Thames Water

Final Water Resources Management Plan 2019

Technical Appendices

Appendix X: Programme appraisal outputs

Table of contents

Figures

Tables

Appendix X.

Programme appraisal outputs

- This Appendix provides additional details in support of the programme appraisal process set out in Section 10 of the main rdWRMP19 report.
- It should be read in conjunction with Appendix W, which contains methodological notes.
- It contains outputs which will be useful for readers interested in following the detail of the Step 2 process, including:
  - output tables providing the full metric and options selected information for each scenario and each EBSD+ optimisation run (for the combined London, SWOX and SWA WRZ)
  - 'relative frequency' analysis, highlighting which options are selected more regularly across the optimisation runs
- We also present further information on Step 4 of the process (performance testing), including:
  - final planning target headroom results by WRZ
  - the derivation of and the outputs from adaptability analysis
  - the derivation of and the outputs from 'what if' analysis tests

A. Report structure

X.1 This Appendix is structured as follows:

- Programme appraisal Step 2: EBSD+ outputs
- Programme appraisal Step 4: Final planning target headroom
- Programme appraisal Step 4: Adaptability analysis outputs
- Programme appraisal Step 4: What-if scenarios and outputs
- Programme appraisal Step 4: What-if summary output table

X.2 The EBSD+ outputs in Step 2 includes sub-sections covering:

- Baseline scenarios (Step 2 a-c), our assessment of the least cost solution and the sustainable economic level of demand management.
- Tables of metric scores and option delivery dates for all optimisation runs in each baseline scenario.
- Tables of relative frequency analysis for the selection of options in each of the scenarios (Steps 2a-c, individually and in total).

B. Programme appraisal Step 2: EBSD+ outputs

X.3 This section provides Economics of Balancing Supply and Demand (EBSD+) outputs for all optimisation runs considered in our programme appraisal for the London, Swindon and Oxfordshire (SWOX) and Slough, Wycombe and Aylesbury (SWA) water resource zones (WRZ)[1]. The combined WRZ is referred to as LSS. These outputs include:

- Performance against all seven metrics used to assess the performance of the plan resulting from an optimisation run as part of programme appraisal. These metrics are listed below. The role of metrics in programme appraisal is explained in Section 10 (Programme appraisal and scenario testing) of the Revised Draft Water Resources Management Plan 2019 (rdWRMP19). The calculation of each metric is discussed in Appendix W: Programme appraisal methods. The metrics are:
  - Financial cost – £m, 80 year net present value (NPV)
  - Environmental benefit
  - Adverse environmental impact
  - Deliverability
  - Resilience
  - Intergenerational equity
  - Customer preference[2]
- The options selected by EBSD+ to balance supply and demand by each optimisation appear in the regulatory year in which they are delivered and begin to impact the supply demand balance. Note that in these tables regulatory years are displayed by writing the calendar year in which the regulatory year starts[3].
- The relative frequency with which an option is chosen over the range of EBSD+ optimisation runs, and when that option is delivered. This is shown through a cumulative frequency chart. Each option is represented by a row within the chart. The adjacent columns show the proportion of optimisation runs in which that option is delivered by the end of the period in the column heading. Each table contains a column for each Asset Management Period[4] (AMP) in the planning period (2020-2100). Each data cell of the table is also shaded for ease of interpretation, the bolder the shade of green the higher the relative frequency that the corresponding option is delivered by the end of the corresponding period.

[1] No additional outputs are provided for Kennet Valley, Guildford or Henley WRZ programme appraisal as these WRZs have comparatively simple planning problems and therefore the programme appraisal is fully presented in Section 10: Programme appraisal and scenario testing.
[2] Note that customer preference is expressed in two ways (preference for frequency of supply restrictions and preference for option type), which are then calculated in to a single metric score. However, both can be optimised individually within EBSD+.
[3] For example, the regulatory year 2024/25 which runs from 1 April 2024 to 31 March 2025 would be shown as 2024.
[4] An AMP is the planning period used by the water industry economic regulator, Ofwat. As part of each AMP companies submit plans to Ofwat and Ofwat then makes a determination on the revenue a company is able to collect from customers in the AMP, along with other items such as performance targets. In the past each AMP has been five years long. We have assumed in the production of this revised draft Water Resources Management Plan that AMPs remain five years long.

X.4 This section is organised into five sub-sections. One sub-section is included for each of the scenarios which have been used in programme appraisal and outputs are provided for all optimisation runs in that scenario. A final sub-section is included to summarise the results of the option relative frequency analysis for all scenarios in a single table.

- Least cost (Step 2 (LC)) and the Sustainable Economic Level of Demand Management (SELDM)
- Step 2a: Baseline supply demand balance (including our policy demand management programme DMP)
- Step 2b: Baseline + Increased resilience to a 1:200 drought event by 2030[5]
- Step 2c: Baseline + Increased resilience to a 1:200 drought event by 2030 + provision of supplies to neighbouring companies agreed as part of our involvement with the Water Resources in the South East (WRSE) planning process

X.5 Within each scenario a suite of EBSD+ optimisation runs are performed. They are designed to test the limits of performance against each metric and then explore the trade-off that exists between each other metric and the financial cost of the plan. Broadly there are three types of optimisation which are used to produce this suite of optimisation runs.

- Optimisation against the performance of a single metric
- Optimisation against the performance of two metrics, one of which is financial cost
- Optimisation against the performance of a single metric (other than cost) with a constraint applied to cost. For the standard suite of runs we use a cost constraint[6] of 120% of the 80 year NPV of financial cost of the least cost programme to balance supply and demand in that scenario

X.6 More detail on this can be found in Appendix W: Programme appraisal methods.

X.7 Table X-1 shows the nomenclature used in EBSD+ to name each of the standard suite of runs, the type of optimisation used, the metrics that are optimised and any constraints applied. This nomenclature is used throughout this section and Section 10: Programme appraisal and scenario testing.

[5] Without causing the environmental damage which would result from the same event today.
[6] A cost constraint means that EBSD+ will not be able to choose a programme which costs more than the limit of the constraint.

Table X-1: Details of standard set of optimisation runs

EBSD+ optimisation run name	Metrics optimised against			Constraints applied
	One	Two	List	
Phased_LC	✓		Financial cost	None
Max_EnvB	✓		Environmental benefit	None
Min_EnvC	✓		Adverse environmental impact	None
Max_DEL	✓		Deliverability	None
Max_RES	✓		Resilience	None
Min_IGEQ	✓		Intergenerational equity	None
Max_TP	✓		Customer preference for scheme type	None
Max_FP	✓		Customer preference for supply restriction frequency	None
Multi-obj_ENVB		✓	Environmental benefit and financial cost	None
Multi-obj_ENVC		✓	Adverse environmental impact and financial cost	None
Multi-obj_DEL		✓	Deliverability and financial cost	None
Multi-obj_RES		✓	Resilience and financial cost	None
Multi-obj_IGEQ		✓	Intergenerational equity and financial cost	None
Multi-obj_TP		✓	Customer preference for scheme type and financial cost	None
Multi-obj_FP		✓	Customer preference for supply restriction frequency and financial cost	None
NearO_ENVB	✓		Environmental benefit	Financial cost must not exceed 120% of least cost run
NearO_ENVC	✓		Environmental dis-benefit	Financial cost must not exceed 120% of least cost run
NearO_DEL	✓		Deliverability	Financial cost must not exceed 120% of least cost run
NearO_RES	✓		Resilience	Financial cost must not exceed 120% of least cost run
NearO_IGEQ	✓		Intergenerational equity	Financial cost must not exceed 120% of least cost run
NearO_TP	✓		Customer preference for scheme type	Financial cost must not exceed 120% of least cost run
NearO_FP	✓		Customer preference for supply restriction frequency	Financial cost must not exceed 120% of least cost run

Least cost (Step 2 (LC)) and the sustainable economic level of demand management (SELDM)

X.8 Summarised below are the raw modelled outputs of three optimisation runs that describe the company's 'Least Cost' solution (80 year NPV) to the supply demand problem and the impact of programmes with alternative levels of demand management selected.

X.9 The Least Cost position is produced by giving the EBSD+ model free choice to select any combination of demand management programme (DMP) and resource development option in order to resolve the deficit at the cheapest overall programme cost.

X.10 This run (Step 2 (LC)) represents the economic level of demand management (ELDM), i.e. the point at which it becomes more expensive to invest in demand management[7] than resource development.

X.11 As we have described in Section 10, the ELDM position does not provide the levels of demand management that we or our stakeholders expect. Consequently, we also assess a sustainable economic level of demand management (SELDM) position and another that accords with our policy position.

X.12 Table X-2 below illustrates that for ~£230m NPV, a further ~120 Ml/d of demand management benefit could be delivered. The cost of moving to the policy-aligned demand management programme and the environmental improvements this provides is a further ~£950m NPV.

Table X-2: EBSD+ run outputs for ELDM, SELDM and policy aligned DMP positions

BASELINE SCENARIO (Combined LSS)		Least Cost/ ELDM	SELDM	DMP Policy
Metrics[8]				
Financial (£m NPV)		2.014	2.245	3.186
Environmental +		90	93	80
Environmental -		98	101	81
Deliverability		0.98	0.97	0.96
Resilience		0.44	0.45	0.45
IGEQ		6.36	6.28	5.34
Customer preference		4.41	4.39	4.37
Options	**Benefit (Ml/d)**	**Implementation date**		
AR_Kidbrooke (SLARS1)	7	2070	2054	2082
AR_Merton (SLARS3)	5		2051	
AR_Streatham (SLARS)	4	2099	2053	2068
ASR_Horton Kirby	5	2036	2044	2035
ASR_South East London (Addington)	3	2042	2052	
ASR_Thames Valley/Thames Central	3	2096	2053	2080
DMP_SWA_0-5-9	14	2020		
DMP_SWA_SD.v2_S4b	22		2020	2020

[7] measures to create 'demand side' savings in water from both leakage reductions and water efficiency savings.
[8] For the non-financial metrics a higher score is better, except for 'Environmental -' where lower is better.

