E. Economic assessment

E.1 Assessment methodology

E.1.1 The CWWTPR project will be publicly funded through a government grant from the HIF to facilitate the regeneration of the existing WWTP site. Without the HIF funding the relocation would not be feasible. The HIF grant is finite, and subject to a capped maximum amount. In addition, Anglian Water is required to use the grant as efficiently as possible.

E.1.2 The economic assessment comprised the calculation of whole life costs for each of the site area options (including sub-options) building on the costs developed during Stage 3 – Fine Screening. The economic assessment was carried out by experienced construction professionals using recent cost data from a range of similar wastewater projects in the UK.

E.1.3 Initially an unmitigated cost for each option was established, which comprised the development of the scheme at each of the three sites and the associated infrastructure, assuming standard industry design approaches and assumptions which would be required across all three site areas, such as compliance with air and water quality related regulations and permits. This approach established the baseline site area option against which all other site area options are compared.

E.1.4 The calculation of the whole life costs included both capital costs (including DEVEX, CAPEX and Capital Maintenance) and operational costs (OPEX) for the new WWTP and associated infrastructure. The Capital Maintenance and OPEX included in the whole cost estimates were forecast over a 20-year period.

E.1.5 Following the formation of the baseline cost estimates, the mitigation and enhancement measures established in the environmental and operational assessments were used to revise the whole life cost estimates for each of the site area options. The revised ‘with mitigation’ cost estimates were then compared to establish the lowest cost mitigated site area option.

E.2 Establishing a cost baseline

Approach

E.2.1 A whole life cost for an unmitigated version of each of the site area options (including sub-options) has been calculated.

E.2.2 As discussed above, the unmitigated versions of the options comprise the development of the scheme at each of the three sites and the associated infrastructure, assuming standard industry design approaches and assumptions which would be required across all three site areas. However, the unmitigated options do not include consideration of any site specific planning or operational constraints or potential impacts that the scheme may have on the environment or local communities.

E.2.3 This approach establishes the baseline site area option against which all other site area options are compared.

E.2.4 The whole life cost of each option is the discounted cost of the option over 20 years (including capital and operational costs over the lifetime of the project), converted into an equivalent unit of cost of waste water treatment in £/m^3 net present value terms. This means that future costs and outputs are discounted, when compared to costs and outputs today.

E.2.5 The following sections outline the assumptions used in the calculation of the unmitigated costs.

CAPEX assumptions

E.2.6 The following assumptions have been used in the calculation of the CAPEX.

E.2.7 The construction cost of the WWTP is the same for all three sites as in an unmitigated version of the option there is no difference in the treatment processes and environmental protection measures employed at each site.

E.2.8 An estimate for the cost of land acquisition and compensation has been factored into the costs based on a preliminary understanding of the current land uses at each of the three site areas.

E.2.9 The cost of the associated transfer infrastructure differs due to the variation in length and method of construction. The main design assumptions for tunnels and pipelines in terms of diameters, construction methods, etc. were outlined in the Stage 3 Fine Screening report and are considered to still be valid. However, further work on defining the corridors for Stage 4 has resulted in some changes in the assumptions in relation to tunnel/pipeline lengths and these are provided in Table E.85.

Table E.85: Transfer infrastructure assumptions – tunnel and pipelines

Parameters		Site 1		Site 2		Site 3
	Unit	Option A	Option B	Option A	Option B	Option A
Waste water transfer tunnel (all options)						
Total tunnel Length	m	2550		3000		2650
Drive shaft depth	m	23.5		26.1		23.7
Reception shaft depth	m	17.3		17.3		17.3
No. Intermediate shafts		0		0		0
Waterbeach waste water transfer pipeline (all options)						
Pipeline length	m	4360		6120		6310
Treated effluent return tunnel (sub-option i)						
Total tunnel length (m)	m	3100	2600	4000	4000	1500
Drive shaft depth	m	12.0	12.0	12.0	12.0	12.0
Reception shaft depth	m	12.4	11.8	11.5	11.5	10.4
No. Intermediate shafts		1	0	1	1	0
Intermediate shaft depth	m	0	0	10.5	10.5	0
Treated effluent return pipeline (sub-option ii)						
Pipeline length		3100	2600	4000	4000	1500

The costs for road access and high-voltage power connections have also been included in the unmitigated cost baseline.

OPEX assumptions

E.2.10 The following assumptions have been used in the calculation of the OPEX.

