to gather additional information to inform the ongoing assessments.
- Wider benefits will be sought for gate two, including opportunities for environmental enhancement, such as reduction of abstraction in chalk streams, contributing to the alleviation of flood risk, positive social outcomes, improved climate resilience, and realisation of low-carbon targets.

Stakeholder engagement

- The Fens Water Partnership has been established with the specific focus of engaging key stakeholders through a participatory approach to decision making.
- A community consultation and engagement strategy has been developed for the project. To consult effectively and meaningfully, it is anticipated that the first phase of community consultation on a preferred site will be held following the screening process.
- An extensive programme of customer engagement has been completed, and the overall consensus is that customers agree with the need for regional water resource collaboration.
- Reservoirs are an option widely accepted by customers – with the majority view that the recreation and environmental benefits outweigh the localised impacts.
- The scheme will be integrated in the wider Future Fens strategy, which is being developed jointly with Water Resources East and the Environment Agency to address the water problems of the Fens in a holistic way, while contributing to the local economy and delivering environmental outcomes.

Key risks & assumptions

- The Water Resources East regional system simulator model will be used to select the preferred option. This will determine if the solution is required, the size needed and when.
- The timescales to align the scheme delivery with the planning (DCO) and procurement (Direct Procurement for Customers, DPC) requirements are not fully aligned and work is ongoing to mitigate the associated risks.
- The development of Fens Reservoir is not fully funded this AMP. This report assumes funding is secured to enable the option to progress through the gated process.

Scheme viability

- Fens Reservoir is a viable solution, and the recommendation is that work should continue with this scheme to ensure it is construction ready in AMP8.
- Anglian Water and Cambridge Water are proposing that Fens Reservoir should be included as a new, additional, strategic water resources solution in the RAPID gated process.
- The inclusion of Fens Reservoir as a new solution has been discussed with RAPID and meets the defined criteria to be included in the programme.

2. Solution description

This section sets out a summary of key information and an initial overview of the Fens Reservoir Strategic Resource Option (SRO) solution.

2.1 Solution outline

- As part of WRMP19, Anglian Water and Cambridge Water identified an increasing supply deficit. One option considered by Anglian Water to mitigate this shortage was the development of a winter storage reservoir in the Fens. It was also identified that this option could alleviate Cambridge Water's supply deficit, and so both companies are committed to working together to develop the Fens Reservoir as part of the RAPID process.

- The initial concept has evolved from Anglian Water's WRMP19 solution, which involved a 50,000Ml reservoir with an abstraction from the River Ely-Ouse at Denver. Additional abstractions from the River Bedford-Ouse at Earith, Middle Level Drain at St Germans and the Ouse Washes have been assessed, which combined would increase the available deployable output (DO) sufficiently to support a regional-scale scheme. The additional scope incorporates abstractions that were identified as sources for Cambridge Water WRMP19 options.

- The location of the reservoir is to be confirmed but is likely to be in the Fens, either to the east or west of the Ouse Washes to ensure proximity to the water sources.

- Water would be abstracted when river flows allow and transferred to the reservoir via pipelines, although open water transfers will be considered as part of the development of the concept design for gate two.

- A treatment works will be located adjacent to the reservoir to treat the water before it is piped to an existing or new service reservoir or reservoirs. The exact location of the treatment works is to be confirmed.

- Fens Reservoir has the potential to provide many benefits to the area in addition to providing public water supply (PWS). The expectation is that Fens Reservoir will contribute to an integrated approach to water management throughout the Fens, including, among other aspects:

  - enhancing water quality conditions in the area through catchment management and/or wetlands;

  - providing flood risk benefits linked to open water transfers and/or flood control storage;

  - supporting the local economy by offering water for irrigation and improving the attractiveness of the area as a tourism destination;

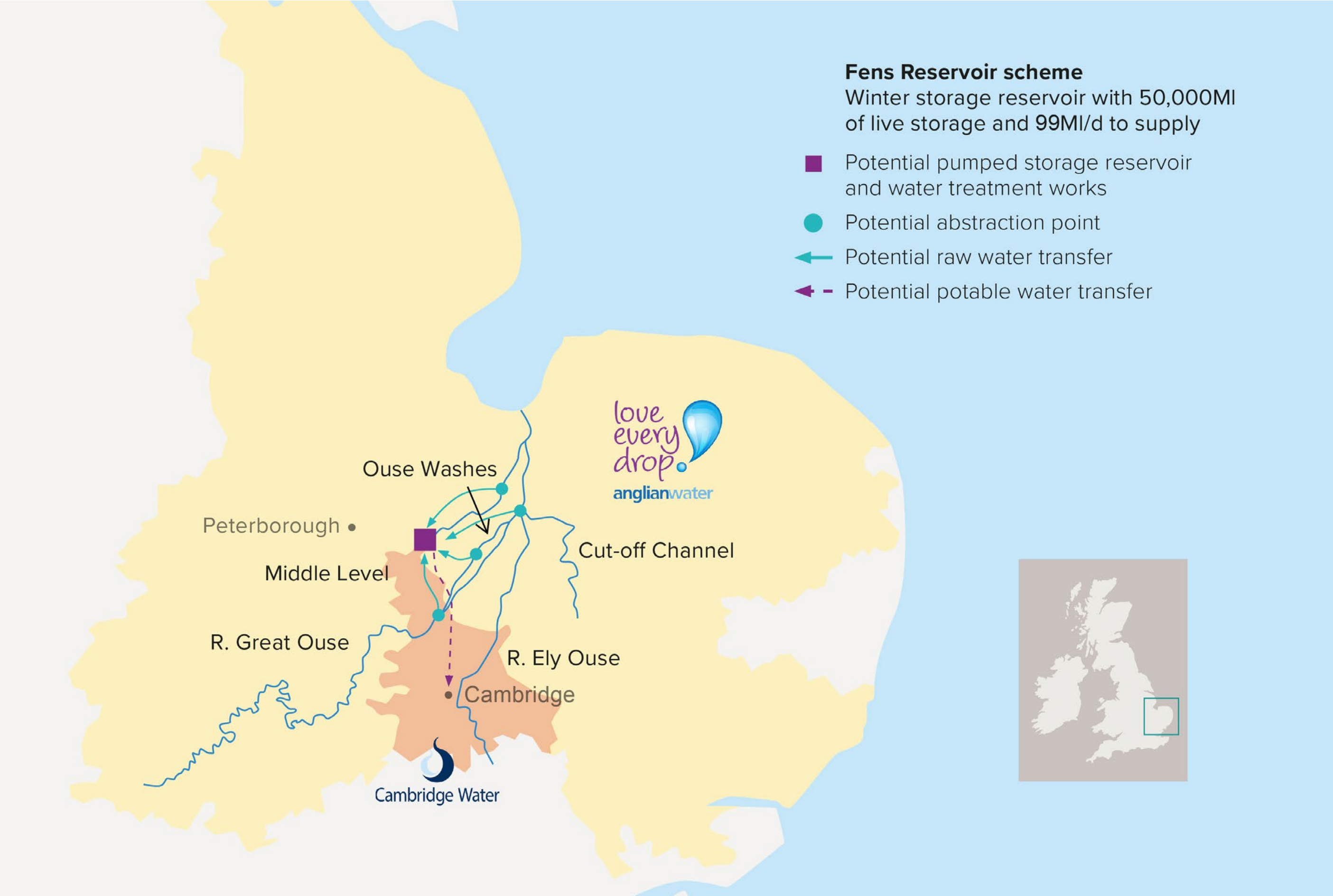
  - improving the environment, removing abstraction pressures on chalk streams and achieving biodiversity net gain[1].

Full details of the solution outline options are presented in Section 4.1.

All the dimensions presented in this submission (including volumes, pipeline lengths, etc) and any site-specific information such as geological and environmental conditions are based on an indicative site only and will be subject to change depending on the final preferred site selection and configuration.

1 Biodiversity net gain is likely to become a requirement rather and a desirable benefit with the passing of the Environmental Bill

Figure 1: Fens Reservoir schematic



2.2 Overall costs

Costs have been developed for the initial concept design. Due to the current level of development at gate one, there is still significant uncertainty embedded into the proposed costs. However, this uncertainty has been incorporated within the proposed Optimism Bias (OB) and risk approaches. The estimate of the overall cost is considered sufficient for gate one. Capital costs of the scheme for a multi-sector option have been estimated as £1,527million. Further detail on the costing approach can be found in Section 4.2.4 and Section 10.

2.3 Resource benefits

The Fens Reservoir will increase water resource availability by storing high flows from the Great Ouse catchment. The water resource benefit for PWS that the scheme could provide has been estimated, for climate conditions in the 2050s, as an increase in total conjunctive deployable output (DO) of 99Ml/d. Refer to Section 4.4 for further detail. In addition to PWS, the Fens Reservoir scheme has the potential to provide additional water resource benefits to other users, depending on the final concept design adopted for gate two. It could, for instance:

- Provide irrigation supply to local farmers, as well as supporting summer river flows.
- Enhance local water quality to meet Water Framework Directive (WFD) standards for good ecological status, as well as reducing chalk stream abstractions in the upper Cam catchment.
- Reduce flood risk in the local area.

2.4 Environmental outcomes

An initial environmental assessment has been completed for the adopted concept design option, including a Habitats Regulations Assessment (HRA), a Strategic Environmental Assessment (SEA) and an Invasive Non-Native Species (INNS) risk assessment.

The abstraction licence arrangements, which will include hands-off flow (HoF) conditions, will be discussed with the Environment Agency to ensure no likely significant effects on any designated sites. Further work will be required to collate information available to inform the assessments as the design continues. This will ensure that any WFD compliance risks are considered and addressed. It is also recognised that gate two concept design will need to be expanded to deliver multi-sector features. These multi-sector features could also offer opportunities for environmental enhancement and realisation of low-carbon targets.

A programme of additional monitoring and environmental studies has been proposed to further develop the environmental assessments for the gate two submission.

2.5 Drinking water considerations

A Water Quality Risk Assessment (WQRA) has been carried out for the Fens Reservoir solution in accordance with the guidance developed for the All Company Working Group (ACWG)[2]. The outcome from the WQRA has been used to design the treatment requirements for the Fens Reservoir scheme.

No significant water quality concerns have been identified from the initial assessment, but further monitoring is required. A water quality monitoring programme is being implemented to provide additional data, which will inform water quality modelling and assessment, including the use of wetlands to remove phosphorus and the potential risk of algae bloom. This will allow the WQRA to be developed to a greater level of detail and confidence for gate two.

2.6 Resilience benefits

The Fens Reservoir solution has been designed to ensure the scheme is resilient to an extreme drought, which is defined as having a one-in-500-year return period. It has also been designed to account for potential climate change impacts in the 2050s, in accordance with the latest Environment Agency Water Resource Planning Guidance. For this stage of assessment, only one medium-range climate change scenario has been adopted corresponding to a temperature rise of 2°C from current conditions. The reported deployable output benefit will contribute to the overall Anglian Water and Cambridge Water supply resilience.

2.7 Links to other options, schemes and elements

The Fens Reservoir is one of the three options being considered as a source of water for the Anglian to Affinity (A2AT) SRO and the associated supporting downstream infrastructure. This will require construction of a pipeline to distribute the flow to where it is required in the Affinity Water supply area. If the Fens Reservoir is selected as the source of water for the A2AT, there will still be additional water resource benefit for Anglian Water and Cambridge Water, although this would be reduced.

The development of the Fens Reservoir is independent of the South Lincolnshire Reservoir (SLR). It is currently considered there is a need for both reservoirs to provide regional benefit to the east of England. It is expected that this will be confirmed in the regional plan.

2.8 Regional planning

A key assumption of the scheme is that the Fens Reservoir is selected by the Water Resources East (WRE) regional system simulator (RSS) and will provide benefits for Anglian Water customers and Cambridge Water customers. This will ascertain the proposed size and its intended use. This assumption will be revisited at gate two once the outputs of the regional plans are available. Due to the potential for the Fens Reservoir to provide water for the A2AT, there is a also a link to the outcome of the Water Resources South East regional plan. The work of the regional planning groups and regional co-ordination groups will be critical to determining the need for and utilisation of the Fens Reservoir resource.