BASELINE SCENARIO (Combined LSS)		Least Cost/ ELDM	SELDM	DMP Policy
DMP_SWX_18-12-1	31	2020		
DMP_SWX_19.A8_S4b	51		2020	2020
DMP_LON_110-70-7	187	2020		
DMP_LON_270.A10_S4b	275		2020	
DMP_LON_428.A13_SD_S4b	421			2020
DSL_Beckton 150	142		2055	2086
GW_Addington	1	2041	2051	
GW_Datchet	5.4	2083	2071	2072
GW_Honor Oak	1	2071		
GW_London confined chalk	2	2069	2052	2066
GW_Merton	2	2098	2050	2085
GW_Moulsford	3.5	2088	2074	2072
GW_Southfleet/Greenhithe	8	2037	2044	2069
IPR_Beckton 100	95	2043	2083	
IPR_Beckton 100	95	2055		
IPR_Beckton 100	95	2072		
IPR_Deephams 45	45	2038	2045	2070
IZT_R Thames to Medmenham	74	2097	2086	2061
NTC_Aston Keynes	1	2089	2071	2069
NTC_Britwell	1	2096	2096	2096
NTC_Epsom	2	2035	2049	2065
NTC_New River Head	3	2020	2020	2025
RWP_Chingford	20	2035	2042	2062
RWP_Didcot	18	2020	2020	2020
RWP_Oxford Canal to Cropredy	11	2035	2082	2077
RWP_Oxford Canal to Dukes Cut	11.9		2082	2077
RWP_Wessex Water to SWX	2.9	2098	2097	2095

Step 2a: Baseline scenario (including policy DMP)

X.13 This sub-section provides outputs from EBSD+ for the standard suite of optimisation runs for the scenario using the baseline supply demand balance (rdWRMP Section 6: Baseline Supply Demand Balance) and including the preferred policy-aligned DMP.

X.14 Table X-3 and Table X-4 each contain results for the optimisation runs, showing performance against the seven metrics and the date that options are selected by the model to be delivered.

Table X-3: Step 2a – EBSD+ optimisation run outputs (Part 1 of 2)

BASELINE SCENARIO (Combined LSS)		Phased _LC	Max _envB	Min _envC	Max _del	Max _res	Min _IGEQ	Max _TP	Max _FP
Programme shortlisted in Section 10, Stage 2a, rdWRMP19		**Yes**	No	No	No	No	**Yes**	No	No
Metrics									
Financial (£m NPV)		3,061	3,335	3,257	3,407	9,205	3,303	3,255	4,117
Environmental +		51	43	22	22	143	40	32	92
Environmental -		53	34	11	13	161	41	27	106
Deliverability		0.92	1.00	1.00	1.00	1.00	0.98	1.00	1.00
Resilience		0.52	0.45	0.59	0.76	0.95	0.75	0.49	0.73
IGEQ		11.94	12.47	12.66	12.66	13.67	11.59	12.19	12.64
Customer preference		4.39	4.46	4.40	4.41	4.55	4.41	4.47	4.44
Option	**Benefit (Ml/d)**	**Implementation date**							
AR_Kidbrooke (SLARS1)	7	2079				2025			2038
AR_Merton (SLARS3)	5	2075				2026	2062		2062
AR_Streatham (SLARS)	4	2078				2024			2058
ASR_Horton Kirby	5	2061				2022	2044		2041
ASR_South East London (Addington)	3	2076				2030			2047
ASR_Thames Valley/Thames Central	7	2077				2030			2065
DMP_SWA_S4a	22	2025	2025	2025	2025	2025	2025	2025	2025
DMP_SWX_Sprint4a	55	2020	2020	2020	2020	2020	2020	2020	2020
DMP_LON_Sprint4a	421	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	142	2081				2029			
DSL_Crossness 100	95		2058			2029		2060	2094
DSL_Crossness 100	95		2079			2051		2074	

BASELINE SCENARIO (Combined LSS)		Phased _LC	Max _envB	Min _envC	Max _del	Max _res	Min _IGEQ	Max _TP	Max _FP
DSL_Crossness 100	95					2051			
GW_Addington	1	2063				2057	2062		2052
GW_Datchet	5.4	2090		2060		2026	2090	2090	
GW_Honor Oak	1					2064			2063
GW_London confined chalk	2	2074				2027	2061		2055
GW_Merton	2					2025			2046
GW_Moulsford	3.5					2023	2060		
GW_Southfleet/Greenhithe	8	2062				2024	2060		2046
IPR_Beckton 100	95					2051			2095
IPR_Beckton 150	138					2029			2030
IPR_Deephams	45	2064				2026			2026
IZT_North SWX to SWA 72	72				2025				
IZT_R Thames to Medmenham	24		2025			2025			2025
NTC_Aston Keynes	2					2022			
NTC_Britwell	1					2022	2065		
NTC_Epsom	2	2060				2025	2060		2066
NTC_New River Head	3	2020				2024	2020		2060
RES_Abingdon 100 Mm^3	210			2060					
RES_Abingdon 125 Mm^3	253				2060				
RES_Abingdon 150 Mm^3	294					2035	2063		2078
RWP_Chingford (E&S)	20	2035		2035	2035	2035	2035	2035	
RWP_Didcot	18	2020				2020	2020		2020
RWP_Oxford Canal to Cropredy	11	2060							2028
RWP_STT Minworth	70					2034			

BASELINE SCENARIO (Combined LSS)		Phased _LC	Max _envB	Min _envC	Max _del	Max _res	Min _IGEQ	Max _TP	Max _FP
RWP_STT Mythe	12					2030			
RWP_STT Netheridge	18					2030			
RWP_STT UU/ST Opt A	6					2038			
RWP_STT UU/ST Opt B	15					2046			
RWP_STT Vyrnwy 148	127					2046			
RWP_STT Welsh 60	45					2034			2069
RWP_Wessex to SWX	2.9					2031			

Table X-4: Step 2a – EBSD+ optimisation run outputs (Part 2 of 2)

BASELINE SCENARIO (Combined LSS)		Multi-obj _envB	Multi-obj _envC	Multi-obj _del	Multi-obj _res	Multi-obj _IGEQ	Multi-obj _TP	Multi-obj _FP	NearO _envB	NearO _envC	NearO _del	NearO _res	NearO _IGEQ	NearO _TP	NearO _FP
Programme shortlisted in Section 10, Stage 2a, rdWRMP19		No	No	No	No	No	No	No	No	No	No	No	No	**Yes**	**Yes**
Metrics															
Financial (£m NPV)		3,177	3,319	3,300	4,456	3,303	3,294	3,707	3,177	3,288	3,343	4,395	3,303	3,230	3,149
Environmental +		43	22	22	54	40	37	105	43	22	22	100	40	37	34
Environmental -		34	11	13	57	41	33	115	34	11	13	106	41	33	32
Deliverability		1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.99
Resilience		0.45	0.64	0.76	0.95	0.75	0.63	0.71	0.45	0.77	0.76	0.95	0.74	0.56	0.50
IGEQ		12.01	11.73	11.99	11.43	11.99	12.48	12.57	12.31	12.39	12.20	13.16	11.99	12.49	12.46
Customer preference		4.46	4.40	4.40	4.42	4.41	4.53	4.43	4.46	4.40	4.41	4.42	4.40	4.50	4.42
Option	**Benefit (Ml/d)**	**Implementation date**													
AR_Kidbrooke (SLARS1)	7							2062				2080			
AR_Merton (SLARS3)	5					2062		2060				2029	2061		
AR_Streatham (SLARS)	4							2065				2029			
ASR_Horton Kirby	5				2026	2044		2061				2026	2045		
ASR_South East London (Addington)	3							2064				2065			
ASR_Thames Valley/Thames Central	3				2062			2055							
DMP_SWA_S4a	22	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DMP_LON_S4a	421	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	142				2029			2079				2029			

BASELINE SCENARIO (Combined LSS)		Multi-obj _envB	Multi-obj _envC	Multi-obj _del	Multi-obj _res	Multi-obj _IGEQ	Multi-obj _TP	Multi-obj _FP	NearO _envB	NearO _envC	NearO _del	NearO _res	NearO _IGEQ	NearO _TP	NearO _FP
DSL_Crossness 100	95	2058					2060	2094	2058					2060	
DSL_Crossness 100	95	2079					2068		2079					2068	
DSL_Crossness 100	95						2068							2090	
GW_Addington	1					2062						2026	2062		
GW_Datchet	5.4		2090		2093	2090	2090	2087		2090		2023	2089	2090	
GW_Honor Oak	1														
GW_London confined chalk	2					2061		2064				2026	2062		
GW_Merton	2							2061							
GW_Moulsford	3.5				2026	2060		2084				2025	2060		
GW_Southfleet/ Greenhithe	8				2026	2060		2060				2028	2060		
IPR_Beckton 100	95														2067
IPR_Beckton 150	138														2092
IPR_Deephams 45	45							2026				2069			2060
IZT_North SWX to SWA 48	48														2061
IZT_North SWX to SWA 72	72			2090	2067						2046	2086			
IZT_R Thames to Medmenham	24	2090							2089						
NTC_Aston Keynes	2				2026			2084				2024			
NTC_Britwell	1				2026	2065		2077				2025	2065		
NTC_Epsom	2				2064	2060		2064				2024	2060		
NTC_New River Head	3				2020	2020		2034				2020	2020		
RES_Abingdon 100 Mm^3	210									2058		2055			

