APPENDIX 7.3
SCORING OF ECONOMIC PERFORMANCES OF MAINS WATER STRATEGIES

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Cost estimates for the construction and operation of WWTW associated with Strategies WW1 and WW7 were developed using PlanIT STOAT (Annexe A), and summarised together with those associated with WW4 in Annexe B.

Initial costing of the six Mains Water strategies has resulted in the following indicated costs in £millions

Strategy	TOTAL CAPEX*	TOTAL OPEX*	PV
WS3(i)+WW1	71.9	29.3	78.1
WS3(i)+WW4	75.8	32.8	83.6
WS3(i)+WW7	74.4	29.3	80.2
WS4(i)+WW1	83.9	46.5	98.2
WS4(i)+WW4	87.8	50.0	101.9
WS4(i)+WW7	86.4	46.5	98.5

* Undiscounted ** over a 30 year period at 3.5% pa

In order to score each strategy on a scale of 1 to 5 for each characteristic, a banding system is proposed.

There is a reasonable indicated spread of CAPEX among the strategies, the average being £88.0 million, so the following is proposed:

Score	Definition	CAPEX Cost range
1	More than 20% above average	> £96.0M
2	Not more than 20% above average cost	£88.0M to £96.0M
3	Within plus or minus 10% of average	£72.0M to £88.0M
4	Not more than 20% below average cost	£64.0M to £72.0M
5	More than 20% below average cost	< £64.0M

The indicted range of OPEX, is significantly wider, reflecting generally the more energy intensive nature of some of the component strategies. The average total (30-year) OPEX, undiscounted, is £39.1 million. The same basis of banding is nevertheless proposed:

Score	Definition	OPEX Cost range
1	More than 20% above average	> £46.9M
2	Not more than 20% above average cost	£43.0M to £46.9M
3	Within plus or minus 10% of average	£35.1M to £43.0M
4	Not more than 20% below average cost	£31.2M to £35.1M
5	More than 20% below average cost	< £31.2M

Due to the general low range of CAPEX values, and the comparability of the 30 years' worth of OPEX it is not surprising that range of PV (averaging £90.1 million) mirrors that of OPEX. The same banding is therefore proposed for scoring PV, namely:

Score	Definition	PV Cost range
1	More than 20% above average	> £108.1M
2	Not more than 20% above average cost	£99.1M to £108.1M
3	Within plus or minus 10% of average	£81.1M to £99.1M
4	Not more than 20% below average cost	£72.1M to £81.1M
5	More than 20% below average cost	< £72.1M

As the report indicates, there are only small differences in the extent to which the Mains Water strategies meet the quality objectives. Each offers slightly different environmental benefits, the relative importance of which may be viewed as being sufficiently close as to make no significant difference. For the scoring of benefit: cost ratio for each Mains Water, it may be assumed that the ratio is simply inversely proportional to cost (taken as PV), and so the definitions of '1' to '5' for cost: benefit ratios may be taken as being the same as that proposed for PV above.

On the basis of the above, the 'economics' scorings of the six Mains Water strategies are as follows:

Strategy	**Total Capex***		**Total Opex***		**PV****	**Score (PV & B:C)**	**Total Economics score**
	£M	**score**	**£M**	**score**	**£M**		
WS3(i)+WW1	71.9	4	29.3	5	78.1	4	17
WS3(i)+WW4	75.8	3	32.8	4	83.6	3	13
WS3(i)+WW7	74.4	3	29.3	5	80.2	4	16
WS4(i)+WW1	83.9	3	46.5	2	98.2	3	11
WS4(i)+WW4	87.8	3	50.0	1	101.9	2	8
WS4(i)+WW7	86.4	3	46.5	2	98.5	3	11

* Undiscounted

** Over a 30-year period at 3.5% pa

ANNEXE A: Plan-It STOAT Modelling

INTRODUCTION

There are several different computer models available for modelling wastewater treatment works. Most of these models are quite complex and intended for detailed process design and design optimisation. Plan-it STOAT is more suited to preliminary design and enables unit process sizes to be determined, together with chemical and power requirements, to estimate capital and annual operating costs for the plant. The output files generated are compatible with other computer models which may be used at a later stage to further develop the design of the wastewater treatment plant

OBJECTIVE

The objective for using the model for the preparation of this report is to carry out outline designs for various sizes of treatment plant to meet the effluent quality standards established in the SIMCAT model and to evaluate the total costs of each alternative scheme.