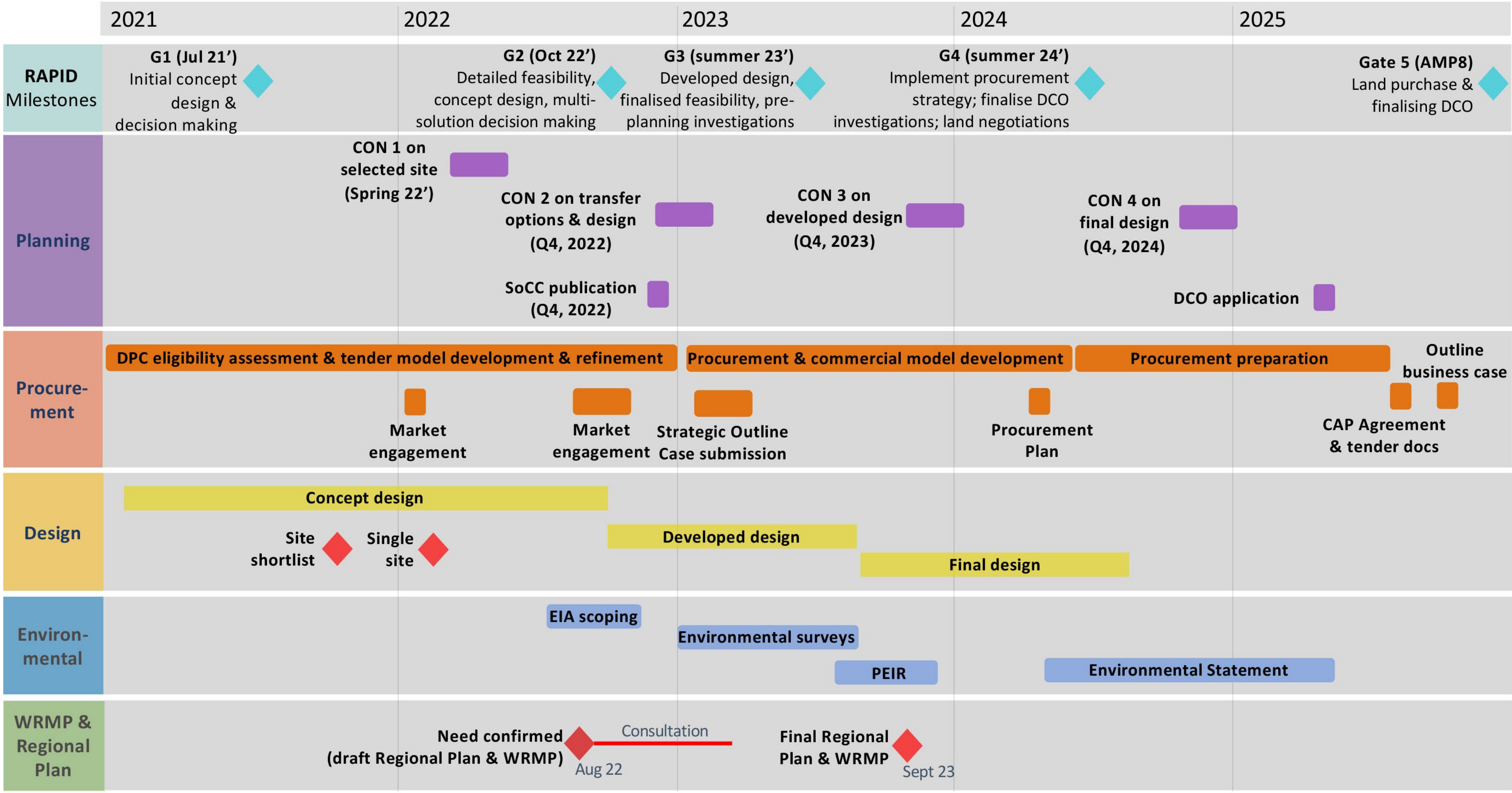
2 *ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 | Jacobs*

3. Outline project plan

This section sets out the key activities and outputs that will ensure successful delivery of the Fens Reservoir scheme, in line with the RAPID gated process. Learning has been shared from work undertaken for the SLR and A2AT SROs with regards to understanding the requirements and interdependencies of the RAPID gates, the WRMP and regional planning process, and the planning and procurement strategies. Option-specific studies have been carried out to understand the existing ecology, hydrology, hydrogeology and water quality, and detailed studies have confirmed the feasibility. A stakeholder group has been established to help co-create the development of the option, and a robust site selection process has been mapped out and agreed with stakeholders. This work has informed the plan and will be further refined during the next stage of the RAPID process.

Although this option is not yet part of the RAPID process, learning from other SROs has enabled the programme to accelerate, and work complete to date is in line with gate one requirements. The plan presented in Figure 2 is aligned to the development of the SLR SRO to enable efficiencies throughout the programme. It provides a coherent approach to delivering the necessary outputs for each gate, with integration across the fundamental workstreams of planning, procurement, design and enabling, and construction.

Figure 2: Project-level plan corresponding to RAPID gateways



CAP = competitvely appointed provider; **CON** = public consultation; **DCO** = development consent order; **DPC** = direct procurement for customers; **EIA** = environmental impact assessment; **PEIR** = preliminary environmental information report; **SoCC** = statement of community consultation; **WRMP** = water resources management plan

3.1 Key activities and decisions

Figure 2 provides a summary of the key activities required to align the planning, procurement, design and enabling activities with the RAPID gateways and the WRMP and regional planning programme.

- **Planning –** It proposed that the Fens Reservoir will be promoted as a Nationally Significant Infrastructure Project (NSIP), requiring a Development Consent Order (DCO) (see Section 7 for more detail). As a result, the project will have to comply with the requirements and guidance associated with the Planning Act 2008, such as developing the plans for Fens Reservoir in response to consultation with a range of stakeholders, including statutory consultees, local authorities and the community. Four public consultations (CON1-4) are planned, with the first in spring 2022, to consult on the preferred site and help inform the concept design. This comes before the need is confirmed in August 2022, but it is necessary to ensure sufficient detail is developed prior to gate two. The DCO application is planned for spring 2025 but will be a focus throughout the programme to ensure the process is robust and well documented.

- **Procurement –** Work carried out so far has confirmed that Fens Reservoir is eligible for Direct Procurement for Customers (DPC) (see Section 6 for more information). Tender model development and refinement are the next key activities for procurement, with two phases of market engagement planned prior to gate two. The Strategic Outline Case will be submitted early 2023 once the concept design is agreed and the need understood, and the Competitively Appointed Provider agreement is planned for summer 2025.

- **Design –** The concept design will continue to be refined prior to gate two. It will utilise innovative processes and be driven by our stakeholder engagement. Further information is presented in Section 15, but the key milestone is to identify a preferred site and concept design by February 2022 to provide sufficient time to develop the detail needed for gate two.

- **Environmental –** A programme of ecology, flow and water quality monitoring is in progress to inform the gate two concept design. The Environmental Impact Assessment (EIA) scoping is planned to commence in autumn 2022, with environmental surveys following in 2023 to inform the final design process.

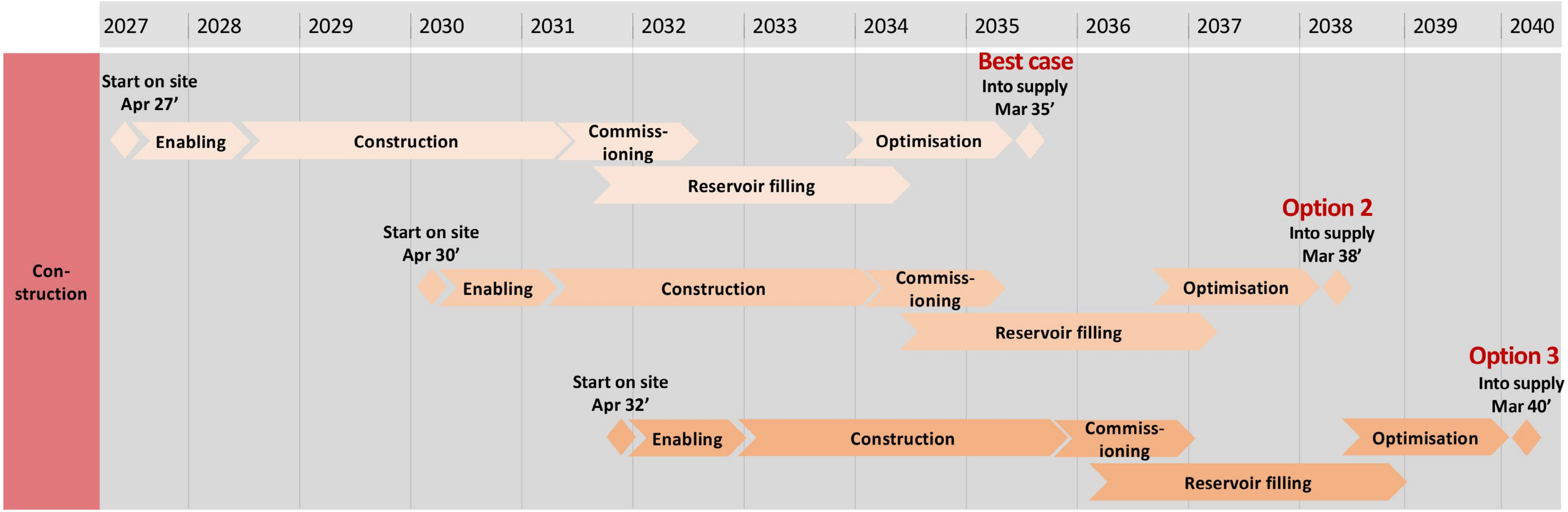
3.2 Construction programme

In line with RAPID aspirations, the programme provided in Figure 2 will enable a 'start on site' date in AMP8. Figure 3 presents a potential start date of 2027 and, with an estimated site programme of eight years, suggests the earliest possible deployable output date is 2035. The draft regional plan and WRMP in August 2022 will confirm the need and dictate this programme. Other options are shown to represent what is possible.

3.3 Assumptions and dependencies

The programme assumes that the Fens Reservoir will be selected in WRE's regional plan and that the need is confirmed to necessitate starting on site in AMP8 and thus following the RAPID standard gated process.

Figure 3: Project-level plan showing indicative construction timescales



4. Technical information

This section sets out the technical information and preliminary feasibility assessment for the concept design considered for the Fens Reservoir up to gate one.

4.1 Initial concept design

The proposed Fens Reservoir scheme comprises the development of a new, large raw water storage reservoir that will be filled during high flows from four river abstraction locations between King's Lynn and Huntingdon.

The proposed site location for the Fens Reservoir has not yet been selected. A robust site selection process is underway in collaboration with stakeholders and an agreed site will be presented at gate two.

For the purpose of this preliminary feasibility stage, a nominal site has been selected for development of a provisional concept design. The nominal site location was chosen with the aim of being broadly representative of the range of sites under consideration in the ongoing site selection process. Key design constraints, such as ground conditions and development constraints, were also considered as these could affect the development of the proposed scheme. This in no way prejudices the ongoing site selection process as it has been done with the sole purpose of allowing a provisional concept design to be developed in advance of the selection of a preferred site.

An initial geotechnical assessment of the nominal reservoir site has identified that approximately 5m depth of superficial material is present above the bedrock Ampthill Clay. This superficial material is unlikely to be suitable for use to construct the reservoir embankment and will require disposal in the form of landscape fill around the reservoir perimeter. A cut-fill balance exercise has been undertaken to optimise the quantity of as-dug material and reduce the requirement for material import or off-site disposal.

The proposed site is located in Flood Zone 2, with an assumed flood level of 1.42m Above Ordnance Datum (AOD) for an undefended scenario, generating a total volume of 10.7MCM for flood mitigation. The embankment will be protected to withstand flooding in case of breach or overtopping of existing defences.

A pipeline routing optimisation exercise has been undertaken to produce preliminary pipeline alignments from abstraction locations to Fens Reservoir.