BASELINE SCENARIO (Combined LSS)		Multi-obj _envB	Multi-obj _envC	Multi-obj _del	Multi-obj _res	Multi-obj _IGEQ	Multi-obj _TP	Multi-obj _FP	NearO _envB	NearO _envC	NearO _del	NearO _res	NearO _IGEQ	NearO _TP	NearO _FP
RES_Abingdon 125 Mm^3	253		2058	2060							2060				
RES_Abingdon 150 Mm^3	294				2041	2063		2075					2063		
RWP_Chingford (E&S)	20		2035	2035	2035	2035	2035	2035		2035	2035	2035	2035	2035	2035
RWP_Didcot	18		2020	2020	2020	2020	2020	2020		2020	2020	2020	2020	2020	
RWP_Oxford Canal to Cropredy	11				2026			2026				2026			
RWP_Oxford Canal to Dukes Cut	11.9				2026			2067				2026			
RWP_STT Mythe	12											2064			
RWP_STT Netheridge	18											2083			
RWP_STT UU/ST Opt A	6							2041				2051			
RWP_STT UU/ST Opt B	15							2057				2096			
RWP_STT Vyrnwy 60	110							2053				2060			
RWP_Wessex Water to SWX	2.9							2085				2081			

Step 2a: Relative frequency analysis

X.15 Table X-5 shows the relative frequency with which specific **resource development options** are chosen, and by when, in the optimisation runs for the baseline scenario, to supplement the demand management measures included in the preferred demand management programme. As noted in X.3, each data cell of the table is shaded for ease of interpretation, the bolder the shade of green the higher the relative frequency that the corresponding option is delivered by the end of the corresponding period.

Table X-5: Step 2a - Relative frequency of resource development option selection (on top of the preferred programme of demand management measures)

Options	WRZ	AMP7	AMP8	AMP9	AMP10	AMP11	AMP12	AMP13	AMP14	AMP15	AMP16	AMP17	AMP18	AMP19	AMP20	AMP21	AMP22
AR_Kidbrooke (SLARS1)	London	0%	5%	5%	9%	9%	9%	9%	9%	14%	14%	14%	18%	23%	23%	23%	23%
AR_Merton (SLARS3)	London	0%	9%	9%	9%	9%	9%	9%	9%	32%	32%	32%	36%	36%	36%	36%	36%
AR_Streatham (SLARS)	London	5%	9%	9%	9%	9%	9%	9%	14%	14%	18%	18%	23%	23%	23%	23%	23%
ASR_Horton Kirby	London	5%	14%	23%	23%	36%	41%	41%	41%	50%	50%	50%	50%	50%	50%	50%	50%
ASR_South East London (Addington)	London	0%	0%	5%	5%	5%	9%	9%	9%	14%	18%	18%	23%	23%	23%	23%	23%
ASR_Thames Valley/Thames Central	London	0%	0%	5%	5%	5%	5%	5%	9%	14%	18%	18%	23%	23%	23%	23%	23%
DSL_Beckton 150	London	0%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	18%	23%	23%	23%	23%
DSL_Crossness 100	London	0%	5%	5%	5%	5%	5%	5%	18%	32%	32%	32%	32%	32%	32%	41%	41%
DSL_Crossness 100	London	0%	0%	0%	0%	0%	0%	5%	5%	5%	14%	18%	32%	32%	32%	32%	32%
DSL_Crossness 100	London	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%	9%	9%	14%	14%
GW_Addington	London	0%	5%	5%	5%	5%	5%	9%	14%	32%	32%	32%	32%	32%	32%	32%	32%
GW_Datchet	SWA	5%	9%	9%	9%	9%	9%	9%	9%	14%	14%	14%	14%	14%	23%	64%	64%
GW_Honor Oak	London	0%	0%	0%	0%	0%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	9%
GW_London confined chalk	London	0%	9%	9%	9%	9%	9%	9%	14%	32%	32%	36%	36%	36%	36%	36%	36%
GW_Merton	London	0%	5%	5%	5%	5%	9%	9%	9%	14%	14%	14%	14%	14%	14%	14%	14%
GW_Moulsford	SWOX	5%	14%	14%	14%	14%	14%	14%	14%	27%	27%	27%	27%	32%	32%	32%	32%
GW_Southfleet/Greenhithe	London	5%	14%	14%	14%	14%	18%	18%	18%	41%	41%	41%	41%	41%	41%	41%	41%
IPR_Beckton 100	London	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%	9%	9%	9%	14%
IPR_Beckton 100	London	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IPR_Beckton 100	London	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IPR_Beckton 150	London	0%	5%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	14%	14%
IPR_Beckton 150	London	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IPR_Deephams 45	London	0%	14%	14%	14%	14%	14%	14%	14%	23%	27%	27%	27%	27%	27%	27%	27%
IZT_North SWX to SWA 48	SWA	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%
IZT_North SWX to SWA 72	SWA	0%	5%	5%	5%	5%	9%	9%	9%	9%	14%	14%	14%	14%	18%	23%	23%
IZT_R Thames to Medmenham	SWA	0%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	18%	23%	23%
NTC_Aston Keynes	SWOX	9%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	18%	18%	18%	18%
NTC_Britwell	SWOX	5%	14%	14%	14%	14%	14%	14%	14%	14%	27%	27%	32%	32%	32%	32%	32%
NTC_Epsom	London	5%	9%	9%	9%	9%	9%	9%	9%	36%	41%	41%	41%	41%	41%	41%	41%
NTC_New River Head	London	32%	32%	32%	32%	32%	32%	32%	32%	36%	36%	36%	36%	36%	36%	36%	36%
RES_Abingdon 100 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	9%	14%	14%	14%	14%	14%	14%	14%	14%
RES_Abingdon 125 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	5%	18%	18%	18%	18%	18%	18%	18%	18%
RES_Abingdon 150 Mm3	Multi-zone	0%	0%	0%	5%	9%	9%	9%	9%	23%	23%	23%	32%	32%	32%	32%	32%
RES_Abingdon 75 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_Chingford (E&S)	London	0%	0%	0%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%
RWP_Didcot	London	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%
RWP_Oxford Canal to Cropredy	London	0%	18%	18%	18%	18%	18%	18%	18%	23%	23%	23%	23%	23%	23%	23%	23%
RWP_Oxford Canal to Dukes Cut	SWOX	0%	9%	9%	9%	9%	9%	9%	9%	9%	14%	14%	14%	14%	14%	14%	14%
RWP_STT Minworth	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_STT Mythe	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	9%	9%	9%	9%	9%	9%	9%	9%
RWP_STT Netheridge	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	9%	9%	9%	9%
RWP_STT UU/ST Opt A	Multi-zone	0%	0%	0%	5%	9%	9%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
RWP_STT UU/ST Opt B	Multi-zone	0%	0%	0%	0%	0%	5%	5%	9%	9%	9%	9%	9%	9%	9%	9%	14%
RWP_STT Vyrnwy 148	Multi-zone	0%	0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
RWP_STT Vyrnwy 180	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_STT Vyrnwy 60	Multi-zone	0%	0%	0%	0%	0%	0%	5%	5%	9%	9%	9%	9%	9%	9%	9%	9%
RWP_STT Welsh 60	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%
RWP_Wessex Water to SWX	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	9%	14%	14%	14%

Step 2b: Baseline + 1:200 drought resilience scenario

X.16 This sub-section provides outputs from EBSD+ for the standard set of optimisation runs for the scenario where 1:200 drought resilience is provided by 2030.

X.17 Table X-6 and Table X-7 each contain results for the optimisation runs, showing performance against the seven metrics and the date that options are chosen to be delivered.

Table X-6: Step 2b - EBSD+ optimisation runs outputs (Part 1 of 2)

BASELINE +DRO (Combined LSS)		Phased_LC	Max_envB	Min_envC	Max_del	Max_res	Min_IGEQ	Max_TP	Max_FP
Programme shortlisted in Section 10, Stage 2b, rdWRMP19		**Yes**	No	No	No	No	**Yes**	No	No
Metrics									
Financial (£m NPV)		3,487	4,609	4,850	4,673	9,056	3,722	4,191	5,359
Environmental +		68	38	27	29	147	59	43	106
Environmental -		77	23	18	24	165	69	41	124
Deliverability		0.89	1.00	1.00	1.00	1.00	0.95	0.99	1.00
Resilience		0.45	0.90	0.90	0.89	0.95	0.77	0.54	0.79
IGEQ		11.87	12.60	12.60	12.50	13.08	11.40	12.51	12.90
Customer preference		4.40	4.42	4.42	4.42	4.53	4.41	4.51	4.44
Options	**Benefit (Ml/d)**	**Implementation date**							
AR_Kidbrooke (SLARS1)	7					2025			2025
AR_Merton (SLARS3)	5	2050				2028	2050		2025
AR_Streatham (SLARS)	4	2052				2024	2052		2024
ASR_Horton Kirkby	5	2048				2022	2030		2022
ASR_South East London (Addington)	3	2049				2030	2049		2030
ASR_Thames Valley/Thames Central	3	2051				2030	2051		2030
DMP_SWA_S4a	22	2025	2025	2025	2025	2025	2025	2025	2025
DMP_SWX_Sprint4a	51	2020	2020	2020	2020	2020	2020	2020	2020
DMP_LON_Sprint4a	421	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	142		2030	2029		2029			2029
DSL_Crossness 100	95					2029		2030	2057
DSL_Crossness 100	95					2052		2042	

