MOTT MACDONALD

# SESRO Engineering

South East Strategic Reservoir Option
Carbon Report

July 2021

Confidential

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# Issue and Revision Record

| Revision | Date | Originator | Checker | Approver | Description |
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| 1 | 14/07/21 | R. McNicoll | A. Mortimore | A. Mortimore | July 2021 Carbon Report |
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# Contents



## Tables

# 1 SESRO Overview

Mott MacDonald have been commissioned by Thames Water and Affinity Water to carry out the Engineering Services for the South East Strategic Reservoir Option (SESRO), identified as one of the Strategic Resource Options (SROs) in Ofwat's PR19 Final Determination. The SESRO design is based on the abstraction of water from the River Thames during high flows, to be conveyed to and stored in a non-impounding reservoir. This water would then be released back into the River Thames so that it would be available for abstraction downstream by Thames Water, Affinity Water (and potentially other companies) during periods of low flow.

The design of SESRO is described in detail in the Conceptual Design Report. A summary of the primary components is provided below:

- Provision of a fully bunded reservoir in Oxfordshire with total storage capacity between 75Mm$^3$ and 150Mm$^3$.
- Pumping station at the toe of the embankment.
- Conveyance tunnel to transfer flows via the pumping station to / from an intake / outfall structure.

This report provides details on the carbon estimates at Gate 1 for the six SESRO variants. These include four single phase variants and two dual phase variants:

- 150Mm$^3$ capacity reservoir
- 125Mm$^3$ capacity reservoir
- 100Mm$^3$ capacity reservoir
- 75Mm$^3$ capacity reservoir
- 30+100Mm$^3$ capacity phased reservoir
- 80+42Mm$^3$ capacity phased reservoir

# 2 Carbon Estimation

## 2.1 Asset Planning System

Carbon information on SESRO has been developed based on cost estimates, both of which are stored on Thames Water's Asset Planning System (APS). APS is a database used within Thames Water to hold candidate investments for the Periodic Review business plan submission to the financial regulator, Ofwat. Information on APS referred to in this Carbon Report was provided by Thames Water[1].

APS has capex estimating models taken from the Engineering Estimating System (EES) and it has unit rates for various different types of operational expenditure. APS also tracks the price base at which solution data is entered and is able to rebase costs to the required price base for reporting. The cost and carbon models are internally and externally validated periodically to ensure accurate costing outputs. Over the years the system has been independently audited by Ofwat and has a proven track record of being a robust and auditable data capture and cost/carbon modelling system.

Each project in APS is known as a Solution, and is given a unique Solution reference. Therefore, for SESRO there are eight different Solution references, one for each variant:

- 150Mm$^3$ – S22304
- 125Mm$^3$ – S25102
- 100Mm$^3$ – S23060
- 75Mm$^3$ – S22303
- 30Mm$^3$ (Phase 1) – S29961
- 100Mm$^3$ (Phase 2) – S29962
- 80Mm$^3$ (Phase 1) – S29963
- 42Mm$^3$ (Phase 2) – S29964

Solution data is read into APS as csv files. These files contain data about each Solution (Title, Description, price base, capex profile), capex costs, operating costs and carbon data. These data are imported into APS so that all of Thames Water's investment options are stored in one place. The following sections provide additional information on how the carbon data was developed for the SESRO variants.

## 2.2 Carbon Estimation within APS

Carbon was estimated within APS using the capital and operational cost estimates as a basis. Capital costs are developed from a scope of lines of investment and operational costs are built up based on operational activities. This information is input to APS and provides a description of the scheme.

APS holds over 6 million embedded carbon values and each value is held against a common asset structure. As cost data is collected and imported into the system the carbon is automatically calculated based upon code, volume, size and/or attributes unique to the project.

The data enables the EES to produce robust process/equipment model(s) from those project calculations and helps Thames Water to support the 3 key areas within the business in an auditable way.

- High level Carbon Estimating for investment purposes and project life-cycle tracking.
- Regulatory 5 yearly carbon - setting baseline for PR19/AMP7.
- Understanding our commitments to being carbon neutral by 2030.

[1] Overview of APS – Provided by Thames Water on 8th March 2021

The carbon estimate developed within APS for the SESRO variants is provided in Table 2-1.