Key technical details for the adopted concept design are as follows:

- 50MCM reservoir: 7.6km long embankment, height between 7.7m and 12.1m. The core material is expected to consist of Ampthill Clay excavated from an internal borrow area, with the anticipation that works will achieve an appropriate cut-fill balance. Rapid drawdown facilities have been considered to allow for the safe removal of water from the PWS reservoir in an emergency.
- Raw water transfer:
  - Denver to Fens Reservoir: 13.3km long, 2200mm diameter pipeline designed for a 500Ml/d capacity
  - Earith to Fens Reservoir: 21.8km long, 2400mm diameter pipeline designed for a 700Ml/d capacity
  - St Germans to Fens Reservoir: 24.2km long, 1000mm diameter pipeline designed for a 125Ml/d capacity
  - Ouse washes to Fens Reservoir: 10.4km long, 2200m diameter pipeline designed for a 500Ml/d capacity
- Water treatment works: with enough capacity to treat the estimated DO and located adjacent to the proposed PWS reservoir.
- Treated water transfer: considered tentatively as a 62km long, 1000mm diameter pipeline designed for conveying the estimated DO and connecting to a notional point in the existing network.

A landscape visualisation of the reservoir is presented in Figure 4. Due to the early stage of design, site specific designs for multi-sector benefits have not yet been fully developed. However, an allowance for multi-sector benefits has been included in the cost and carbon estimates in recognition that incorporation of measures to enhance the existing environment and provide lasting and measurable change to the local communities is a core component of the scheme.

Figure 4: Visualisation of proposed reservoir (not location specific)

4.2 Initial costing and estimating report

Costs have been developed for two sub-options of the Fens Reservoir initial concept design: a baseline design, consisting of the Fens PWS reservoir, pipelines, and water treatment works (WTW); and a multi-sector benefits design, including for the addition of a flood storage area (FSA), farm reservoirs and wetlands. The latter design has not been defined at this gate, but costs have been approximated to provide a comparison in anticipation of the concept design that will be developed ahead of gate two. Due to the current level of development at gate one, there is significant uncertainty embedded into the proposed costs. However, this has been incorporated within the proposed Optimism Bias (OB) and risk approaches.

The estimate of the overall cost for each design is considered sufficient for gate one. Where significant areas of uncertainty remain, this has been highlighted, either within cost rates or the actual design, procurement and delivery of the scheme and how this uncertainty can be mitigated as the scheme progresses through the gateway stages.

To ensure consistency in costing, the ACWG guidance[3] has been followed and relevant templates have been used. Recent WRMP guidelines and HM Treasury Green book guidance[4] have both been followed for the valuation of greenhouse gasses. The overall estimate of carbon emissions has taken on best practice, using PAS2080 accredited carbon data and tools. The assessments have also taken into account ACWG guidance on consistency of data sources and scope boundaries.

4.2.1 Approach to costing and data used

The approach to costing has been driven by the best available data for the concept designs based on their level of development. Where possible, existing costing systems have been used, which have gone through significant assurance and are considered the most representative costs available. Where this has not been possible, due to the size or type of assets being delivered not being covered by existing cost data, unit rates have been used that represent industry norms and have been validated through benchmarking industry data. Costing reflects the early stages of design development. Costs have been developed based on the design scope for each of the components as they stand at gate one with the intention that further, more refined costing will be provided following further scheme definition.

3 *Mott MacDonald (2020), Cost Consistency Methodology, Technical Note and Methodology*
4 *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)*

Detailed scope lists have not yet been developed for the Fens FSA, wetlands, and farm reservoirs. As such, the costs for these elements included in the multisector benefits design have been derived from the costs of similar components costed for the South Lincolnshire Reservoir. This is considered sufficiently accurate for the current level of scheme development. As the Fens Reservoir design develops, costs of multi-sector elements specific to the scheme will be recalculated.

Additional variations on pipelines required to supply transfer of raw or treated water not using existing infrastructure will also be considered when these costs are available.

4.2.2 Communicating and accounting for uncertainty, risk and Optimism Bias (OB)

Considering the early stage of scheme development at gate one, it is important that the major areas of uncertainty are identified, estimated and communicated clearly and transparently to stakeholders. In particular, the communication of principal risk can enable a clear focus on activities that will allow the largest reduction in uncertainty during future phases of scheme development and progression through the later gates. The principal methods for this communication included the following:

- Risk register: A project risk register has been developed and is summarised in Section 9. The risk register has been used to inform the OB assessment to ensure that sufficient allowance has been made for uncertainty in project costs. The risk register will be developed with risks quantified and used to monitor and manage ongoing cost risk as the scheme develops.
- Optimism Bias (OB): OB is the tendency to be over optimistic about large infrastructure projects, resulting in the underestimation of project costs, as well as other project parameters such as duration. To account for this, a percentage uplift can be applied to the calculated scheme costs. In this case, the ACWG OB template[5] has been used to estimate the OB at the current stage in design and reflect project cost uncertainty appropriately. The ACWG guidance requires 22 confidence statements to be assessed and scored. The template also requires a split in inputs between 'Standard Civil Engineering' and 'Non-Standard Engineering' depending on the perceived complexity of the infrastructure. The scheme elements were defined as follows:
  - Reservoir elements classified as 'Non-Standard' with an OB allowance of 51.7%.
  - Pipeline and WTW elements classified as 'Standard' with an OB allowance of 31.2%.

As a result, the OB for each of the elements was calculated separately and combined to form an overall OB allowance for both designs. In the initial stages of project development, there is typically more uncertainty surrounding the project and confidence in the costs is lower. As such, the impact of OB reduces with project development. As the development of the scheme progresses and the associated uncertainty decreases, the inputs to the ACWG OB template will be reviewed, and the applied uplift will be reduced accordingly. It is likely that some of the current scoring will be updated based on project specific circumstances. The OB has been reviewed against the project risk register to avoid double counting of risk.

4.2.3 Indirect/on-costs allowances

The actual level of indirect costs for clients and contractors will vary dependant on the size and type of scheme. The Fens Reservoir is significantly larger than any typical water resource scheme delivered by Anglian Water or Cambridge Water, and consideration will therefore need to be made with respect to whether the typical client indirect cost allowances are suitable for a scheme of this scale.

The total indirect cost allowance for the concept design options are 78% of base materials Capex cost. The indirect cost allowances for Fens Reservoir have been broken down to provide transparency and clarity on the total overhead uplift and to enable analysis to inform alternative procurement routes.

4.2.4 Capital costs

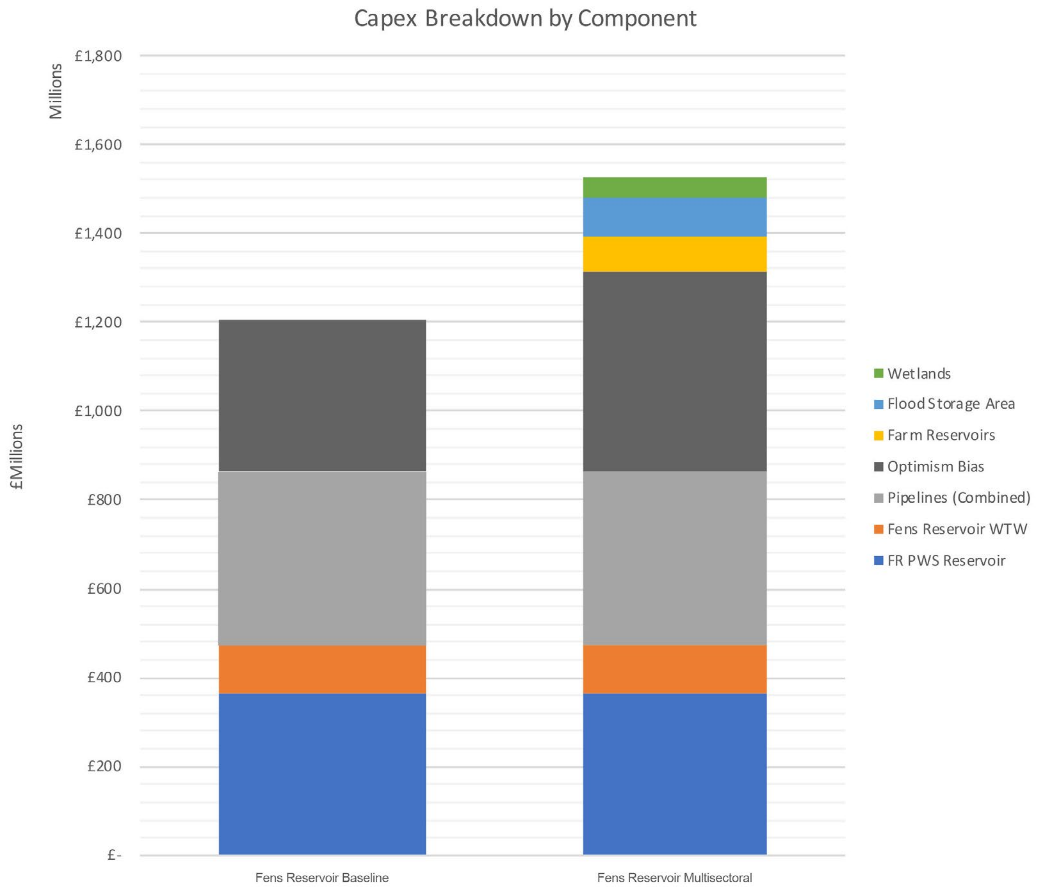
Table 1 provides a summary of the overall capital costs, including a breakdown of the costs associated with each design component. These are also presented in Figure 5, with the breakdown of capital costs by component displayed for each design. Overall costs are approximately £1,527million and £1,207million for the multisectoral design and the baseline design respectively, including indirect costs and optimism bias.

Table 1: Overview of capital costs

Scheme element	Baseline (£M)	Multisector (£M)
Public water supply (PWS) reservoir	366	366
Farm reservoirs	–	76
Flood storage area	–	89
Wetlands	–	46
Fens Reservoir WTW	107	107
Pipelines (combined)	390	390
Optimism Bias	344	453
Total cost (£M)	1,207	1,527

5 *Mott MacDonald (2020), Cost Consistency Methodology, Technical Note and Methodology*

Figure 5: Overview of capital costs by design component for the baseline and multisectoral designs



4.2.5 Operational costs

The operational costs for the reservoir, pipelines and WTW have been calculated based on the power consumption of any mechanical scoped elements, such as pumping stations and intakes. The Opex costs also allow for chemical consumption at the WTW and an estimate of maintenance costs. Table 2 presents the annual operational costs for each component of the design options. Maintenance costs of flood defences will be added at gate two if required, once the location of the reservoir is confirmed.

Table 2: Overall estimate of average annual operational costs

Scheme element	Fens Base (£M/y)	Fens Multisector (£M/y)
PWS reservoir	0	0
Pipelines and pumping stations	7.4	7.4
Fens WTW	5.3	5.3
FSA, wetlands and farm reservoir	0	.73
Total	12.65	13.38

4.2.6 Capital replacement costs

An allowance has been made for capital replacement costs based on the recommendations by the ACWG on asset life for water resources planning and summarised in Table 3. Asset capital replacement costs were calculated after an estimated capital construction period of 10 years. This will need further refinement once a specific capital delivery profile is developed.

Table 3: Proposed standard asset life classes for water resource planning (from ACWG Cost Consistency report)

Asset life (years)	Asset description
Non depreciating	Land, planning and development, other non-depreciating assets
4	Process-related carbon media, including Granular Activated Carbon (GAC), vehicles, computers and data logging
10	Fencing, domestic meters, building services, membranes, ICA (Instrumentation, Control and Automation)
15	Plant and machinery
20	M&E (Mechanical and Electrical) works on pumping stations and treatment works, raw water and district meters
25	Power supply
30	Steel/timber/GRP structures, landscaping/environmental works, borehole screening and casing
40	Bridges
50	Brick/concrete office structures
60	Treatment and pumping station civils (incl. intakes), roads and car parks, water towers, borehole installation, headworks/valves, underwater assets
80	Reinforced concrete tanks /service reservoirs
100	Weirs, pipelines, tunnels, aqueducts
250	Embankment works

4.2.7 Embodied and operational carbon emissions

In addition to the assessment of cost, a carbon assessment has been developed for each of the design options. Due to the current level of development for gate one, there is still significant uncertainty embedded into the proposed values and the aim will be to reduce this uncertainty as much as possible as the scheme develops further.

The carbon assessment for the river intake and conveyance pipelines was carried out separately to the reservoir using existing carbon data from Anglian Water's carbon calculator.