BASELINE +DRO (Combined LSS)		Phased_LC	Max_envB	Min_envC	Max_del	Max_res	Min_IGEQ	Max_TP	Max_FP
DSL_Crossness 100	95					2052		2063	
GW_Addington	1	2052				2029	2052		2025
GW_Datchet	5.4	2082				2026	2082		2095
GW_Honor Oak	1	2092				2027			2029
GW_London confined chalk	2	2051				2030	2051		2026
GW_Merton	2					2025			2025
GW_Moulsford	3.5					2023	2060		
GW_Southfleet/Greenhithe	8	2031				2024	2030		2025
IPR_Beckton 100	95	2053			2029	2030			2072
IPR_Beckton 100	95	2067				2031			2082
IPR_Beckton 100	95	2093				2031			
IPR_Deephams	45	2030				2026	2030		2026
IZT_North SWX to SWA 48 MLD	48			2025	2025	2025			
IZT_North SWX to SWA 72 MLD	72							2082	2025
IZT_R Thames to Medmenham	24	2095	2025				2095		
NTC_Aston Keynes	2					2026			2099
NTC_Britwell	1					2024	2065		2099
NTC_Epsom	2	2030				2025	2048		2029
NTC_New River Head	3	2020				2027	2020		2021
RES_Abingdon 100 Mm^3	210								2099
RES_Abingdon 125 Mm^3	253				2035				
RES_Abingdon 150 Mm^3	294		2035	2035		2075	2053	2093	
RWP_Chingford (E&S)	20	2035		2035	2035	2035	2035	2035	2035
RWP_Didcot	18	2020				2020	2020		2020
RWP_Oxford Canal to Cropredy	11	2030				2057	2031		2028
RWP_STT Minworth	70					2073			

BASELINE +DRO (Combined LSS)		Phased_LC	Max_envB	Min_envC	Max_del	Max_res	Min_IGEQ	Max_TP	Max_FP
RWP_STT Mythe	12					2099			2030
RWP_STT Netheridge	18					2074			2091
RWP_STT UU/ST Opt A	6					2077			
RWP_STT UU/ST Opt B	15					2098			
RWP_STT Vyrnwy 148	127					2030			
RWP_STT Welsh 60	45					2061			2048
RWP_Wessex to SWX	2.9					2030			

Table X-7: Step 2b - EBSD+ optimisation runs outputs (Part 2 of 2)

BASELINE SCENARIO		Multi-obj _envB	Multi-obj _envC	Multi-obj _del	Multi-obj _res	Multi-obj _IGEQ	Multi-obj _TP	Multi-obj _FP	NearO _ENVB	NearO _ENVC	NearO _DEL	NearO _RES	NearO _IGEQ	NearO _TP	NearO _FP
Programme shortlisted in Section 10, Stage 2b, rdWRMP19		**Yes**	No	**Yes**	No	No	No	No	No	No	No	No	No	No	No
Metrics															
Financial (£m NPV)		3,898	4,273	3,943	4,154	3,722	4,007	4,141	4,083	4,627	3,993	4,805	3,713	4,179	4,059
Environmental +		38	27	29	82	59	46	98	38	27	29	101	59	43	47
Environmental -		23	18	24	92	69	44	101	23	18	24	109	69	41	51
Deliverability		1.00	1.00	1.00	0.98	0.95	0.99	1.00	1.00	1.00	1.00	1.00	0.95	0.99	0.99
Resilience		0.73	0.86	0.77	0.95	0.77	0.51	0.69	0.8	0.89	0.78	0.95	0.77	0.61	0.46
IGEQ		11.97	11.44	11.9	11.82	12.24	13.15	13.1	12.83	13.64	12.85	13.77	12.26	13.29	13.5
Customer preference		4.41	4.42	4.41	4.4	4.41	4.5	4.43	4.41	4.42	4.41	4.44	4.41	4.52	4.46
Option	**Benefit (Ml/d)**	**Implementation date**													
AR_Kidbrooke (SLARS1)	7				2062			2049				2026			
AR_Merton (SLARS3)	5				2037	2050		2053				2025	2050		
AR_Streatham (SLARS)	4					2052		2031				2084	2052		
ASR_Horton Kirby	5				2026	2030		2030				2025	2030		
ASR_South East London (Addington)	3				2060	2049		2034				2031	2049		
ASR_Thames Valley/Thames Central	3				2063	2051		2031				2074	2051		
DMP_SWA_S4a	22	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DMP_SWX_S4a	51	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DMP_LON_S4a	421	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	142	2029	2029						2029	2029		2029			

BASELINE SCENARIO		Multi-obj _envB	Multi-obj _envC	Multi-obj _del	Multi-obj _res	Multi-obj _IGEQ	Multi-obj _TP	Multi-obj _FP	NearO _ENVB	NearO _ENVC	NearO _DEL	NearO _RES	NearO _IGEQ	NearO _TP	NearO _FP
DSL_Crossness 100	95						2029					2098		2029	2030
DSL_Crossness 100	95						2048							2035	
DSL_Crossness 100	95						2063							2056	
GW_Addington	1				2063	2052		2035				2064	2052		
GW_Datchet	5.4				2026	2082						2024	2082		2085
GW_London confined chalk	2				2035	2051		2049				2041	2051		
GW_Merton	2							2049				2043			
GW_Moulsford	3.5				2026	2060						2026	2060		
GW_Southfleet/Greenhithe	8				2026	2030		2052				2026	2030		
IPR_Beckton 100	95			2030							2030				2091
IPR_Beckton 150	138							2055				2030			2060
IPR_Beckton 150	138							2089				2052			
IPR_Deephams 45	45				2071	2030		2026					2030		2053
IZT_North SWX to SWA 48	48									2031					
IZT_North SWX to SWA 72	72		2077	2082							2082			2082	2074
IZT_R Thames to Medmenham	24	2082			2095	2095	2082	2072	2082			2095	2095		
NTC_Aston Keynes	2				2059			2098				2026			
NTC_Britwell	1				2026	2065							2065		
NTC_Epsom	2				2026	2048		2050				2038	2048		
NTC_New River Head	3				2020	2020		2020				2020	2020		
RES_Abingdon 100 Mm^3	210							2088							
RES_Abingdon 125 Mm^3	253			2053					2048		2052				

BASELINE SCENARIO		Multi-obj _envB	Multi-obj _envC	Multi-obj _del	Multi-obj _res	Multi-obj _IGEQ	Multi-obj _TP	Multi-obj _FP	NearO _ENVB	NearO _ENVC	NearO _DEL	NearO _RES	NearO _IGEQ	NearO _TP	NearO _FP
RES_Abingdon 150 Mm^3	294	2058	2043			2053	2093			2037			2053	2093	
RWP_Chingford (E&S)	20		2035	2035	2035	2035	2035	2035		2035	2035	2035	2035	2035	2035
RWP_Didcot	18		2020	2020	2020	2020	2020	2020			2020	2020	2020	2020	
RWP_Oxford Canal to Cropredy	11				2026	2031		2030				2030	2031		
RWP_STT Minworth	70				2058			2030							
RWP_STT Mythe	12				2070										
RWP_STT Netheridge	18				2053										
RWP_STT UU/ST Opt A	6							2064				2055			
RWP_STT UU/ST Opt B	15							2078				2086			
RWP_STT Welsh 60	45							2080							
RWP_Wessex Water to SWX	2.9				2063										

Step 2b: Relative frequency analysis

X.18 Table X-8 shows the relative frequency with which resource development options are chosen, on top of the preferred demand management programme, and by when, in the optimisation runs for the baseline + 1:200 drought resilience scenario.

Table X-8: Step 2b - Relative frequency of resource development option selection (in addition to the programme of preferred demand management measures)