MODEL SIMULATION AND RESULTS

Plan-it STOAT is only capable of modelling conventional treatment processes, in particular the more engineered processes such as the activated sludge process and the newer processes that have been developed from it; natural processes are more difficult to model. For the purposes of this report, the models for the different options are all based on the activated sludge process.

The existing works at Bybrook employs biofilters; however, insufficient information is currently available to model this, and to check the additional requirements if the existing filters are modified and/or new filters are added, as might be appropriate for Option T2. At this stage, it has been assumed that a new activated sludge stream will be provided operating in parallel with the existing biofilters.

In addition to the modelling a conventional activated sludge plant, a module has been included for chemical phosphorus removal, in order to meet the required standards determined by the SIMCAT model.

If a new works is constructed at Lower Wye, there is the possibility that the sludge treatment centre will be moved to the new treatment works. However, the costs of this would be prohibitive, and it has been assumed that the sludge treatment centre will be retained at Bybrook. No attempt has been made in evaluating the costs of any additional sludge treatment facilities at Bybrook that may be necessitated by the additional sludge produced. As all the options include the activated sludge processes, it has been assumed that sludge production will not vary significantly between the options, so it has been assumed that the additional sludge facilities required at Bybrook will be the same for all options. However, Options T3(a) and (b) will produce sludge that will need to be tankered to Bybrook for treatment, thus the sludge thickening/holding tanks that will be required at the new works have been included in the model.

Plan-it STOAT is capable of producing Net Present Costs. However, although provision figures have been inserted for power costs, no figures have been inserted for the costs of chemicals or labour. At this stage, the Net Present Costs generated by the model should be ignored.

The following options have been re-modelled for the Final Report:

T1(a)	Extended WwTW at Bybrook for all flows
T2	Extended WwTW at Bybrook for limited flows
T3(a)	A single new conventional works to serve all new development areas to south and west of town discharging to the Great Stour.

Model Reports are included in the following pages.

Plan-it STOAT
Costs of conventional WWTW Options

Costs - Option T3(a)													
Unit	Anoxic	Recycle	Aerated tank	FST	BW thickener	6. Thickener	15. Equalization	Filter	Ferric dosing	PST	16. Bar screen	17. Grit trap	Totals
Capital cost, £'000	320	0	1200	800	86	7.7	72	3100	56	360	170	160	6331.7
Chemicals, £'000/y	0	0	0	0	0	0	0	0	22	0	0	0	22
Labor cost, £'000/y	0	0	0	0	0	0	0	0	0	0	0	0	0
Power, £'000/y	0	0	45	0	0	0	0	0	0.5	0	0	0	45.5
Total capital cost, £'000													7600

Costs - Option T2											
Unit	Anoxic	Recycle	Aerated tank	FST	BW thickner	Filter	Ferric dosing	PST	14. Bar screen	15. Grit trap	Totals
Capital cost, £'000	370	0	1400	980	110	4500	54	490	200	200	8304
Chemicals, £'000/y	0	0	0	0	0	0	37	0	0	0	37
Labor cost, £'000/y	0	0	0	0	0	0	0	0	0	0	0
Power, £'000/y	0	0	61	0	0	0	1.1	0	0	0	62.1
Total capital cost, £'000											10000

Costs - Option T1(a)											
Unit	Filter	Ferric dosing	PST	Anoxic	Recycle	Aerated tank	FST	BW thickner	14. Bar screen	15. Grit trap	Totals
Capital cost, £'000	530	110	250	140	0	670	490	33	110	170	2503
Chemicals, £'000/y	0	1.9	0	0	0	0	0	0	0	0	1.9
Labor cost, £'000/y	0	0	0	0	0	0	0	0	0	0	0
Power, £'000/y	0	0.41	0	0	0	23	0	0	0	0	23.41
Total capital cost, £'000											3000

Note: No costs for chemicals and for labour have been inserted into the model and costs for power are subject to confirmation.

CONCLUSIONS

Retaining the WWTW at Bybrook and extending it to cater for all flows from the new development areas is the cheapest of the schemes involving conventional technologies.

The above costs have been derived from data contained within the Plan-it STOAT model, and are valid for comparative purposes. Care should be exercised in comparing the above costs with the costs of alternative options which have been derived from other sources.