The reservoir elements, which were dominated by earthworks activities, used emissions factors from CESMM4 Carbon & Price Book and aligned these to the different scope items. An emission factor or unit rate representing the activity or material was then assigned to each scope item. In some cases, multiple emissions factors have been combined to represent a specific activity more accurately, or to represent a scoped element that was assumed to include multiple activities. For example, 'excavation' has been modelled with a combination of three-unit rates, representing the excavation, stockpiling and double handling of the material from the CESMM4 Carbon & Price Book.

The carbon calculations have followed best practice from the CESMM4 Carbon & Price Book[6].

A summary of the capital carbon cost of each design component is presented in Table 4. Total capital carbon is approximately 657,510tCO2e and 563,170tCO2e for the multisectoral design and the baseline design respectively, including indirect costs and optimism bias.

Table 4: Overview of capital carbon costs by scheme element

Scheme element	Baseline (tCO2e)	Multisector (tCO2e)
PWS reservoir	190,470	190,470
Farm reservoirs	–	28,430
Flood storage area	–	41,980
Wetlands	–	16,450
Fens Reservoir WTW	–	7,480
Pipelines (combined)	372,700	372,700
Total carbon (tCO2e)	563,170	657,510

6 *CESMM4: Carbon & Price Book 2013; Mott MacDonald & BRE; ICE Publishing*

Operational carbon has been estimated (maintenance carbon is yet to be completed) based on the power consumption of any mechanical scoped elements by applying emissions factors from the UKWIR Carbon Accounting Workbook (CAW) v14[7] and the Treasury Green book data table 1[8]. Hundred-year projections and operational carbon profiles have been calculated using the projected emission factors in Green book data table one, while one-off operational carbon calculations have been calculated using UKWIR CAW v14 EF for 2020. Table 5 provides a summary of the estimated operational carbon impact using the CAW v14 grid carbon emission factor.

Table 5: Overview of average annual operational carbon costs by scheme element

Scheme element	tCO2e/year[A]
PWS reservoir	1,636
Farm reservoirs	1,183
FSA	99
Wetlands	355
Pipelines	22,960
WTW	1,360
Maintenance	N/A
Total carbon	24,320

A Assumes running at full capacity and no offsetting measures (eg. wetlands, tree planting)

4.3 Whole life costs and NPV

The whole life net present value (NPV) for all options has been calculated using the WRSE NPV/AIC calculation templates. An individual template has been populated for each component, which provides an NPV finance cost, NPV Opex (at min (25%) and max (100%) utilisation). The NPVs for each component are then added together to provide the total concept design cost in Table 6 and Table 7.

Table 6 shows that the NPV costs for all concept designs at a maximum 100% utilisation. The Fens base option has a whole life (planning period) NPV of £1.15billion compared to £1.47billion for the multi-sector option.

Table 7 shows that the PV costs for all concept designs at 25% utilisation. The Fens base option has a whole life (planning period) NPV of £0.98billion, compared to £1.30billion for the multi-sector option.

Table 6: Overall estimate of whole life NPV for each concept design over 80 years @100% utilisation

Option name	Units	Fens - base	Fens - Multisector
Option benefit – additional resources or demand saved (based on full implementation)	Ml/d	99	99
Total planning period option benefit (NPV)	Ml	575,000	575,000
Total planning period indicative capital cost of option (CAPEX NPV)	£000	912,121	1,216,842
Total planning period indicative operating cost of option (OPEX NPV)	£000	242,755	254,425
Total planning period indicative option cost (NPV)	£000	1,154,875	1,471,267
Average Incremental Cost (AIC)	p/m3	201	256

Table 7: Overall estimate of whole life NPV for each concept design over 80 years @25% utilisation

Option name	Units	Fens - base	Fens - Multisector
Option benefit – additional resources or demand saved (based on full implementation)	Ml/d	99	99
Total planning period option benefit (NPV)	Ml	575,000	575,000
Total planning period indicative capital cost of option (CAPEX NPV)	£000	912,121	1,216,842
Total planning period indicative operating cost of option (OPEX NPV)	£000	67,945	79,615
Total planning period indicative option cost (NPV)	£000	980,065	1,296,457
Average Incremental Cost (AIC)	p/m3	170	225

7 Workbook for Operating Operation GHG Emissions – Version 14; UKWIR (08/12/20)
8 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/793632/data-tables-1-19.xlsx (Table3)

4.4 Data provided to regional groups

WRE has built a regional system simulator (RSS) to support best value decision-making. Apart from PWS needs, the RSS incorporates the demand for agriculture and the industry, as well as the environmental requirements defined by the Environmental Flow Indicator. A multi-criteria optimisation will define the preferred regional portfolio of supply and demand options to fulfil the needs of all sectors, with the Fens Reservoir being one of the supply-side options considered.

In order to ensure consistency between the WRE RSS and the DO assessment conducted for the Fens Reservoir, the updated hydrology assessments completed as part of this work for the Great Ouse catchment have been shared, as well as the abstraction licence arrangements for potential new intakes (see Section 4.5 for further detail). In the WRE RSS, the storage capacity of the Fens Reservoir is not fixed, allowing the optimisation to select the optimum size considering the wider regional needs and options. However, the configurations to be tested as regards sources of water have been defined based on the work presented in this gate one submission.

4.5 Initial water resource benefit assessment

Several baseline studies have contributed to the estimation of the water resource benefit of the scheme. A new hydrology assessment has been produced, in close collaboration with the Environment Agency, using the most up to date climate, hydrometric and artificial influence information. The assessment has adopted innovative rainfall-runoff modelling techniques, involving distributed approaches in areas with limited or unreliable flow data and undertaking long-term verification during historical droughts. The Environment Agency regional groundwater models in the Chalk dominated part of the Ouse catchment have been consulted as well for further corroboration.

Potential extreme droughts (e.g. a one- in-500-year return period) have been derived using a weather generator conditioned by climate drivers that represent key aspects of the climate system. Stochastic rainfall and potential evapotranspiration series have also been perturbed to represent conditions in the 2050s using the latest UKCP18 spatially coherent projections. For this stage of assessment, only one medium-range climate change scenario has been adopted corresponding to the high-emissions scenario as an upper-end stress test, with a wider range of scenarios to be used as part of the work ahead of gate two.

With the aim of increasing the output from the reservoir over the solution considered in WRMP19, different potential sources of water for the reservoir have been tested and compared in terms of the yield they could sustain using Aquator modelling. They included the original abstraction from the Ely-Ouse at Denver as well as from the Bedford-Ouse at Earith, the Middle Level at St Germans and the Ouse Washes when they are flooded. In addition, the use of the Flood Relief Channel and a potential integration of the current Essex and Suffolk Water licence at Denver with a new Anglian Water abstraction have been explored.

Potential abstraction licence constraints have been introduced following discussions with the Environment Agency and several reservoir capacities tested. Results evidenced that Denver cannot provide substantial yield as a standalone source and is also heavily affected by climate change. The extension of the flow series back to the 19th century in combination with the new climate change projections implies a significant reduction of yield for this WRMP19 configuration. A combined use of Anglian Water and Essex and Suffolk Water licences at Denver would improve the yield of a Fens Reservoir supported by Denver alone, and this option could be explored from a regional point of view.

Earith and/or the Ouse Washes should also be considered as additional or alternative sources of water in combination with Denver to provide a substantial yield for the Fens Reservoir. Earith is the best source to support the Fens Reservoir due to its large catchment area. St Germans could also be adopted depending on the location of the reservoir. A study of the Flood Relief Channel found little water resource potential due to its main flood alleviation function, which restricts the volume stored prior to droughts.

The yield assessment concluded that a 50,000Ml Fens Reservoir supported by all four sources could provide close to 100Ml/d under climate change conditions. This is a similar order of magnitude as a potential option for combining the existing Essex and Suffolk Water licence at Denver with a new one for the Fens Reservoir. Although the benefits provided by individual sources in terms of yield diminish while in combination with others (it is not always possible to store all available water when several sources operate in conjunction), particularly in the case of Denver, all of them are being considered at this stage of the scheme development to allow flexibility in the future configuration.

The choice of these sources has also been supported by a preliminary water quality risk assessment based on available sampling information and land use. This has not identified major concerns. A preliminary INNS risk assessment has also been undertaken. This has identified the main potential risks and related mitigation needs. These studies will be revisited for gate two based on the results of a new monitoring programme.

Likewise, an ecology gap analysis and scoping study has highlighted where efforts will need to be concentrated to ensure no impact on aquatic ecology. Hydro-ecological modelling will be undertaken to determine environmental flows in freshwater flowing waterbodies. It will also explore the relationship between flow and water quality in level-managed watercourses. In addition, the impact of a reduced flow on siltation downstream and on the Wash will be considered.

The adopted Fens Reservoir configuration at gate one has been modelled for conjunctive use DO, to establish the water resource benefit of the scheme when connected to the network. To support this assessment in advance of completion of the regional modelling, a sub-regional Pywr model focusing on the Anglian Water Ruthamford system has been developed. This allowed for infrastructure and licence constraints to limit the supply from the reservoir and for a combined operation of the scheme with other existing sources. The use of Pywr over Aquator has enabled testing of a wider set of climate conditions given its quick runtime and allowed a degree of comparability with the WRE regional model.

The Scottish method for establishing DO has also been implemented, where the system is simulated for the whole set of climate change perturbed stochastics for different values of demand and number of years with a failure (when rota cuts are required) recorded. The DO has then estimated as the maximum demand that can be satisfied without failing more than one in every 500 years. This has resulted in a final water resource benefit of 99Ml/d.

4.6 Wider benefits

While the principal focus of the Fens Reservoir is PWS, it is also recognised that the configuration of the scheme could be enhanced to offer wider benefits. This could be achieved by adopting a concept design that is properly integrated in the landscape, utilising existing infrastructure where possible, applying integrated water resource management principles and realising common opportunities between sectors. This is in line with:

- RAPID's aim to secure long-term resilience on behalf of customers while protecting the environment and benefitting wider society.
- The new Water Resources Planning Guidance, which states that water resources solutions must aim to increase the overall benefit to customers and consider the wider environment and overall society.
- The Design Principles for National Infrastructure developed by the National Infrastructure Commission.

It also links with the multi-agency Future Fens: Integrated Adaptation programme, which aspires to deliver integrated water management across the Fens, with benefits to communities, the economy and the environment.

Given this, multi-sector benefits will need to be integrated into the Fens Reservoir concept design between gates one and two. To facilitate this, a budget allocation has been incorporated into the gate one scheme costs. Potential features to be investigated will include:

- A multi-purpose reservoir to capture flood flows and supply irrigation demand alongside PWS.
- Flood storage areas linked to the PWS reservoir to maximise the storage capacity and allow an integrated water resources management in line with the water companies role as Risk Management Authorities.
- Bank storage wetlands to capture winter flows and support summer flows, with potential linkage to the PWS reservoir.
- Wetlands on water courses to slow the flow in winter and support biodiversity.
- Farming reservoirs connected to the PWS reservoir or sharing the same source of water.
- Open water transfers as opposed to pipelines to allow navigation, increase flood storage, reduce pumping and enhance biodiversity.
- Catchment management practices aiming to improve water quality conditions in the area.

These and other suitable features will be identified during a Participatory System Mapping (PSM) process, which is described in more detail in Section 15, through engagement with the stakeholders. This system thinking technique is specifically designed to understand problems holistically. It has an emphasis on identifying the interdependency of different features while ensuring the experience and expertise of the stakeholders in the area can be represented. The PSM will:

- Develop a conceptual map bespoke to the Fens area.
- Represent stakeholder aspirations and priorities.
- Establish system vulnerabilities and problems needing solving.
- Identify how potential design features would align with sectoral objectives (both the reservoir and associated environmental, social and economic interventions).
- Test concept designs to explore overall impacts and benefits so as to maximise outcomes.

5. Environmental and drinking water quality considerations

This section summarises the initial environmental assessments and drinking water quality risk assessments that have been completed for the Fens Reservoir solution.

5.1 Environmental assessment overview

An Environmental Assessment Report (EAR) has been completed for the initial concept design. The EAR was undertaken in-line with the methodology in the ACWG environmental assessment guidance and will align to the regional Integrated Environmental Assessment approach that will be completed by WRE.

Three accompanying regulatory assessments have also been completed: The Habitats Regulations Assessment (HRA), the Water Framework Directive (WFD) Assessment and the Strategic Environmental Assessment (SEA). The risk of spreading invasive non-native species (INNS) associated with the option has also been investigated. These assessments are summarised in the following sections below.