Options	WRZ	AMP7	AMP8	AMP9	AMP10	AMP11	AMP12	AMP13	AMP14	AMP15	AMP16	AMP17	AMP18	AMP19	AMP20	AMP21	AMP22
AR_Kidbrooke (SLARS1)	London	0%	14%	14%	14%	14%	19%	19%	19%	24%	24%	24%	24%	24%	24%	24%	24%
AR_Merton (SLARS3)	London	0%	14%	14%	19%	19%	19%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
AR_Streatham (SLARS)	London	10%	10%	14%	14%	14%	14%	33%	33%	33%	33%	33%	33%	38%	38%	38%	38%
ASR_Horton Kirby	London	10%	19%	38%	38%	38%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
ASR_South East London (Addington)	London	0%	0%	14%	14%	14%	33%	33%	33%	38%	38%	38%	38%	38%	38%	38%	38%
ASR_Thames Valley/Thames Central	London	0%	0%	14%	14%	14%	14%	33%	33%	38%	38%	43%	43%	43%	43%	43%	43%
DSL_Beckton 150	London	0%	38%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
DSL_Crossness 100	London	0%	14%	19%	19%	19%	19%	19%	24%	24%	24%	24%	24%	24%	24%	24%	29%
DSL_Crossness 100	London	0%	0%	0%	5%	10%	14%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
DSL_Crossness 100	London	0%	0%	0%	0%	0%	0%	5%	10%	19%	19%	19%	19%	19%	19%	19%	19%
GW_Addington	London	0%	10%	10%	14%	14%	14%	33%	33%	43%	43%	43%	43%	43%	43%	43%	43%
GW_Datchet	SWA	5%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	33%	33%	33%	38%
GW_Honor Oak	London	0%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	14%	14%
GW_London confined chalk	London	0%	5%	10%	14%	19%	24%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
GW_Merton	London	0%	10%	10%	10%	14%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
GW_Moulsford	SWOX	5%	14%	14%	14%	14%	14%	14%	14%	29%	29%	29%	29%	29%	29%	29%	29%
GW_Southfleet/Greenhithe	London	5%	19%	38%	38%	38%	38%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
IPR_Beckton 100	London	0%	5%	19%	19%	19%	19%	24%	24%	24%	24%	29%	29%	29%	29%	29%	29%
IPR_Beckton 100	London	0%	0%	5%	5%	5%	5%	5%	5%	5%	10%	10%	10%	14%	14%	14%	14%
IPR_Beckton 100	London	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	10%	10%
IPR_Beckton 150	London	0%	0%	5%	5%	5%	5%	5%	10%	10%	10%	10%	10%	10%	10%	10%	10%
IPR_Beckton 150	London	0%	0%	0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%	10%	10%	10%
IPR_Deephams 45	London	0%	14%	33%	33%	33%	33%	33%	33%	33%	33%	38%	38%	38%	38%	38%	38%
IZT_North SWX to SWA 48	SWA	0%	14%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
IZT_North SWX to SWA 72	SWA	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	10%	29%	29%	29%	29%
IZT_R Thames to Medmenham	SWA	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	10%	10%	24%	24%	24%	52%
NTC_Aston Keynes	SWOX	0%	10%	10%	10%	10%	10%	10%	14%	14%	14%	14%	14%	14%	14%	14%	24%
NTC_Britwell	SWOX	5%	10%	10%	10%	10%	10%	10%	10%	10%	24%	24%	24%	24%	24%	24%	29%
NTC_Epsom	London	0%	14%	19%	24%	24%	38%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
NTC_New River Head	London	38%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%
RES_Abingdon 100 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	10%
RES_Abingdon 125 Mm3	Multi-zone	0%	0%	0%	5%	5%	10%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
RES_Abingdon 150 Mm3	Multi-zone	0%	0%	0%	14%	19%	19%	33%	38%	38%	38%	38%	43%	43%	43%	57%	57%
RES_Abingdon 75 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_Chingford (E&S)	London	0%	0%	0%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%	86%
RWP_Didcot	London	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%
RWP_Oxford Canal to Cropredy	London	0%	10%	38%	38%	38%	38%	38%	43%	43%	43%	43%	43%	43%	43%	43%	43%
RWP_Oxford Canal to Dukes Cut	SWOX	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_STT Minworth	Multi-zone	0%	0%	5%	5%	5%	5%	5%	10%	10%	10%	14%	14%	14%	14%	14%	14%
RWP_STT Mythe	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	10%	10%	10%	10%	10%	14%
RWP_STT Netheridge	Multi-zone	0%	0%	0%	0%	0%	0%	5%	5%	5%	5%	10%	10%	10%	10%	14%	14%
RWP_STT UU/ST Opt A	Multi-zone	0%	0%	0%	0%	0%	0%	0%	5%	10%	10%	10%	14%	14%	14%	14%	14%
RWP_STT UU/ST Opt B	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	10%	10%	14%
RWP_STT Vyrnwy 148	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
RWP_STT Vyrnwy 180	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
RWP_STT Vyrnwy 60	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	5%	10%	10%	10%	10%	10%	10%	10%
RWP_STT Welsh 60	Multi-zone	0%	0%	0%	0%	0%	5%	5%	5%	10%	10%	10%	10%	14%	14%	14%	14%
RWP_Wessex Water to SWX	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	10%	10%	10%	10%	10%	10%	10%	10%

Step 2c: Baseline + 1:200 drought resilience + WRSE transfer scenario

X.19 This sub-section provides outputs from EBSD+ for the optimisation runs for the baseline scenario including 1:200 drought resilience and WRSE transfer requirements.

X.20 Table X-9 and Table X-10 each contain results for the optimisation runs, showing performance against the seven metrics and the date that options are selected by the model to be delivered.

Table X-9: Step 2c – EBSD+ optimisation run outputs (Part 1 of 2)

Baseline + Drought + WRSE		Phased _LC	Max _envB	Min _envC	Max_del	Max_res	Min_IGEQ	Max_TP	Max_FP
Programme shortlisted in Section 10, Stage 2c rdWRMP19		**Yes**	No	No	No	No	**Yes**	No	No
Metrics									
Financial (£m NPV)		4,105	4,632	4,828	4,721	9,200	4,188	4,412	6,927
Environmental +		70	38	27	29	142	70	30	137
Environmental -		81	23	18	24	160	82	21	152
Deliverability		0.96	1.00	1.00	1.00	1.00	0.96	1.00	1.00
Resilience		0.84	0.90	0.87	0.87	0.95	0.87	0.87	0.89
IGEQ		11.33	12.43	12.40	12.31	12.74	11.66	12.43	12.85
Customer preference		4.41	4.42	4.42	4.43	4.55	4.42	4.42	4.44
Options	**Benefit (Ml/d)**	**Implementation date**							
AR_Kidbrooke (SLARS1)	7					2025			2025
AR_Merton (SLARS3)	5	2030				2026	2031		2025
AR_Streatham (SLARS)	4	2086				2024	2080		2024
ASR_Horton Kirkby	5	2030				2022	2030		2022
ASR_South East London (Addington)	3	2087				2030	2031		2030
ASR_Thames Valley/Thames Central	3	2088				2030	2031		2030
DMP_SWA_S4a	22	2025	2025	2025	2025	2025	2025	2025	2025
DMP_SWX_Sprint4a	51	2020	2020	2020	2020	2020	2020	2020	2020
DMP_LON_Sprint4a	421	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	142	2089	2030	2030		2029	2098	2030	2029
DSL_Crossness 100	95					2030			2075
DSL_Crossness 100	95					2030			2099

Baseline + Drought + WRSE		Phased _LC	Max _envB	Min _envC	Max_del	Max_res	Min_IGE Q	Max_TP	Max_FP
DSL_Crossness 100	95					2030			2099
GW_Addington	1	2030				2027	2031		2025
GW_Datchet	5.4	2082				2026	2081		2029
GW_Honor Oak	1					2028	2093		2029
GW_London confined chalk	2	2083				2026	2080		2026
GW_Merton	2	2087				2029			2025
GW_Moulsford	3.5	2082				2027	2051		2031
GW_Southfleet/Greenhithe	8	2031				2024	2030		2025
IPR_Beckton 100	95					2030			
IPR_Beckton 150	138				2030	2060			
IPR_Deephams	45	2030				2026	2030		2026
IZT_North SWX to SWA 48	48					2025			
IZT_North SWX to SWA 72	72			2025	2025				2025
IZT_R Thames to Medmenham	24	2095	2025				2095	2082	
NTC_Aston Keynes	2	2082				2038	2097		2022
NTC_Britwell	1	2083				2022	2060		2022
NTC_Epsom	2	2030				2025	2031		2029
NTC_New River Head	3	2020				2026	2020		2021
RES_Abingdon 125 Mm^3	253	2039							2065
RES_Abingdon 150 Mm^3	294		2035	2035	2038	2037	2039	2039	
RWP_Chingford (E&S)	20	2035		2035	2035	2035		2035	2035
RWP_Didcot	18	2020				2020			2020
RWP_Oxford Canal to Cropredy	11	2030				2049	2031		2028
RWP_Oxford Canal to Dukes Cut	11.9								2081
RWP_STT Minworth	70					2031			2030

Baseline + Drought + WRSE		Phased _LC	Max _envB	Min _envC	Max_del	Max_res	Min_IGE Q	Max_TP	Max_FP
RWP_STT Mythe	12					2050			2052
RWP_STT Netheridge	18					2038			2040
RWP_STT UU/ST Opt A	6					2059			2040
RWP_STT UU/ST Opt B	15					2060			2044
RWP_STT Vyrnwy 148	127								2042
RWP_STT Vyrnwy 60	110					2045			
RWP_STT Welsh 60	45					2030			2030
RWP_Wessex to SWX	2.9	2085				2034	2097		2031

Table X-10: Step 2c – EBSD+ optimisation run outputs (Part 2 of 2)

Baseline + Drought + WRSE		Multi-obj _ENVB	Multi-obj _ENVC	Multi-obj _DEL	Multi-obj _RES	Multi-obj _TP	Multi-obj _FP	NearO _ENVB	NearO _ENVC	NearO _DEL	NearO _RES	NearO _TP
Programme shortlisted in Section 10, Stage 2c rdWRMP19		No	No	No	**Yes**	No	**Yes**	No	No	No	**Yes**	**Yes**
Metrics												
Financial (£m NPV)		4,397	4,728	4,575	5,353	4,471	4,997	4,397	4,783	4,510	4,634	4,554
Environmental +		38	27	29	95	27	117	38	27	29	103	30
Environmental -		23	18	24	107	18	126	23	18	24	111	21
Deliverability		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Resilience		0.87	0.90	0.87	0.95	0.87	0.88	0.87	0.88	0.87	0.95	0.87
IGEQ		11.34	11.72	11.59	11.30	13.25	13.97	12.86	13.87	12.95	13.62	13.18
Customer preference		4.42	4.42	4.43	4.44	4.42	4.44	4.42	4.42	4.44	4.42	4.42
Options	**Benefit (Ml/d)**	**Implementation date**										
AR_Kidbrooke (SLARS1)	7				2063		2053					
AR_Merton (SLARS3)	5				2026		2050				2072	
AR_Streatham (SLARS)	4				2091		2052					
ASR_Horton Kirkby	5				2026		2047				2026	
ASR_South East London (Addington)	3				2033		2049				2062	
ASR_Thames Valley/Thames Central	3				2031		2052				2073	
DMP_SWA_S4a	22	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025
DMP_SWX_Sprint4a	51	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DMP_LON_Sprint4a	421	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	142	2029	2030			2030	2065	2029	2029		2029	2030
DSL_Crossness 100	95											