**Table 2-1: Carbon Estimate for SESRO Variants**

| Option variant | Embodied Carbon ($tCO_2e$) | Fixed (annual) Operational Carbon ($tCO_2e$)* | Variable Operational Carbon ($tCO_2e$ / Ml) * |
|---|---|---|---|
| 150Mm³ | 352,081 | 913.09 | 0.013 |
| 125Mm³ | 329,148 | 725.51 | 0.014 |
| 100Mm³ | 305,205 | 595.20 | 0.015 |
| 75Mm³ | 281,972 | 494.20 | 0.015 |
| 30+100Mm³ Phase 1 | 250,871 | 200.14 | 0.014 |
| 30+100Mm³ Phase 2 | 151,774 | 641.36 | 0.019 |
| 80+42Mm³ Phase 1 | 301,151 | 523.53 | 0.015 |
| 80+42Mm³ Phase 2 | 102,159 | 315.12 | 0.027 |

Note: * assuming ‘normal’ grid, based upon Total UK Grid average (Carbon Accounting Workbook v14) - 0.000277 tCO2e / kWh

# 3 Carbon Challenge Workshop

A virtual carbon challenge workshop was held in December 2020 to consider opportunities for reducing the embodied and operational carbon of the SESRO scheme. The workshop adopted the principles of the Infrastructure Carbon Review (ICR) and PAS 2080, contesting that focussing on carbon reduction will lead to cost reduction, more collaborative and innovative design teams, and result in leaner, more efficient projects. The workshop was attended by Thames Water, Affinity Water and members of the Gate 1 consultancy team, and focussed on the 150Mm$^3$ variant. The workshop focussed on embodied and operational carbon hotspots in the design based on analysis of WRMP19 estimates (see Table 3-1 below).

SESRO has a high embodied carbon as it is a very large infrastructure scheme requiring significant earth movements and construction of large structures. The table below indicates that earth moving accounts for around 68% of the construction carbon. In contrast the operational carbon is lower than some other WRMP option types, such as desalination. The reservoir stores water for use in dry years and therefore pumping into the reservoir (with consequent power / carbon use) is an intermittent activity. Aeration / mixing equipment in the reservoir would be used more regularly to maintain water quality.

**Table 3-1: Carbon hotspots**

| Process | Approximate contribution to carbon | Reduced carbon opportunities |
|---|---|---|
| **Construction** | **Embodied carbon** | |
| Earthworks for embankment | 47% | • Ensure cut and fill balance is achieved (as per current concept design) to ensure material is used on site with no requirement for offsite disposal<br>• Use of electric or hydrogen powered plant (or HVO fuel (Hydrotreated Vegetable Oil) as a diesel alternative), particularly for the fleet of earth moving plant<br>• Automation of plant to increase efficiency of earth movements<br>• Engage local workforce to reduce transport emissions |
| Land re-purposing | 12% | |
| Site preparation | 9% | |
| Structures | 8% | • Use of low carbon construction materials<br>• Recycling of concrete and other materials from demolition of existing on-site infrastructure<br>• Use of rail for material transport (as included in the current design concept)<br>• Use of river for materials transport to site (considered have low feasibility due to size of river at this location compared with the material quantities required)<br>• Local recycling of spare construction materials to other construction sites or local community |
| Roads and paths | 6% | |
| **Operation** | **Operational carbon** | |
| Pumping to fill reservoir | 55% | • Further consider opportunities for on-site power generation from renewable sources (see sections below)<br>• Provision for on-site electric vehicle (EV) charging facilities for use by visitors and staff<br>• Consider opportunities for integration with other large scale planned developments, such as the OxCam Arc, on low carbon initiatives |
| Reservoir aerators | 39% | |

The workshops identified a number of opportunities to reduce carbon and support net zero carbon objectives. It is recommended that these are investigated further during Gate 2, as follows:

- Investigate options to use low carbon construction plant and lower carbon intensity construction materials, quantify the likely carbon reduction of low carbon alternatives on the total embodied carbon and provide recommendations for an adaptable phased construction approach in tune with future advances in technology. Pursuing change in this area is likely to have the most significant impact on the carbon footprint of the scheme.

- Further develop options for renewable power generation at the site.
- Further consider potential for local low carbon initiatives such as recycling of construction materials, provision of on-site EV charging and synergies with OxCam Arc.
- Engage the supplier chain to start to remove barriers to lower carbon alternative options so that they are ready to implement by the construction phase.

The findings from the carbon challenge workshop should be considered in further detail during Gate 2 in line with a route map for the carbon ambition for SROs. This will require carbon management principles to be integrated in the design development process by applying a PAS2080 (or similar) framework. The findings from the carbon challenge workshop can also inform a carbon mitigation plan, which engages designers, contractors and product and material suppliers, which will also need to consider the water companies net zero carbon plans with the commitment to reach net zero (for Scope 1, 2 and outsource activities under Scope 3) by 2030.

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