No Biodiversity Net Gain and Natural Capital assessments have been undertaken at this stage given that multi-sector benefits features will be incorporated for gate two and they will change the metrics significantly.

5.2 Habitats Regulations Assessment (HRA)

The HRA Test of Likely Significance (ToLS) was completed for the initial concept design to assess the potential impacts on Natura 2000 sites. The HRA identified potential likely significant effects and a number of uncertain effects during both construction and operation. This ToLS was undertaken without consideration of mitigation as determined by the ruling arising from People Over Wind and Peter Sweetman v Coillte. The following designated sites might be affected:

- The Wash and North Norfolk Coast Special Area of Conservation (SAC)
- The Wash Special Protection Area (SPA)
- The Wash Ramsar
- The Ouse Washes SPA
- Ouse Washes SAC
- Ouse Washes Ramsar

The HRA report does not present the results of an Appropriate Assessment (AA) as further modelling is being proposed to confirm whether or not the environmental flow indicators used to determine the Hands-Off Flow conditions are appropriate. The AA will need consideration at the next stage of the process once the relevant information has been produced.

5.3 Water Framework Directive (WFD) assessment

A two stage WFD assessment following the ACWG methodology has been undertaken for the adopted concept design. The Level 1 WFD assessment indicated that there were five waterbodies that required further assessment: Middle Level, Counter Drain (Manea and Welney Internal Drainage Board (IDB)), Ouse (Roxton to Earith), Great Ouse and Ely Ouse (South Level). Level 2 WFD assessments were completed for these five waterbodies. The findings indicate that there are precautionary WFD compliance risks associated with the operation of the four new abstractions. The potential hydrological effects could conflict with achieving WFD status objectives. The potential biological effects, particularly on fish, would require further assessment. The impact on wetlands water level and their frequency of flooding will need to be determined.

5.4 Strategic Environmental Assessment (SEA)

Among the SEA objectives, the adopted concept design at this stage would only have a moderate positive impact during operation for the delivery of reliable and resilient water supply in line with the intended use. There could be, however, major or moderate positive effects for the local communities and the environment if wider benefit features are implemented for gate two, such as wetlands, flood storage areas, visitor centres or enhanced public rights of way/ cycle routes.

The assessment has identified a potential major negative impact to biodiversity due to the proximity to statutory designated sites. This could be partially mitigated by the implementation of best practice methods to minimise disturbance effects, as well as the reinstatement of priority habitats where possible with the aim of delivering substantial net benefits for biodiversity. In addition, moderate negative impacts would be related to:

- The functionality, quantity and quality of soils due to the reservoir and pipelines falling within Grade 1 and 2 agricultural land.
- The presence of two authorised landfill sites within 500m with potential to disturb contaminated material.
- The location of the reservoir within Flood Zone 2 and 3, albeit it benefits from flood defences at the one-in-100-year flood level at present.
- The location within the Fens National Character Area.
- The existence of several listed buildings and a scheduled monument within 500m and the potential for unknown archaeology to be discovered during excavation of the reservoir.

These impacts are associated with the selected representative site and are therefore subject to change once the ongoing site selection process is completed. In addition, with the adequate mitigation measures they could be reduced to minor.

It is noted that the SEA does not at this stage include for any in-combination assessment with other SROs, water company capital investments or third-party development plans or projects. However, there is no specific requirement to undertake a full cumulative effects assessment for gate one, and it is proposed that the SEA will be reviewed at gate two once the solution has progressed and the regional plans have developed further.

5.5 Invasive Non-Native Species (INNS) risk assessment

An initial INNS risk assessment was undertaken to establish the risk associated with the transfers included in the initial concept design. The assessment compared the concept design against relevant Environment Agency guidance and key legislation. This screening highlighted that the area is connected to adjacent catchments via the Grand Union Canal and River Nene at Stanground sluice. Hence, an INNS risk assessment was required, which the Environment Agency will use to decide whether subsequent mitigation is required.

Screening of risks associated with legislation required an assessment of current INNS distribution, for which the assessment area included the WFD operational catchments of the potential abstraction sources. The desk assessment highlighted the presence of 15 aquatic and riparian plant, eight fish and 15 macro-invertebrate INNS. This was supplemented by field surveys, which identified the presence of 4 INNS (Caspian mud shrimp, demon shrimp, Florida/Northern river crangonyctid, and zebra mussel). Further, environmental sampling has identified quagga mussel in the Ten Mile River at Denver. All potential source waterbodies were found to contain high-impact INNS named in the environmental legislation, meaning that mitigation of the additional INNS transfer risk will be required. No threat of re-classification of High Status WFD waterbodies due to the spread of UK Technical Advisory Group High Impact species was identified.

An INNS risk assessment tool was used to compare the four proposed abstraction options. The Earith intake scored the greatest Inherent Risk Score due to the frequency, magnitude and distance of transfer. Adjusted Risk Scores did not differentiate between options further, as the same exacerbating factors and mitigation options apply to all options. When the distribution of INNS, protected species and protected sites is incorporated into the Weighted Risk Score, the source waterbodies are ranked in the following order of risk, from high to low: Earith, Ouse Washes, Ely Ouse, Middle Level Main Drain.

The tool indicated that risk would be significantly reduced if designed with a closed transfer to the reservoir, as well as designed as a closed system (i.e. discharged water is returned to the reservoir). The potential effectiveness of mitigation options was investigated using the tool. Two-stage treatment (i.e. coagulation and filtration) before discharge into the reservoir was found to be most effective whereas screening through 3-10mm mesh at both ends of the transfer route with no other measures was least beneficial.

5.6 Landscape assessment

A Landscape Concept Design has been developed with the aim to assess the landscape sensitivity for the initial concept design. This has been indicatively visualised to provide a better understanding of how the Fens Reservoir would integrate into the adopted representative location. The proposed embankment height at this stage of 10m would not significantly contrast with existing embankments (e.g. the Ouse Washes' 5m middle level barrier) or agricultural buildings in the locality. The adoption of extensive landscaping and tree planting around the reservoir footprint would also contribute to limit the visual impact. Other measures to enhance the existing environment and provide lasting and measurable change to the local communities could include:

- **Wetland creation –** creation helps promote ecological benefits, restore wetland landscapes and promote sustainable development.
- **Floating island ecosystems –** riparian ecosystems are critical for many species of fish and aquatic life that can provide a measurable increase towards Biodiversity Net Gain.
- **Enhanced access and connectivity –** recreational provision of footpaths, cycle paths and nature trails will provide positive opportunities for the local community and other visitors.
- **Species-rich meadow creation and woodland enhancement –** wildflower measures offer a diverse and attractive habitat for invertebrates, birds and mammals. Native shrub and woodland planting will help link existing woodland and enhance natural wildlife corridors.
- **Visitor centre/outdoor recreation hub –** multi-use venue that can both serve on-site recreational activities, school visits, corporate workshops and serve as a community hub.

5.7 Assessment of opportunities for net-zero carbon contributions

A key part of delivering an efficient net-zero strategy is to focus efforts on where the largest and most efficient reductions can be made. As a starting point, it will be important to develop an understanding of the major carbon contributors from a capital and operational perspective for the scheme to help focus efforts on areas with the greatest reduction potential.

A more granular baseline will be analysed as the scheme progresses to provide a more detailed understanding of specific carbon emission sources. Nature-based solutions such as tree planting, peat restoration and wetlands will be explored to reduce the carbon footprint of the scheme. This will also link with the Future Fens: Integrated Adaptation programme and initiatives such as the Fens Biosphere and the Lowland Agricultural Peat Taskforce.

5.7.1 Capital carbon reduction opportunities

- Earth works: the most significant source of carbon emissions during construction will be associated with the earth works for the reservoir. To reduce capital carbon, the following key areas have been identified:
  - Minimising earthworks movements and double handling.
  - Minimising the use of imported materials and maximising use of materials on site.
  - Use of low-carbon plant vehicles to reduce emissions from fuels. This will rely on suitable plant vehicles being available and will require early coordination with the supply chain (contractors and plant manufacturers).
- Materials (reinforced concrete, pipelines): there is also a significant amount of embodied carbon in the reinforced concrete required for elements of the scheme and the material for the pipelines for the transfers. Specification of the lowest carbon materials and working with the supply chain to reduce the embodied carbon of supplied materials will further reduce the carbon impact.

5.7.2 Operational carbon reduction opportunities

- Power consumption: power consumption and the power intensity of the pumping requirements and the treatment processes is the most significant source of operational carbon emissions. Mitigation options include:
  - Opportunities for renewable generation: the scheme could look to generate all, or a proportion, of the power requirements through renewables onsite. Alternatively, the scheme could look for commercial arrangements to procure green power through a direct wire Power Purchase Agreement (PPA). This would reduce the carbon impact of the associated power consumption with the site from the grid average value to zero.
  - Procurement of green tariff electricity: Renewable Energy Guarantees of Origin (REGO) backed green energy tariffs would reduce the generation impact of grid power from the grid average to zero but would still incur the associated transmission and distribution losses associated with grid supply.

5.8 Initial drinking water quality considerations and risk assessments

5.8.1 Water Quality Risk Assessment

A Water Quality Risk Assessment (WQRA) was carried out for the Fens Reservoir scheme. The purpose of the WQRA at this stage of the scheme development is to provide a high-level review of the risks to drinking water quality. The WQRAs were carried out based on guidance developed for the ACWG[9].

The process included workshop sessions attended by representatives from the water quality teams from Anglian Water and Cambridge Water. The Drinking Water Inspectorate (DWI) also attended a meeting prior to the workshop at which the WQRA methodology was outlined and discussed. The DWI will continue to be invited to meetings to ensure ongoing discussion at a solution-specific level.

The key outcomes from the WQRA for the Fens Reservoir are as follows:

- 4-log removal of cryptosporidium must be considered in the treatment designs.
- Careful consideration must be given to bromate formation, with changes to the treatment options potentially required post-gate one.
- Careful consideration must be given to disinfection by-product formation, with changes to the treatment options potentially required post-gate one.
- Metaldehyde must be considered going forward on the project despite the fact it is expected to be banned in March 2022.
- Further water quality data must be gathered for the Fens Reservoir sources.

Following the completion of this preliminary WQRA, a subsequent water quality monitoring programme has been established to gather additional water quality data. This data will be used to further develop the WQRAs to a greater level of detail and confidence. The programme will include a review of the data against the list of limiting hazards to ensure that the preliminary list is appropriate and to determine whether any additional hazards need to be added.

5.8.2 Treatment process

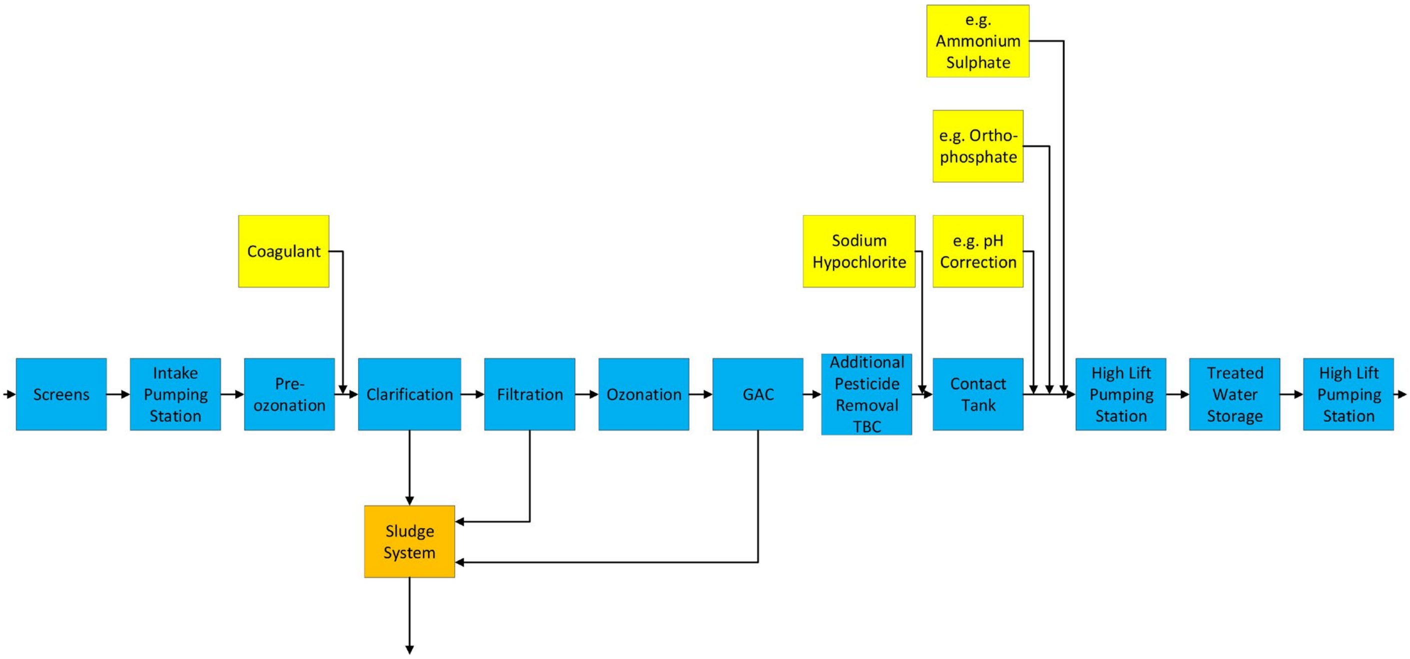
The outputs from the WQRA have been used to inform the development of the treatment requirements for the Fens Reservoir scheme. As presented in Figure 6, the following treatment processes have been assumed to be required:

- Coagulation.
- Clarification (either by settlement or flotation).
- Filtration (commonly rapid gravity sand filters).
- Pesticide removal.
- Ozonation.
- GAC adsorption.
- Disinfection with sodium hypochlorite solution.
- Other chemical additions such as orthophosphate for lead control, pH adjustment and ammonium sulphate to produce a chloramine residual.