E.2.11 As per the CAPEX the operational cost for treatment of the waste water is equal for all three sites due to the identical requirements for treatment processes and operational controls in an unmitigated scenario. However, there are differences in the operational costs in terms of the

energy requirements for transferring waste water from Cambridge and Waterbeach to the new WWTP as well as returning treated effluent to the River Cam. These differences arise due to the variations in length and depth of the tunnels as well as the length of pipelines as described in the CAPEX assumptions above.

Calculated CAPEX and whole life costs

E.2.12 Table E.86 details the baseline (unmitigated) CAPEX and equivalent unit costs calculated for each of the options.

E.2.13 From the CAPEX comparison it can be seen that Option 3Aii has the lowest baseline CAPEX estimate. These CAPEX estimates are based on a preliminary design for the proposed options and it is not unusual for an uncertainty range to be applied to the CAPEX estimates. In this case an uncertainty range of +20% / -15% would be reasonable given the stage of project development. This range is in line with the US Association for Advancement of Cost Engineering (AACE) cost estimation classification scheme[75], which provides guidance on cost estimate classification and uncertainty ranges. If the final CAPEX was at the higher end of this uncertainty range then both options 3Ai and 3Aii provide greater certainty of being within budget than the other options.

E.2.14 From the whole life cost comparison it can be seen that Option 3Aii has the lowest whole life costs, closely followed by option 3Ai. However, the difference between the options is small, with a maximum difference of 6% between the lowest and highest whole life cost options (2Ai, 2Aii, 2Bi and 2Bii).

Table E.86: Comparison of total capex and whole life costs (unmitigated)

Option	Total CAPEX as % of lowest cost options	WLC as % of lowest cost options
1Ai	107%	103%
1Bi	105%	102%
1Aii	107%	103%
1Bii	105%	102%
2Ai	113%	106%
2Bi	113%	106%
2Aii	112%	105%
2Bii	112%	105%
3Ai	101%	101%
3Aii	100%	100%

[75] AACE, International Recommended Practice No. 18R-97, Cost estimate classification system – as applied in engineering, procurement, and construction for the process industries, TCM Framework: 7.3 – Cost Estimating and Budgeting, 2005. Available at: https://www.costengineering.eu/Downloads/articles/AACE_CLASSIFICATION_SYSTEM.pdf

Baseline option

E.2.15 The calculation of the whole life costs has identified that the baseline option is a new WWTP on site area 3, using pipelines for returning treated effluent to the River Cam. This represents the option that all other options will be compared against in the mitigated scenarios.

E.3 Mitigated costs

Approach

E.3.1 The mitigation measures for the different options are outline in mitigation identification sections in Appendices B, C and D. Some of these mitigation measures would have either no impact or very low impact on the cost of each option. However, some options would have a more significant cost impact and these additional mitigation costs should be taken into account in site selection and reflected in the 'with mitigation' option costs. The 'with mitigation' costs (CAPEX, OPEX and WLC) for each option have been assessed by adding the estimated costs of proposed mitigation measures to the baseline (unmitigated) costs discussed in Appendix E.1.1.

E.3.2 The following mitigation measures were estimated to have significant cost impacts and have been included in the 'with mitigation' option costs:

- Use of a primary and secondary lining for tunnel sections and shafts passing through the Lower Greensand or Grey Chalk aquifers to prevent interaction with groundwater in the aquifers
- Access impact mitigation measures. For site area 3, construction of proposed operational access via High Ditch Road/Low Fen Drove Way from Junction 35 of the A14 (see Appendix D.2).
- Nature Conservation and Biodiversity.
- Landscape and visual amenity. Provision of tree and hedge planting, modification of structure elevations and appearance and other landscape modifications
- Odour. Installing covers on additional process units, orientation and design of the WWTP such that process units would be further away from receptors at site area 1. Similar mitigation measure not required for sites 2 and 3 (see Appendix B.8).

Results

E.3.3 The mitigated costs are compared with the unmitigated costs in Table E.87.

Table E.87: Mitigated vs unmitigated costs

	% compared to lowest cost option (CAPEX)		% compared to lowest cost option (WLC)	
Site area option	Unmitigated	Mitigated	Unmitigated	Mitigated
1Ai	107%	111%	103%	105%
1Bi	105%	109%	102%	104%
1Aii	107%	109%	103%	104%
1Bii	105%	107%	102%	103%
2Ai	113%	116%	106%	107%
2Bi	113%	116%	106%	107%
2Aii	112%	113%	105%	105%
2Bii	112%	113%	105%	105%
3Ai	101%	102%	101%	101%
3Aii	100%	100%	100%	100%