Baseline + Drought + WRSE		Multi-obj _ENVB	Multi-obj _ENVC	Multi-obj _DEL	Multi-obj _RES	Multi-obj _TP	Multi-obj _FP	NearO _ENVB	NearO _ENVC	NearO _DEL	NearO _RES	NearO _TP
DSL_Crossness 100	95											
DSL_Crossness 100	95											
GW_Addington	1				2096		2057				2094	
GW_Datchet	5.4				2029		2082				2026	
GW_Honor Oak	1				2068							
GW_London confined chalk	2						2057				2071	
GW_Merton	2				2069		2081					
GW_Moulsford	3.5				2026		2039				2026	
GW_Southfleet/Greenhithe	8				2026		2031				2026	
IPR_Beckton 100	95				2029						2074	
IPR_Beckton 100	95				2029						2095	
IPR_Beckton 150	138			2030			2085			2030		
IPR_Beckton 150	138						2085					
IPR_Deephams	45						2026				2063	
IZT_North SWX to SWA 48	48					2082	2095					
IZT_North SWX to SWA 72	72		2025	2082	2095				2062	2082		
IZT_R Thames to Medmenham	24	2082						2082			2095	2082
NTC_Aston Keynes	2				2026		2039				2026	
NTC_Britwell	1				2041		2037				2026	
NTC_Epsom	2				2026		2030				2031	
NTC_New River Head	3				2020		2020				2020	
RES_Abingdon 125 Mm3	253						2039					
RES_Abingdon 150 Mm3	294	2039	2035	2038	2063	2039		2039	2039	2039		2039
RWP_Chingford (E&S)	20		2035	2035	2035	2035	2035		2035	2035	2035	2035

Baseline + Drought + WRSE		Multi-obj _ENVB	Multi-obj _ENVC	Multi-obj _DEL	Multi-obj _RES	Multi-obj _TP	Multi-obj _FP	NearO _ENVB	NearO _ENVC	NearO _DEL	NearO _RES	NearO _TP
RWP_Didcot	18		2020	2020	2020	2020	2020			2020	2020	2020
RWP_Oxford Canal to Cropredy	11				2026		2028				2026	
RWP_Oxford Canal to Dukes Cut	11.9											
RWP_STT Minworth	70				2039		2030				2039	
RWP_STT Mythe	12				2030		2031				2055	
RWP_STT Netheridge	18				2030		2030				2030	
RWP_STT UU/ST Opt A	6						2030				2030	
RWP_STT UU/ST Opt B	15						2093				2059	
RWP_STT Vyrnwy 148	127											
RWP_STT Vyrnwy 60	110				2030		2044				2030	
RWP_STT Welsh 60	45						2086					
RWP_Wessex to SWX	2.9				2063							

Step 2c: Relative frequency analysis

X.21 Table X-11 shows the relative frequency with which resource development options are chosen, and by when, in the optimisation runs for the baseline + 1:200 drought resilience + WRSE transfers scenario.

X.22 Note this scenario includes the preferred demand management programme in all runs.

Table X-11: Step 2c - Relative frequency of resource development option selection, in addition to preferred demand management measures

Options	WRZ	AMP7	AMP8	AMP9	AMP10	AMP11	AMP12	AMP13	AMP14	AMP15	AMP16	AMP17	AMP18	AMP19	AMP20	AMP21	AMP22
AR_Kidbrooke (SLARS1)	London	0%	11%	11%	11%	11%	11%	16%	16%	21%	21%	21%	21%	21%	21%	21%	21%
AR_Merton (SLARS3)	London	0%	16%	26%	26%	26%	26%	32%	32%	32%	32%	37%	37%	37%	37%	37%	37%
AR_Streatham (SLARS)	London	11%	11%	11%	11%	11%	11%	16%	16%	16%	16%	16%	16%	21%	26%	32%	32%
ASR_Horton Kirby	London	11%	21%	32%	32%	32%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
ASR_South East London (Addington)	London	0%	0%	21%	21%	21%	26%	26%	26%	32%	32%	32%	32%	32%	37%	37%	37%
ASR_Thames Valley/Thames Central	London	0%	0%	21%	21%	21%	21%	26%	26%	26%	26%	32%	32%	32%	37%	37%	37%
DSL_Beckton 150	London	0%	32%	63%	63%	63%	63%	63%	63%	63%	68%	68%	68%	68%	74%	74%	79%
DSL_Crossness 100	London	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	11%	11%	11%	11%	11%
DSL_Crossness 100	London	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	11%
DSL_Crossness 100	London	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	11%
GW_Addington	London	0%	11%	21%	21%	21%	21%	21%	26%	26%	26%	26%	26%	26%	26%	32%	37%
GW_Datchet	SWA	0%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	37%	37%	37%	37%
GW_Honor Oak	London	0%	11%	11%	11%	11%	11%	11%	11%	11%	16%	16%	16%	16%	16%	21%	21%
GW_London confined chalk	London	0%	11%	11%	11%	11%	11%	11%	16%	16%	16%	21%	21%	32%	32%	32%	32%
GW_Merton	London	0%	11%	11%	11%	11%	11%	11%	11%	11%	16%	16%	16%	21%	26%	26%	26%
GW_Moulsford	SWOX	0%	16%	21%	26%	26%	26%	32%	32%	32%	32%	32%	32%	37%	37%	37%	37%
GW_Southfleet/Greenhithe	London	5%	21%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
IPR_Beckton 100	London	0%	5%	11%	11%	11%	11%	11%	11%	11%	11%	16%	16%	16%	16%	16%	16%
IPR_Beckton 100	London	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	11%
IPR_Beckton 100	London	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IPR_Beckton 150	London	0%	0%	16%	16%	16%	16%	16%	16%	21%	21%	21%	21%	21%	26%	26%	26%
IPR_Beckton 150	London	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	5%
IPR_Deephams 45	London	0%	16%	26%	26%	26%	26%	26%	26%	32%	32%	32%	32%	32%	32%	32%	32%
IZT_North SWX to SWA 48	SWA	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	11%	11%	11%	16%
IZT_North SWX to SWA 72	SWA	0%	21%	21%	21%	21%	21%	21%	21%	26%	26%	26%	26%	37%	37%	37%	42%
IZT_R Thames to Medmenham	SWA	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	26%	26%	26%	42%
NTC_Aston Keynes	SWOX	5%	16%	16%	26%	26%	26%	26%	26%	26%	26%	26%	26%	32%	32%	32%	37%
NTC_Britwell	SWOX	11%	16%	16%	21%	26%	26%	26%	26%	32%	32%	32%	32%	37%	37%	37%	37%
NTC_Epsom	London	0%	16%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
NTC_New River Head	London	32%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
RES_Abingdon 100 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RES_Abingdon 125 Mm3	Multi-zone	0%	0%	0%	11%	11%	11%	11%	11%	11%	16%	16%	16%	16%	16%	16%	16%
RES_Abingdon 150 Mm3	Multi-zone	0%	0%	0%	74%	74%	74%	74%	74%	79%	79%	79%	79%	79%	79%	79%	79%
RES_Abingdon 75 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_Chingford (E&S)	London	0%	0%	0%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%
RWP_Didcot	London	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%
RWP_Oxford Canal to Cropredy	London	0%	21%	32%	32%	32%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
RWP_Oxford Canal to Dukes Cut	SWOX	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%	5%	5%
RWP_STT Minworth	Multi-zone	0%	0%	16%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
RWP_STT Mythe	Multi-zone	0%	0%	11%	11%	11%	11%	21%	26%	26%	26%	26%	26%	26%	26%	26%	26%
RWP_STT Netheridge	Multi-zone	0%	0%	16%	21%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
RWP_STT UU/ST Opt A	Multi-zone	0%	0%	11%	11%	16%	16%	16%	21%	21%	21%	21%	21%	21%	21%	21%	21%
RWP_STT UU/ST Opt B	Multi-zone	0%	0%	5%	5%	11%	11%	11%	16%	21%	21%	21%	21%	21%	21%	26%	26%
RWP_STT Vyrnwy 148	Multi-zone	0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
RWP_STT Vyrnwy 180	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_STT Vyrnwy 60	Multi-zone	0%	0%	16%	16%	21%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
RWP_STT Welsh 60	Multi-zone	0%	0%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	16%	16%	16%
RWP_Wessex Water to SWX	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	11%	11%	11%	11%	11%	16%	16%	21%

Relative frequency of option selection across all scenarios

X.23 This sub-section provides a summary of the relative frequency of resource development option selection across Steps 2a-c of programme appraisal. Table X-12 shows the relative frequency with which options are chosen, and by when.

X.24 As in all other analyses, resource development options are used in addition to the preferred programme of demand management measures.

Table X-12: Steps 2 a-c - Relative frequency of resource development option selection, in addition to the preferred programme of demand management measures