ANNEXE B: Comparison of WWTW costs for WW1, WW4 and WW7

Strategy	WW1	WW7	WW4 - Natural Treatment Processes	
	Extensions at Bybrook WWTW to accommodate all new flows to Bybrook	1 No New Activated sludge plant (in addition to limited extensions at Bybrook)	2 No plants employing the Fed Batch Reactor System (FBRS) (in addition to limited extensions at Bybrook)	*2 No plants employing Eco-restorer system & polishing (in addition to limited extensions at Bybrook)*
Designed to achieve:	BOD < 7.8	BOD < 8 mg/l	BOD < 8 mg/l	*BOD < 8 mg/l*
	NH3-N < 3.6	NH3-N < 4 mg/l	NH3-N < 4 mg/l	*NH3-N < 4 mg/l*
	NO3 < 17	NO3 < 6	TON < 6 mg/l	*TON < 6 mg/l*
	PO4 < 0.5	PO4 < 0.3	PO4<0.3 mg/l	*PO4<0.3 mg/l*
DWF (m3/d)	19632 (to Bybrook)	12685 (to new works)	12685 (to new works)	*12685 (to new works)*
New "South" Works				
Surface area (m2)	N/A	4494	4450	*35,000*
Capital cost [1][2]	N/A	£8,000,000	£8,700,000	*£6,800,000*
Additional:				
Bar screen [3]	N/A	already included	already included	*£200,000*
Grit trap [3]	N/A	already included	£150,000	*£150,000*
Chemical dosing [3]	N/A	already included	£50,000	*£50,000*
Sand filter [3]	N/A	already included	£3,100,000	-
Additional surface area (m2)	N/A	0	1,128	*593*
Additional Capital Cost	N/A	0	£3,300,000	*£400,000*
Total Surface area (m2)	**N/A**	**4,494**	**5,578**	***35,593***
Total Capital Cost	**N/A**	**£8,000,000**	**£11,800,000**	***£7,200,000***
Area m2 / m3 /d	**N/A**	**0.36**	**0.45**	***2.85***
Cost /m3/d	**N/A**	**£641**	**£946**	***£577***
Bybrook Extensions Capital cost (£)	**£10,000,000**	**£3,000,000**	**£3,000,000**	***£3,000,000***
Total Capital cost (T2 + Option) (£)	**£10,000,000**	**£11,000,000**	**£14,800,000**	***£10,200,000***
Annual chemical Cost [4]	£36,000	£36,000	£36,000	*£36,000*
Annual power cost - new "south" works [6]	£0.00	£46,500	£174,000	*£91,500*
Annual power cost - Bybrook [5]	£62,100	£23,500	£23,500	*£23,500*
Total annual operating costs for chemicals and electricity but excluding labour etc.	**£98,100**	**£106,000**	**£233,500**	***£151,000***

Notes to table

1) The above estimates are provided to facilitate comparison of the short-listed options on a like for like basis. The costs for WW1, WW4 and WW7 are estimates of the costs incurred in providing the additional treatment capacity needed to accommodate the flows from the new developments, leaving the existing Bybrook works unchanged. Whilst the new works are designed to treat flows to the tight standards evaluated by the SIMCAT Model, no allowance has been made for upgrading Bybrook to meet to the revised standards; it being assumed that these will be the same for all the short-listed options.
No allowance has been made for the work that SWS will be undertaking at Bybrook under the AMP4 Programme, under which the capacity of the works will be increased from 18,000 to 24,000 m^3/day to meet a standard of (summer/winter) of 30/20mg/l-SS; 20/10mg/l-BOD; 7/3mg.l-NH_3 and 1mg/l-P. This could have an impact the future strategy and may need to be reviewed in the light of long term needs.
(2) Costs for Option T3 were derived from Planit Stoat. Costs were evaluated in US$ in the US. In addition to converting the currency, a location factor of 0.6 has been applied to obtain UK costs.

(3) Costs were derived from Planit Stoat. Costs were evaluated in US$ in the US. In addition to converting the currency, a location factor of 0.6 has been applied to obtain UK costs.

(4) Annual chemical costs for phosphorus removal have been assumed to be the same for all options.

(5) Power costs for conventional systems were derived from Planit Stoat using a unit cost of 13.9 cents per kWh (based on equivalent UK price of 5 pence per kWh).

(6) Power costs for natural systems have been derived from power usage figures provided by Living Technologies using a cost per unit of 5 pence.