While not included here, further considerations such as the capture, removal and disposal of mussels will need to be considered at later design stages. Bankside storage has not been included at this stage but may be required if water quality sampling indicates unpredictable water quality, notably sediment.

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

Figure 6: Schematic of treatment process for Fens Reservoir



In addition, it is likely that the Fens Reservoir design will include an aeration system installed within the base of the reservoir to promote circulation and mixing to manage any water quality issues associated with the storage of the impounded water.

6. Initial outline of procurement and operation strategy

6.1 Background

Under the RAPID process, it is assumed that all solutions will meet the PR19 criteria for Direct Procurement for Customers (DPC) and follow the DPC process route. Under this framework, appointees run a competitive procurement process and award a Design, Build, Finance, Operate and Maintain (DBFMO) type contract to the Competitively Appointed Provider (CAP) for a predefined revenue period.

6.2 Procurement strategies

As part of the gate one submission, DPC has been considered as the preferred route for delivery of the Fens Reservoir solution. Alternative procurement strategies may be employed at a later stage if the scheme is deemed not suitable for DPC delivery and an alternative offers more value for customers. For delivery under the DPC route, three procurement structures have been considered:

- **Single appointee –** One company contracts with CAP and the other company receives no supply.
- **Joint Venture (JV) –** Anglian Water and Cambridge Water form a JV that contracts with CAP.
- **Single appointee and a Bulk Supply Agreement (BSA) –** Anglian Water contracts with CAP and holds BSA with Cambridge Water.

Following further evaluation, if the solution is deemed not suitable for DPC, there are various alternative procurement strategies such as in-house delivery, in-house delivery with a BSA, through a Regulated Third Party, through a Non-DPC DBFMO contract or other models.

6.3 Eligibility assessment

The eligibility assessment for DPC is made up of a three-stage test. 1) Is the project greater than £100m whole life Totex? 2) Is the project sufficiently discrete? 3) Will the scheme deliver Value for Money (VfM) for customers if delivered via DPC?

1. Size test

Table 8: Size Test

Initial Capex (£m)	Opex over 25-year period (£m)	Maintenance Capex over 25-year period (£m)	Whole life Totex (£m)	Greater than £100m?
1,525	335	113	1,973	Yes

2. Discreteness assessment

Table 9: Results of the discreteness assessment

Discreteness criteria	Assessment summary
Stakeholder interactions and statutory obligations	Medium/high (2.5)
Interoperability considerations	High (3)
Output type and stability	Medium/high (2.5)
Asset and operational service failures	Medium (2)
Summary	Medium/high (2.5)

6.4 DPC tender model

Under DPC, there are several tender models to split the activities and responsibilities between the appointee and the CAP. This could be at a very early (before the preferred option is selected), early (before the initial design is completed), late (after the consents have been awarded), very late (post-construction) or a split model. At this stage in the process, a late DPC tender model appears to be to be the most appropriate for the Fens Reservoir solution. The planning and consenting stage of the process is likely to be the riskiest and most efficiently delivered by Anglian Water. In addition, the late tender model aligns with the existing RAPID framework.

6.5 Next steps

Post-gate one submission, further eligibility assessments and development of the DPC tender model will be performed, followed by development of initial commercial model and early market engagement.

6.6 Anticipated operation

The operation of the asset is linked to the procurement strategy; the chosen procurement route will confirm who will be responsible for the operation. If DPC, the CAP could operate the asset, whereas if an alternative procurement strategy is selected such as in-house delivery, the water company would be responsible. Further work will be done prior to gate two to clarify these options.

The Fens Reservoir will operate continuously adding to the storage capacity of the Anglian Water system, from which it will be transferred to Cambridge Water, and potentially Affinity Water. Therefore, it will operate in combination with other assets to supply the demand required during the year, with a peak expected in July and August. The scheme is being designed to meet future growth demand and long-term environmental ambition and is not expected to reach its full design capacity immediately.

Abstraction will occur mainly between November and March, when streamflow is above the established Hands-Off Flows, whereas transfer from the Ouse Washes will extend to May due to the storage they provide. Preference will be given to this transfer in order to achieve a quicker drawdown of the Washes in spring and avoid low-level floods disturbing the birds' breeding season. On average, the Ouse Washes would provide 60% of the water required by the Fens Reservoir, and Earith would offer a further 25%. This highlights the relevance of the Bedford Ouse as a source of the scheme.

The stored volume in the reservoir will be above 80% of its capacity on average, being almost full between March to May before drawing down on storage through until October to November. In normal years, the minimum storage volume will not fall below 60% of the storage capacity. It is projected that it will only fall below this during drought years. Once the configuration of the scheme is confirmed at gate two, drought curves will be developed so that demand saving measures can be activated when required.

7. Planning considerations

This section summarises the key anticipated features of the likely consenting process for the Fens Reservoir. The consenting strategy will evolve as the scheme progresses to gate two.

It is proposed that the Fens Reservoir will be promoted as a Nationally Significant Infrastructure Project (NSIP), requiring a DCO under the Planning Act 2008.

The reservoir abstraction and transfer infrastructure and related highways and other development would also be consented as part of the DCO, as "associated development" (as defined in the 2008 Act).

The DCO will be developed through comprehensive community and stakeholder engagement. This will involve effective stakeholder engagement, such as through the Fens Water Partnership, as well as up to four rounds of consultation. This will consist of one round of non-statutory consultation prior to gate two, with up to three further rounds of consultation taking place between gate two and the DCO submission, at least two of which being statutory under Section 42 and 47 of the 2008 Act.

An Environmental Impact Assessment (EIA) will be carried out in accordance with the process mandated by the 2008 Act and relevant guidance. This will commence with EIA scoping, followed by environmental surveys, the production of Preliminary Environmental Information (PEI) and, in support of the DCO application, the delivery of an Environmental Statement. The existing environmental assessments will form the basis for any future EIA and PEI.

The DCO can also provide compulsory acquisition powers. While the Anglian Water and Cambridge Water preference is to acquire land by agreement, the project will ensure that these powers can be fully exercised if required. Land referencing and landowner engagement will take place between gate one and gate two to inform this process.

Comprehensive and focused site selection and concept design development will ensure that risks around environmental impact assessment and compulsory acquisition will be appropriately managed, particularly in respect of the consideration of alternative locations or designs.

The scheme faces several risks or uncertainties in respect of the DCO process, summarised in Section 9, including:

- Uncertainty over the timing of the approval of the National Policy Statement.
- The risk of public inquiry or legal challenge in respect of the WRMP.
- Sustained objector risk, particularly if compulsory acquisition powers are sought, resulting in increased consultation and EIA effort, potential delays and higher risk of legal challenge.

8. Stakeholder engagement

Fens Reservoir is being developed and co-created in collaboration with WRE and wide-ranging stakeholders across the region, organisations and other SROs. Key stakeholders include the Environment Agency, Natural England, councils, wildlife organisations and local internal drainage boards (IDBs). This way of working is building a strong foundation for the aspirations of the Fens Reservoir. This will ensure that scheme development between gate one and gate two is transparent and, most importantly, informed by the wider stakeholder community. This participatory approach will help to deliver a scheme that meets the needs of all water users, driving economic development while restoring and enhancing the natural environment.

Key to this is the Fens Water Partnership (FWP), which is being established to foster an inclusive decision-making environment that will shape the future of Fens Reservoir. Organisations currently involved represent a wide variety of interests, such as the environment, public water supply, agriculture, and local communities. It is expected that this partnership base will continue to evolve, reflecting the rich tapestry of the Fens and the organisations that feel so passionately about it. Due to the nature and scale of the scheme, there will be a need for extensive engagement with landowners, local authorities and communities as the design is developed and preferred sites are identified. The engagement programme and planned activities for gate two are presented in Section 15.

The Fens Reservoir and South Lincolnshire Reservoir proposals are also central to the work being led by the Future Fens: Integrated Adaptation Partnership. This ground-breaking partnership, led by Anglian Water, the Environment Agency and WRE, is bringing together key partners to address the challenges of climate change in the UK's most exposed area. The partnership will draw on international experience, bringing together drainage and flood management with water resources. The ambition is for the reservoir systems to form part of a broader overarching strategy which delivers environmental, social and economic prosperity to the Fens.

8.1 Regional customer engagement

A programme of customer engagement was commissioned in collaboration with the other SROs and involving 10 water companies to examine customers' understanding of water resources and the need for regional solutions. This research programme was an industry first and ensured that feedback was comparable across companies and solutions in addition to being cost efficient. The scope and the approach were agreed in advance with a coalition of representatives from the participating water companies' Customer Challenge Groups, Consumer Council for Water (CCW) and RAPID.

The research relevant to Fens Reservoir was as follows:

- An evidence review of over 100 documents across the 10 companies to compile insights from PR19 and WRMP19 research to ensure development on previously available information.

- Qualitative research with Anglian Water customers to test broad priorities, including the proposals for sharing water between companies.

The key findings from the customer engagement research were:

- The evidence compiled to this point demonstrates that proposals to share water between companies are seen in a positive light by customers. There is a recognition that collaborative planning and options can be efficient and fairer because water is a communal resource. However, schemes like Fens Reservoir are seen by customers as not being a substitute for demand measures such as reducing leaks, saving water and localised supply options.

- Reservoirs are a widely accepted option by customers – with a majority view that the recreation and environmental benefits outweigh the localised impacts and disruption of construction. It is evident, though, from the qualitative research that Fens Reservoir cannot be tested with customers separately from the associated transfer solution(s) or the alternative source(s) and transfer combinations that could be substitute options. A preference to avoid negative environmental impacts strongly underscores customer views on supply options, hence the level of support for Fens Reservoir will depend on the combined impacts from source and transfer.

- Customers want to see a clear view on the "choice" that will be faced for the Fens Reservoir in relation to the need for and timing of other SROs, including comparative costs and the potential impacts that could be avoided, so framing this scheme in the broader strategic planning context for water resources will be important as the scheme develops.

Anglian Water and Cambridge Water will work together between gates one and two to ensure further customer engagement is undertaken, incorporating the views of their customers.

8.2 Regional planning group engagement

The Fens Reservoir is a key component of the WRE regional plan. WRE brings together partners from a wide range of sectors including water, energy, retail, the environment, land management and agriculture, to work in collaboration to manage the region's challenges, building on the area's unique opportunities for sustainable future growth and pioneering a new approach to managing water resources. The Fens Reservoir will be central to the decisions on the combination and timing of strategic options that will be undertaken through the WRE planning conferences throughout summer and autumn 2021.

8.3 Targeted Fens Reservoir technical engagement

Specific stakeholder engagement for the Fens Reservoir to this stage has focused on the FWP, statutory consultees and regulators to ensure close alignment on issues of data collection and assessment. A summary of the engagement to date is presented in Table 10.