Options	WRZ	AMP7	AMP8	AMP9	AMP10	AMP11	AMP12	AMP13	AMP14	AMP15	AMP16	AMP17	AMP18	AMP19	AMP20	AMP21	AMP22
AR_Kidbrooke (SLARS1)	London	0%	10%	10%	11%	11%	13%	16%	16%	21%	21%	22%	24%	27%	27%	27%	27%
AR_Merton (SLARS3)	London	0%	13%	16%	17%	17%	17%	29%	29%	37%	37%	38%	40%	40%	40%	40%	40%
AR_Streatham (SLARS)	London	8%	10%	11%	11%	11%	11%	21%	22%	22%	25%	25%	27%	30%	32%	33%	35%
ASR_Horton Kirby	London	8%	17%	32%	35%	41%	46%	46%	46%	49%	49%	49%	49%	49%	49%	49%	49%
ASR_South East London (Addington)	London	0%	0%	13%	13%	14%	24%	25%	25%	30%	32%	32%	33%	33%	35%	35%	35%
ASR_Thames Valley/Thames Central	London	0%	0%	13%	13%	13%	13%	22%	24%	27%	29%	32%	33%	35%	37%	37%	38%
DSL_Beckton 150	London	0%	27%	38%	38%	38%	38%	38%	40%	40%	41%	41%	43%	44%	48%	48%	49%
DSL_Crossness 100	London	0%	6%	11%	11%	11%	11%	11%	17%	22%	22%	22%	24%	24%	24%	27%	29%
DSL_Crossness 100	London	0%	0%	2%	3%	5%	6%	10%	10%	10%	13%	14%	19%	19%	19%	19%	21%
DSL_Crossness 100	London	0%	0%	2%	2%	2%	2%	5%	6%	10%	11%	11%	11%	11%	11%	13%	14%
GW_Addington	London	0%	8%	11%	13%	14%	14%	24%	27%	37%	37%	37%	37%	37%	37%	38%	40%
GW_Datchet	SWA	3%	14%	14%	14%	14%	14%	14%	14%	16%	16%	19%	19%	32%	37%	51%	52%
GW_Honor Oak	London	0%	6%	6%	6%	6%	6%	6%	6%	10%	11%	13%	13%	13%	13%	16%	16%
GW_London confined chalk	London	0%	8%	10%	11%	13%	14%	22%	25%	32%	35%	38%	38%	41%	41%	41%	41%
GW_Merton	London	0%	8%	8%	8%	10%	13%	14%	14%	16%	17%	17%	17%	19%	22%	22%	24%
GW_Moulsford	SWOX	3%	14%	16%	17%	17%	17%	19%	19%	29%	29%	32%	32%	35%	37%	37%	37%
GW_Southfleet/Greenhithe	London	5%	17%	30%	32%	33%	35%	37%	37%	44%	46%	46%	46%	46%	46%	46%	46%
IPR_Beckton 100	London	0%	3%	10%	10%	11%	11%	14%	14%	14%	16%	19%	19%	21%	21%	22%	24%
IPR_Beckton 100	London	0%	2%	3%	3%	3%	3%	3%	5%	5%	6%	6%	6%	8%	8%	8%	10%
IPR_Beckton 100	London	0%	0%	2%	2%	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	5%	5%
IPR_Beckton 150	London	0%	2%	10%	10%	10%	10%	10%	11%	14%	14%	14%	14%	14%	16%	17%	17%
IPR_Beckton 150	London	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%	2%	5%	5%	5%
IPR_Deephams 45	London	0%	14%	24%	25%	25%	27%	29%	29%	33%	35%	38%	38%	38%	38%	38%	38%
IZT_North SWX to SWA 48	SWA	0%	6%	8%	8%	8%	8%	8%	8%	10%	10%	10%	10%	11%	11%	11%	13%
IZT_North SWX to SWA 72	SWA	0%	10%	10%	10%	10%	11%	11%	11%	13%	14%	16%	17%	27%	29%	30%	32%
IZT_R Thames to Medmenham	SWA	0%	8%	8%	8%	8%	8%	8%	8%	10%	10%	11%	11%	22%	25%	27%	43%
NTC_Aston Keynes	SWOX	5%	13%	13%	16%	16%	16%	16%	17%	17%	19%	21%	21%	24%	25%	25%	30%
NTC_Britwell	SWOX	6%	13%	13%	14%	16%	16%	16%	16%	17%	27%	27%	29%	30%	30%	30%	37%
NTC_Epsom	London	2%	13%	21%	24%	24%	30%	32%	32%	41%	44%	44%	44%	44%	44%	44%	44%
NTC_New River Head	London	37%	41%	41%	41%	41%	41%	41%	41%	43%	43%	43%	43%	43%	43%	43%	43%
RES_Abingdon 100 Mm3	Multi-zone	0%	0%	0%	2%	3%	3%	3%	6%	10%	10%	10%	10%	10%	11%	11%	13%
RES_Abingdon 125 Mm3	Multi-zone	5%	5%	5%	10%	10%	11%	14%	16%	21%	22%	22%	22%	22%	22%	22%	22%
RES_Abingdon 150 Mm3	Multi-zone	0%	0%	0%	29%	32%	32%	37%	38%	44%	44%	44%	49%	49%	49%	54%	54%
RES_Abingdon 75 Mm3	Multi-zone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
RWP_Chingford (E&S)	London	0%	0%	0%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%
RWP_Didcot	London	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
RWP_Oxford Canal to Cropredy	London	0%	16%	29%	30%	30%	32%	32%	33%	35%	35%	35%	37%	38%	38%	38%	38%
RWP_Oxford Canal to Dukes Cut	SWOX	0%	3%	3%	3%	3%	3%	3%	3%	3%	5%	5%	6%	10%	10%	10%	10%
RWP_STT Minworth	Multi-zone	0%	0%	6%	10%	10%	10%	10%	11%	11%	11%	13%	13%	13%	13%	13%	13%
RWP_STT Mythe	Multi-zone	0%	0%	6%	6%	6%	6%	10%	11%	13%	13%	14%	14%	14%	14%	14%	16%
RWP_STT Netheridge	Multi-zone	0%	0%	6%	8%	10%	10%	11%	11%	11%	11%	13%	13%	14%	14%	16%	16%
RWP_STT UU/ST Opt A	Multi-zone	0%	0%	3%	5%	8%	8%	10%	13%	14%	14%	14%	16%	16%	16%	16%	16%
RWP_STT UU/ST Opt B	Multi-zone	0%	0%	2%	2%	3%	5%	5%	8%	10%	10%	10%	11%	11%	13%	14%	17%
RWP_STT Vyrnwy 148	Multi-zone	0%	0%	2%	2%	3%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
RWP_STT Vyrnwy 180	Multi-zone	0%	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
RWP_STT Vyrnwy 60	Multi-zone	0%	0%	6%	6%	8%	10%	11%	11%	13%	14%	14%	14%	14%	14%	14%	14%
RWP_STT Welsh 60	Multi-zone	0%	0%	3%	3%	3%	5%	5%	5%	6%	8%	8%	8%	10%	11%	11%	11%
RWP_Wessex Water to SWX	Multi-zone	0%	0%	5%	5%	5%	5%	5%	5%	8%	8%	8%	8%	10%	13%	13%	19%

C. Programme appraisal Step 4: Final planning target headroom

X.25 This section presents target headroom estimates for the period 2020 to 2045, based on the uncertainties associated with the new supply and demand schemes included in the (rdWRMP19) plan, plus those of the baseline supply and demand position.

X.26 Target headroom is a methodology by which the uncertainty around the supply demand balance is converted into a value for each year. This target headroom value is added to demand as part of the supply demand balance to ensure the appropriate balance of risk between cost and potentially failing to meet levels of service (with extra cost being incurred to provide the planning margin (headroom) to cover uncertainties, and extra risk being incurred if no planning margin is provided).

X.27 Section 5: Risk and uncertainty of the main plan (rdWRMP19) provides detail on the methodology for calculating target headroom and the results of baseline target headroom analysis. Baseline analysis is a calculation performed without knowledge of what options may be selected in the preferred programme and therefore only includes uncertainty around the baseline supply and demand forecasts. Because the contribution to the supply demand balance of options that are selected to be part of a plan are inherently also uncertain, target headroom must be re-assessed to ensure supply and demand still balance when the uncertainty around different sets of selected options is included.

Baseline and Final Target Headroom charts (All WRZs)

X.28 The outputs of our rdWRMP19 target headroom determinations are shown in Figure X-1 to Figure X-6. These show baseline and final plan target headroom data[9] for each WRZ, where the variance between these implicitly is the additional uncertainty brought by the new (supply and demand) options included in the (rdWRMP19) plan.

[9] For the dry year annual average (DYAA) condition for the London WRZ, and the dry year critical period (DYCP) condition for the Thames Valley WRZs, reflecting, respectively, the condition under the supply-demand balance of the WRZ is the more testing.

Figure X-1: London target headroom (DYAA)

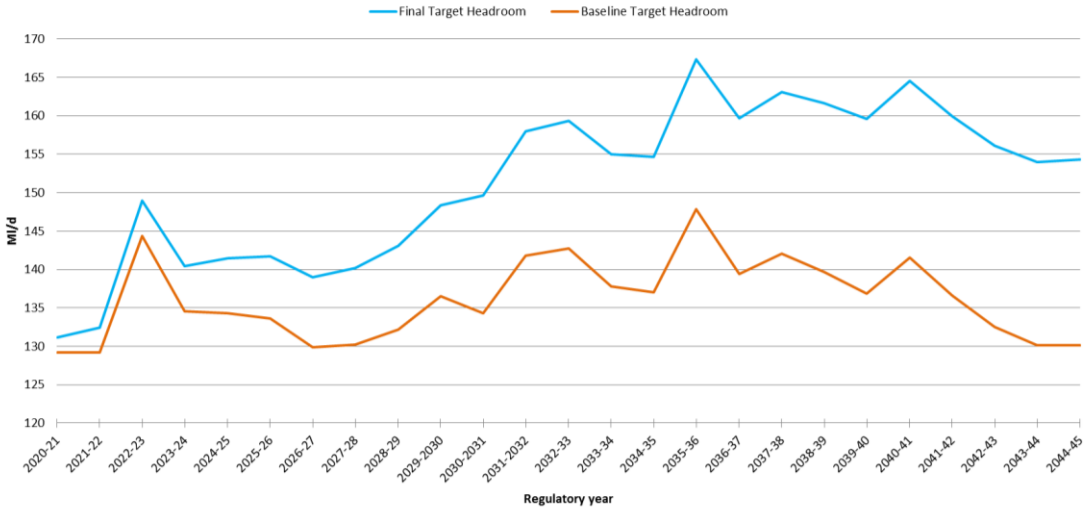


Figure X-2: SWOX target headroom (DYCP)