Table 10: Fens Reservoir specific engagement

Stakeholder	Assessment summary	Activity to date
Drinking Water Inspectorate (DWI)	Regulation of drinking water quality. Interested in the progression of this scheme as an alternative source of water into the region.	Introductory meeting in January and WQ monitoring plan discussion in April.
Environment Agency (EA)	Regulation of water resources (quantity and quality), environmental and hydrological monitoring and assessment. Delivery of wider environmental ambition and objectives.	Active engagement as member of FWP. Fortnightly progress calls with local team. Detailed workshops on key development areas. Flood and Coastal risk management (FCRM) technical inputs provided.
Fens Water Partnership (FWP)	The partnership is aiming to find a multi-sector water resource management solution for the Fens.	Monthly meetings with workshops as required.
Highways England	Long term planning on road infrastructure. Early engagement to align plans.	Attending participatory system mapping workshops.
Historic England	To ensure the historic environment is protected but to reconcile that with the economic and social needs and aspirations of the people who live and use the area.	Attended site selection workshops.
Local Authorities	Responsible for the planning process regarding location and disruption of any works involving abstraction, transportation and treatment for the scheme.	Regular updates and engagement through FWP and additional ad hoc meetings.
Natural England	Legal and regulatory requirements with respect to the natural environment plus landscape and environmental benefits and opportunities for enhancement.	Active engagement as member of FWP.
Ofwat	Economic regulation of water industry. Ultimate approval of option progression to business plans.	Scheme updates via the RAPID meetings, plus additional meetings to update on procurement strategy.
RAPID	Regulatory alliance with responsibility for overseeing the work to examine the SROs and for administering the gated process.	Introductory meeting in January 2021 and agenda item at RAPID's quarterly liaison meeting in March 2021. A written summary of the solution was also submitted by Anglian Water and Cambridge Water to RAPID in April.

There is general agreement from stakeholders that they are keen to ensure the Fens Reservoir can deliver the desired outcome of a multi-sector solution, set against the WRE ambition of a thriving 'water market' in eastern England. Stakeholders also recognise that the scheme will need to provide a viable public water supply option for inclusion in the WRMP24 and PR24 Business Plans for Anglian Water and Cambridge Water.

8.4 Preparing for community engagement

In preparation for the DCO application for this scheme, an independent specialist communications, PR and public affairs organisation has been engaged to provide additional support on the development of plans for community engagement.

A community consultation and engagement strategy has been developed for the project. Through consideration of opportunities to consult effectively and meaningfully, we anticipate holding the first phase of community consultation on a preferred site following the screening process.

9. Key risks and mitigation measures

For gate one, a qualitative risk register has been used to manage programme risk. The key risks are summarised in Table 11, alongside the mitigation measures put in place and the latest trend; these risks have been reported in the RAPID quarterly dashboards.

Table 11: Programme risk summary

Risk details		Mitigation plan	Trend
Risk (event)	Effect(s)		
Delay in WRE preferred portfolio	WRE selects a Fens Reservoir with a different output to the one estimated with the gate one concept design.	Maintain flexibility in the site selection process in case a larger reservoir is required. Continue hydrology work to allow changes in sources of water.	Stable
Site selection to define preferred site	Robustness of site selection methodology, to inform preferred site and option for gate two, challenged as part of DCO consultation or examination process, undermining case for project or compulsory powers.	Comprehensive site selection and consultation programme to ensure project progresses on a robust and proportionate evidence base. Use of participatory systems mapping (PSM) and multiple-criteria decision analysis (MCDA) techniques.	Stable
RAPID, DCO and DPC inter-dependencies	All three elements have differing timescales, complexities and gateway requirements that need to be understood. Programme misalignment could result in delays.	Understand and overlay all three processes to enable alignment, with identification of critical path, to deliver a coherent strategy. Further detailed investigation of each workstream ongoing through to gate two.	Decreasing
Embankment material uncertainty	Inadequate ground information leading to incorrect assumption of existing material at preferred site, impacting required on-site excavation works and potential requirement for costly material import.	Targeted and phased ground investigation programme to be developed, to run in parallel with process to select a preferred site for gate two, to mitigate risk of uncertain ground conditions.	Stable
Stakeholders oppose options considered	Lack of stakeholder buy-in to solution (site and concept) resulting in programme delays, particularly from formal DCO consultation requirements.	Mitigation is being undertaken through ongoing stakeholder engagement and collaborative decision-making.	Stable
Delivery route approach	Uncertainty about potential delivery routes and necessary work required to understand respective programmes.	Identification of delivery route options and programme implications for delivery of scheme undertaken for gate two to be reviewed, and market engagement will take place in preparation for gate two.	Decreasing
Legal challenge or public inquiry	External challenge to programme resulting in delays; eg. public inquiry of WRMP resulting in delays in publishing WRMP24 or DCO grant unsuccessful	DCO programme and approach to consultation to be developed to manage and mitigate this risk.	Stable

10. Option cost/benefits comparison

The cost of the gate one concept design is presented in Section 4.2, which also includes a description of the costing approach and confirmation that the costs have been developed in accordance with relevant methodologies and guidance.

The Fens Reservoir will provide wider benefits beyond just PWS, by incorporating into the concept design multi-sector features to maximise outcomes. As described in Section 4.6, a PSM approach is being undertaken to identify the aspirations of each sector and to establish the best interventions to tackle the existing problems in the Fens. Building on that knowledge, a Multi Criteria Decision Analysis (MCDA) approach is proposed for identifying the preferred concept design and site that will be presented at gate two.

The MCDA process will draw on the concept design work that has been completed to date and combine multi-sector features to deliver best value. Criteria will be mapped to the agreed objectives, while their relevance in the decision will be defined with stakeholders using a facilitation tool and adjusted to reflect a fair representation of sectors. Scoring will be applied based on the results of multi-sector modelling/assessments or on stakeholder feedback when a quantitative assessment is not possible. Additional criteria to be considered in the analysis include: geology and cost, flood risk impact, biodiversity net gain, natural capital, WFD compliance, revenue generated, etc.

The MCDA tool will be used to present stakeholders with the inherent trade-offs of the concept design and site selection and as a way of supporting decision making. It will also provide the best value option that satisfies a certain set of constraints and will allow both promoters and stakeholders to consider the implications of their own selections and choices.

Finally, as part of the regional plan, WRE will select a portfolio of demand management and supply-side options to meet the needs of all of those with an interest in the abstraction and use of water in the region over the period to 2050 and beyond. This process will involve:

- A portfolio selection using the multi-objective robust decision making (MO-RDM) process previously developed by WRE. Based on a multi-sector regional water resource simulator, MO-RDM allows the vulnerabilities of the various water resource and water supply systems in the region to be quantified and the performance of different options for meeting agreed targets to be tested. From this, the preferred set of options will be selected.

- A delivery strategy will be agreed, distinguishing between sub-options that should primarily be delivered through water company business plans and options that should be delivered by other sectors. For the water company options, the order in which these should be delivered will be based on a least cost optimiser (Economics of Balancing Supply and Demand, EBSD), considering the strategies that are more flexible and adaptive and so better suited for dealing with the uncertainties associated with growth and climate change.

The Fens Reservoir will form part of this regional assessment as one of the key supply-side options, with the MO-RDM optimisation expected to select the size of the scheme that will be required and the regional EBSD establishing when it should be delivered. The optimisation will consider not only cost (Capex and Opex) and PWS reliability, but also agriculture deficit, energy reliability and deviations from environmental flow requirements to ensure that the best value option is selected.

11. Impacts on current plan

This section describes the impact of the Fens Reservoir on current delivery plans and places this solution within the wider context of company and regional WRMPs.

Anglian Water WRMP19 highlighted the need for an adaptive plan to enable better management of future uncertainties. Several strategic options were identified as part of this plan for pre-planning activities this AMP, recognising there could be a need for additional supply-side capacity as early as 2030. The Fens Reservoir was one of the options included - a 50,000Ml winter storage reservoir to supply North Fenland water resource zone (WRZ). However, it was only selected in the extended preferred plan in 2080, mainly due to the reduced DO benefit of a scheme only supported from Denver. The additional sources of water explored at this gate increase the benefit-cost ratio of the scheme to support other Anglian Water WRZs and open the opportunities of trading, something that will need to be confirmed by the WRE plan and WRMP24.

Cambridge Water WRMP19 identified a deficit from the beginning of the plan period due to the growth in population and properties, impacts on supply from climate change and reductions in DO to protect the environment. The preferred portfolio to mitigate the problem included demand management options, recommissioning groundwater sources and, beyond the 2040 planning period, other options such as trading with Anglian Water and Affinity Water and new sources of supply. Trades with neighbouring water companies would be dependent on company scale or WRE options enabling surplus resources to be available in existing infrastructure; for example, the Affinity Water North ring main or from Anglian Water's Grafham sources.

New sources of supply options considered by Cambridge Water were variations on winter storage reservoir options capturing flows from the Bedford-Ouse or Ely-Ouse ranging from 20-40Ml/d of DO. These options were being selected beyond the 2040 planning period for the WRMP19 preferred plan modelling and not earlier due to economic comparison. As WRE options have developed and, in particular, the proposed Fens Reservoir option that would rely on some of the same water sources, the Cambridge Water new supply options are most likely to be more effectively combined as a single, larger shared regional option. Therefore, the evolved option to include additional sources for abstraction for the Fens Reservoir would replace a number of options selected by Cambridge Water at WRMP19 for consideration just beyond the planning period. If Fens Reservoir is developed, these would no longer be available to Cambridge Water, with remaining feasible supply options largely limited to transfers from other companies.

The development of the Fens Reservoir ties in with the current planning for WRMP24 for both Anglian Water and Cambridge Water, who have worked closely to develop the Fens Reservoir proposals. It also fits with the long-term ambitions and strategies relating to environmental ambitions and growth for both companies and for the region as a whole. The solution provides supply resilience for both companies as abstraction reductions and climate change impacts begin to impact existing sources and is aligned with WRE's mission to provide multi-sector solutions that benefit a range of water users and support sustainable housing and economic growth in the region. WRE estimates a regional deficit for public water supply alone of 1,176Ml/d[10] by 2050 – Fens Reservoir has the potential to supply 8% of this.

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12. Board statement and assurance

The decision to promote the Fens Reservoir into the RAPID process has been assured using Anglian Water's internal governance processes and through joint working with Cambridge Water.

A comprehensive assurance framework, consistent with the framework used for Anglian Water's other solutions in the RAPID process, has been developed and applied to the tasks undertaken to date in developing the solution. The full assurance process, including third-party assurance, will be applied ahead of the gate two submission should RAPID accept the solution into the process.

Both Anglian Water and Cambridge Water Boards support this submission and have signed off the Board statement in accordance with the RAPID guidance, based on the above controls and assurance.

13. Solution or partner changes

Anglian Water and Cambridge Water are currently working in partnership to develop a mutually beneficial solution for the Fens Reservoir scheme. This partnership arrangement between the two companies is anticipated to remain unchanged through to gate two, at which point the arrangement will be reviewed in light of scheme developments across the other inter-related RAPID SROs.

As has been described above, this scheme is linked to the A2AT SRO and, as such, Cambridge Water has an interest in the Fens Reservoir. The nature of Cambridge Water's future involvement will be determined through further assessment of the A2AT option and through the WRE regional planning process.

Essex and Suffolk Water is also a key stakeholder. It is actively involved in the solution's development and in WRE, and will consider if/whether to join ahead of gate two.

14. Efficient spend of gate allowance

14.1 Gate one expenditure

In accordance with RAPID guidance, as this is a new solution that is not currently in the programme, all work completed to date has been funded as base activity from Anglian Water's adaptive planning programme.

14.2 Gate two costs

The full forecasted spend for the planned gate two activities is provided in Table 12. Governance and funding arrangements will be established between Anglian Water and Cambridge Water before gate two.

Table 12: Breakdown of gate two budget

	Deliverable	Budget (£k)
1	Solution feasibility and data collection:	–
1.1	Hydrology	192
1.2	Site selection	146
1.3	Concept design (including environmental assessments)	846
1.4	Site surveys	265
1.5	Ecology	79
1.6	Flood risk considerations	130
1.7	Water quality considerations (including water quality monitoring surveys)	460
2	Procurement strategy	200
3	Considerations of planning application route	25
4	Contribution to Regional Planning	50
5	External assurance	50
6	Customer and stakeholder engagement	246
7	Environment Agency and Natural England contribution	467
8	Project Management	688
9	Specialist consultants (legal support, land agent, landscape architect, design panel)	430
	Risk	250
		4,524

Further work is required to understand the requirements and budget post gate two, to inform discussions with RAPID regarding future funding.

15. Proposed gate two activities and outcomes

The project-level plan for gate two is provided in Figure 7 and detailed in Table 13. This demonstrates how the site selection and concept design workstreams are converging to ensure a robust process is in place to inform the selection of a preferred concept design. The site selection process is ongoing and involves an initial coarse screening stage. During this stage, sites posing a risk to achieving DCO consent as well as those with unfavourable geology are discounted. The fine screening stage will involve ranking the suitability of the remaining sites to fulfil the objectives of the scheme while minimising impacts and associated mitigation measures, all the time ensuring affordability.

This site selection process will be structured around a MCDA, involving scoring sites against a set of criteria agreed with stakeholders. It also considers stakeholders' aspirations and any local issues identified as part of a Participatory System Mapping (PSM) process. Both the MCDA and PSM have been commissioned. Weightings for criteria will be agreed with stakeholders using a facilitation tool and adjusted to reflect a fair representation of sectors. Some criteria will be quantifiable through modelling (eg. flood risk benefits and impacts), assessments (eg. biodiversity net gain, natural capital, etc) or engineering (eg. cost and carbon informed by preliminary ground investigation etc). Other criteria will require stakeholder feedback.

Consideration will be given to the monetisation of costs and benefits based on existing water company value frameworks. It is anticipated that affordability will be the main constraint during this process so consideration will be given to customer choices. To ensure costs are reliably integrated in the process, a geological review of each site will be conducted and a high-level design of a reservoir sitting in each site undertaken.

Once a reduced number of sites is identified, there will be another iteration of the MCDA optimisation. This will aid the selection of the integrated preferred site and concept design. As part of this, there will be an opportunity to review criteria, weighting and scoring agreed during the fine screening stage. Ground investigations will offer better information on the geological implications of each site and a more detailed flood risk analysis will be conducted.

The PSM process conducted during the fine screening phase will support the process by establishing how well concept designs would fulfil stakeholder aspirations and how they could be shaped to maximise outcomes. Once a single preferred site and concept design are selected, engineering design will be carried out to confirm feasibility and estimate costs for gate two submission. Environmental assessments, a preliminary flood risk assessment and a drinking water quality risk assessment will also form part of the preferred concept design development.

Alongside site and concept design selection, water quality and ecology monitoring will take place to confirm the environmental flows, verify the suitability of the proposed sources and serve as the basis of the environmental assessments, including the INNS risk assessment. Water quality modelling will investigate the potential benefits of catchment management and wetlands while also establishing the reservoir mixed water quality condition to inform the drinking water quality risk assessment and treatment needs. Water resources modelling will evaluate the water resource benefit of the scheme and quantify the potential multi-sector benefits. Finally, flood modelling will explore ways in which the scheme can deliver flood risk benefits to local communities while avoiding negative impacts.

In addition to the development of the reservoir itself, work will be undertaken to develop the transfer from Fens Reservoir to Cambridge Water. Efficiencies can be achieved by utilising the work done to date on the A2AT SRO and this will be further developed to understand the preferred route for this pipeline.

Figure 7: Project-level plan for gate two

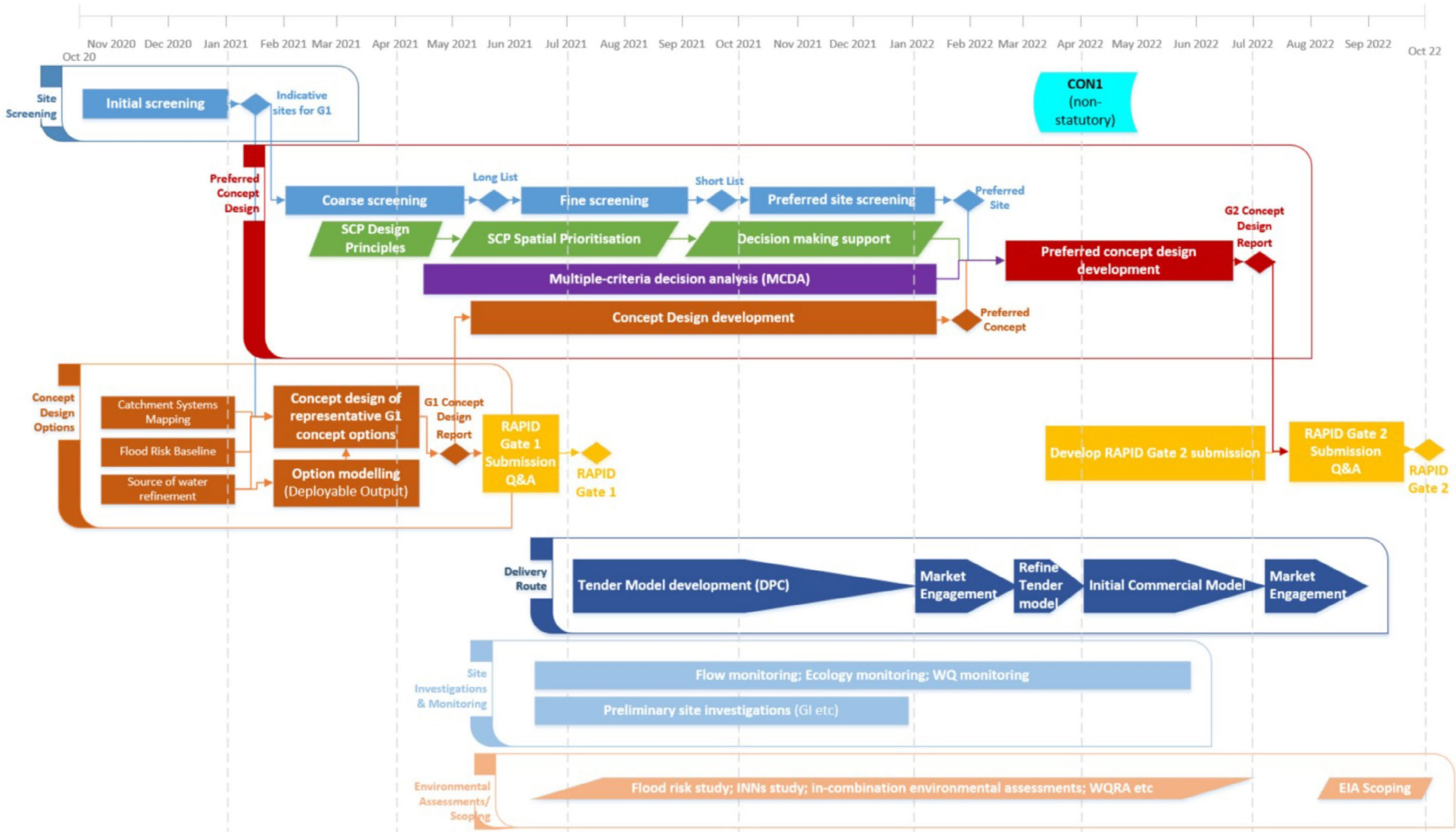

Table 13: Proposed activities for gate two

	May 21 -> Oct		Nov -> Jan 22		Feb 22 -> Oct 22
Planning and procurement	• Planning and procurement for DCO application • Consider potential regional model outputs to inform DO and source of water • Update and convert existing qualitative risk assessment into quantitative assessment • Procurement: tender model development • Legal advice on DCO process	**Regional model output**	• Analyse regional modelling outcome to amend/inform preferred concept design • Assess interaction with other SROs • Consideration of consents and licences required • Procurement – DPC market engagement • Engage landscape architect to challenge thinking	**Single option selection**	• Land referencing • Public consultation (non-statutory) • External assurance of high/critical gate two activities • Procurement – refine tender model and develop initial commercial model • Procurement – DPC market engagement (continued)
Engineering	• Commence water quality monitoring • Site selection: fine screening to determine shortlist of sites • Participatory System Mapping and multi-sector modelling • Multi-criteria decision analysis tool development to determine preferred concept design and site location • Costing analysis of long list of site locations • Economic modelling • Stochastics and climate change study • Search area ground investigation		• Site selection: preferred site screening • Concept designs for WTW • Develop operational philosophy • Preliminary ground investigation on shortlist of sites • Archaeological assessment • Topographical survey on shortlist of sites • Water quality modelling		• Finalise water quality risk assessment • Engineering concept design of preferred option – possible early contractor involvement • Develop layouts
Environmental	• Ecology monitoring • Hydro ecological modelling • INNS study to inform concept design		• Update HRA to include an in-combination assessment. • Further investigation into the potential BNG and NC effects		• Update SEA and WFD • Preliminary Flood Risk Assessment • Field work and desk studies for EIA for DCO process • Quantify soil movements and develop landscaping plans to minimise waste transfer • Quantify impact of construction vehicles • Commence EIA scoping (August 22 start)
Engagement	• Club project across a number of SROs to explore customer preferences for recreational benefit on reservoirs. • Utilise learning from regional engagement to inform our communication plans regarding SROs more generally. • Continue programme of stakeholder engagement.		• Regional consultation on WRE plan • Begin early engagement with landowners, highways/rail regarding construction.		• Phase One consultation on site selection (TBC) • WRMP public consultation • Statement of Community Consultation to set out upcoming statutory consultation opportunities for local communities • Ongoing engagement with stakeholders, landowners and wider community

16. Conclusions and recommendations

The work undertaken to gate one has highlighted that the Fens Reservoir has the potential to deliver a water resource benefit of a regional scale that could contribute to the future demand for water in the Anglian Water and Cambridge Water regions. A collaborative approach to decision making involving relevant stakeholders is ongoing to ensure that multi-sector features can be incorporated in the concept design to maximise outcomes. Work carried out to date is in line with the RAPID requirements for gate one, and the forward plan demonstrates that Fens Reservoir will be developed sufficiently to be comparable with other SROs by gate two. Fens Reservoir meets the criteria to become a RAPID SRO as detailed below, and it is recommended that it joins the process from gate one.

Is there value in accelerating the solution's development to be 'construction ready' for the 2025-2030 period?

The deficit in WRMP24 is expected to be greater than in WRMP19 due to factors such as 1:500 drought resilience, the OxCam Arc growth and enhanced environmental benefit. Hence, it is currently expected that there will be a need for Fens Reservoir to be in supply in AMP10. This, along with the required output, will be confirmed when the drafts of the Regional Plan and WRMP24 are published in August 2022. Joining RAPID now will enable the scheme to be in a 'construction ready' state sooner than the current programme of work being undertaken as part of the adaptive planning programme would allow.

Does the solution need additional enhancement funding for investigations and development?

Fens Reservoir is currently funded as part of Anglian Water's Adaptive Planning Programme, based on the simple WRMP19 solution and limited DO allowance, to circa £1million. Additional enhancement funding is required to progress the scheme to gate four to ensure it can be in supply in AMP10. Further work is required to understand requirements and budget post gate two to inform conversations with RAPID regarding the additional funding.

Does the solution need the additional regulatory support and oversight provided by the Ofwat gated process and RAPID?

Yes. Anglian Water and Cambridge Water are collaborating on the scheme so RAPID's oversight and support will benefit both companies. The support will also provide efficiencies, especially working in parallel with the South Lincolnshire Reservoir, a RAPID scheme for Anglian Water and Affinity Water.

Does the solution provide a similar or better cost /water resource benefit ratio compared to current solutions?

Recent investigations have shown that using multiple sources improves the deployable output for the same size reservoir, making this solution more competitive against other possible solutions. However, until the Regional Plan and draft WRMP are published, required deployable output will not be known.

Does the solution have the potential to provide similar or better value (environmental, social and economic value – aligned with the Water Resources Planning Guideline) compared to current solutions?

The Fens Water Partnership has been established to identify and advance multi-sector benefits. Links have already been identified to flood storage, biodiversity and agricultural needs. The scheme could form a key part of a broader water management strategy for the Fens as part of the Future Fens collaborative initiative.

Annex A: Landscape plan of Fens Reservoir initial concept design

Cover photo – Grafham Water