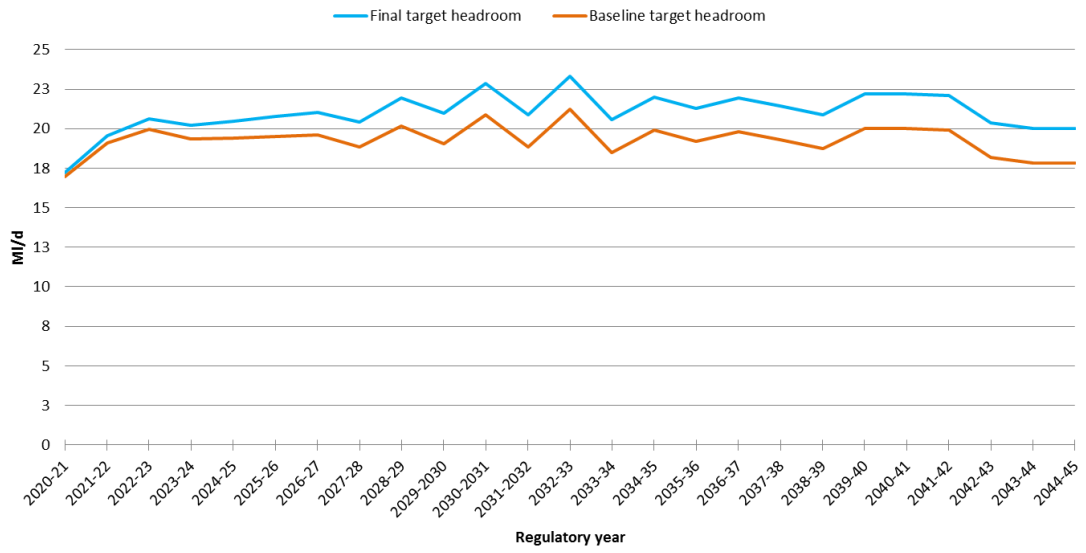


Figure X-3: SWA target headroom (DYCP)

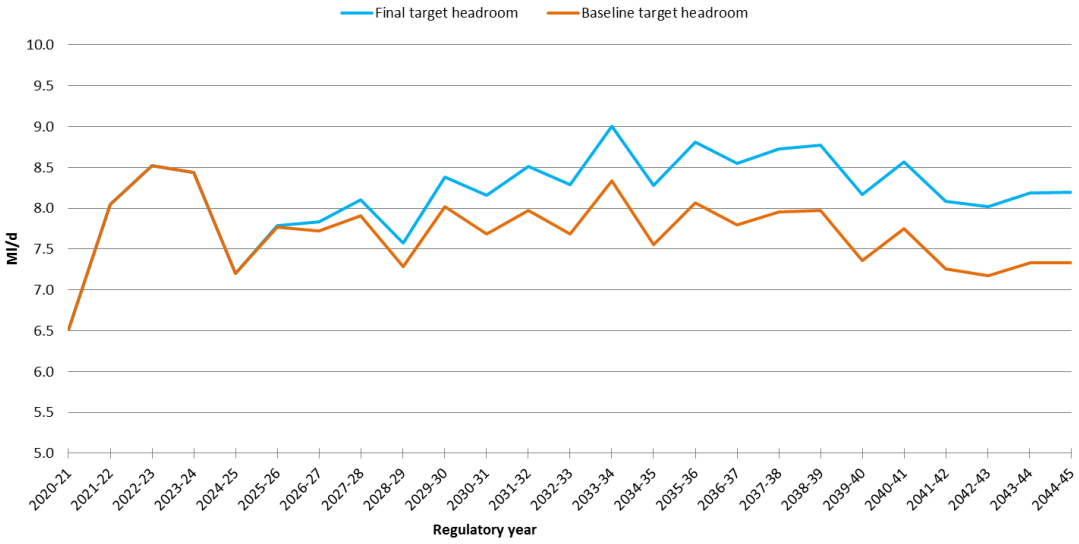


Figure X-4: Kennet Valley target headroom (DYCP)

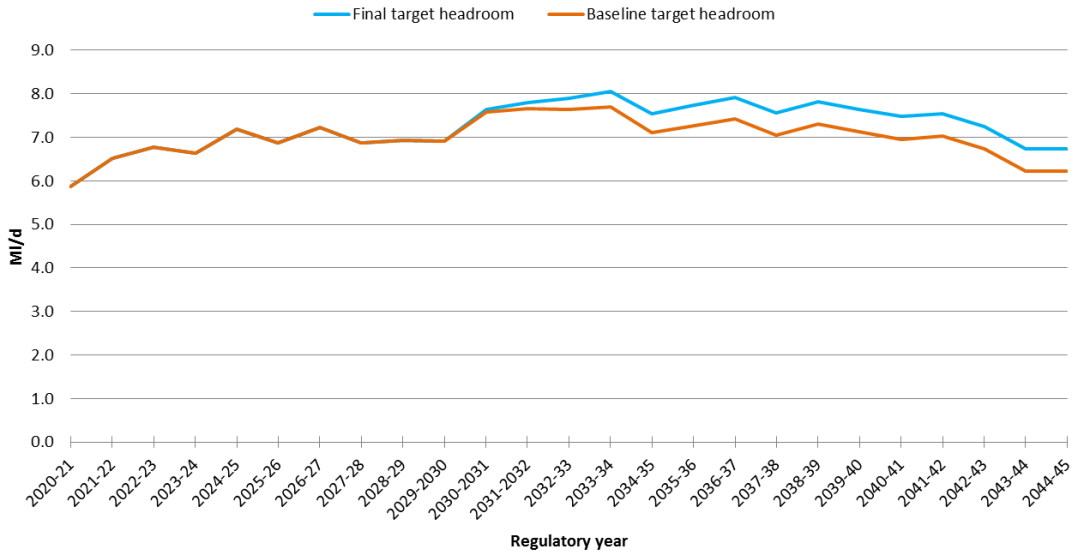


Figure X-5: Guildford target headroom (DYCP)

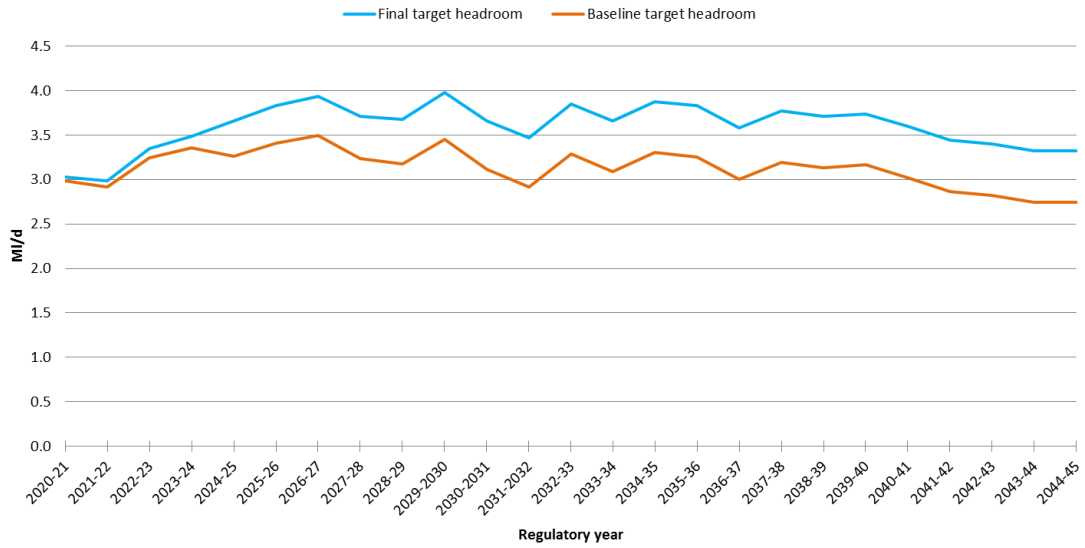
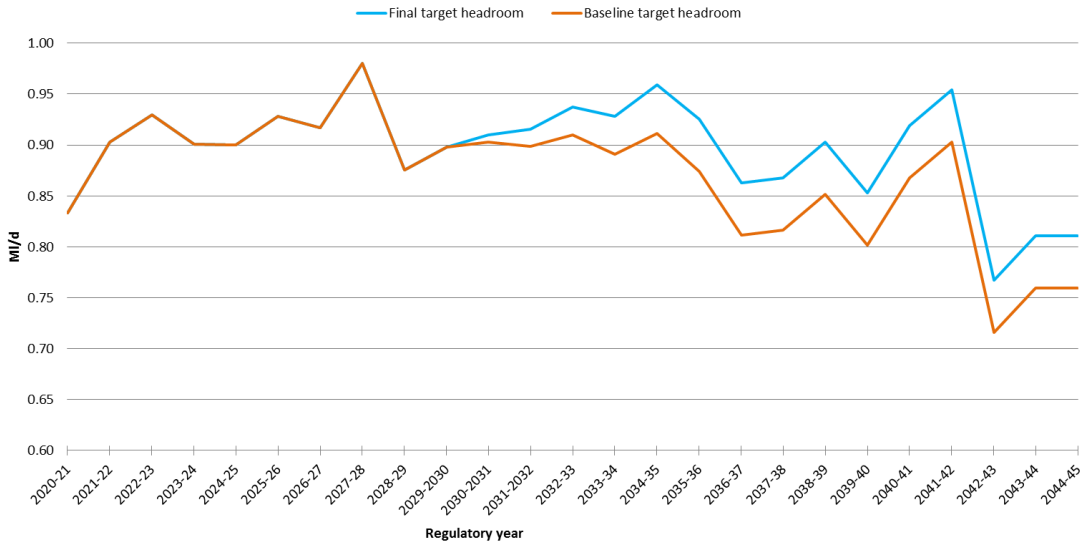


Figure X-6: Henley target headroom (DYCP)



D. Programme appraisal Step 4: Adaptability analysis outputs

X.29 Adaptability analysis has been carried out on the shortlisted Reasonable Alternative Programmes (RAPs) that address and resolve the preferred baseline deficits (Step 2c - Baseline + Resilience to 1:200 drought + WRSE transfers) in the combined London, SWOX and SWA (LSS) WRZ.

X.30 The methodology used is described in Appendix W.

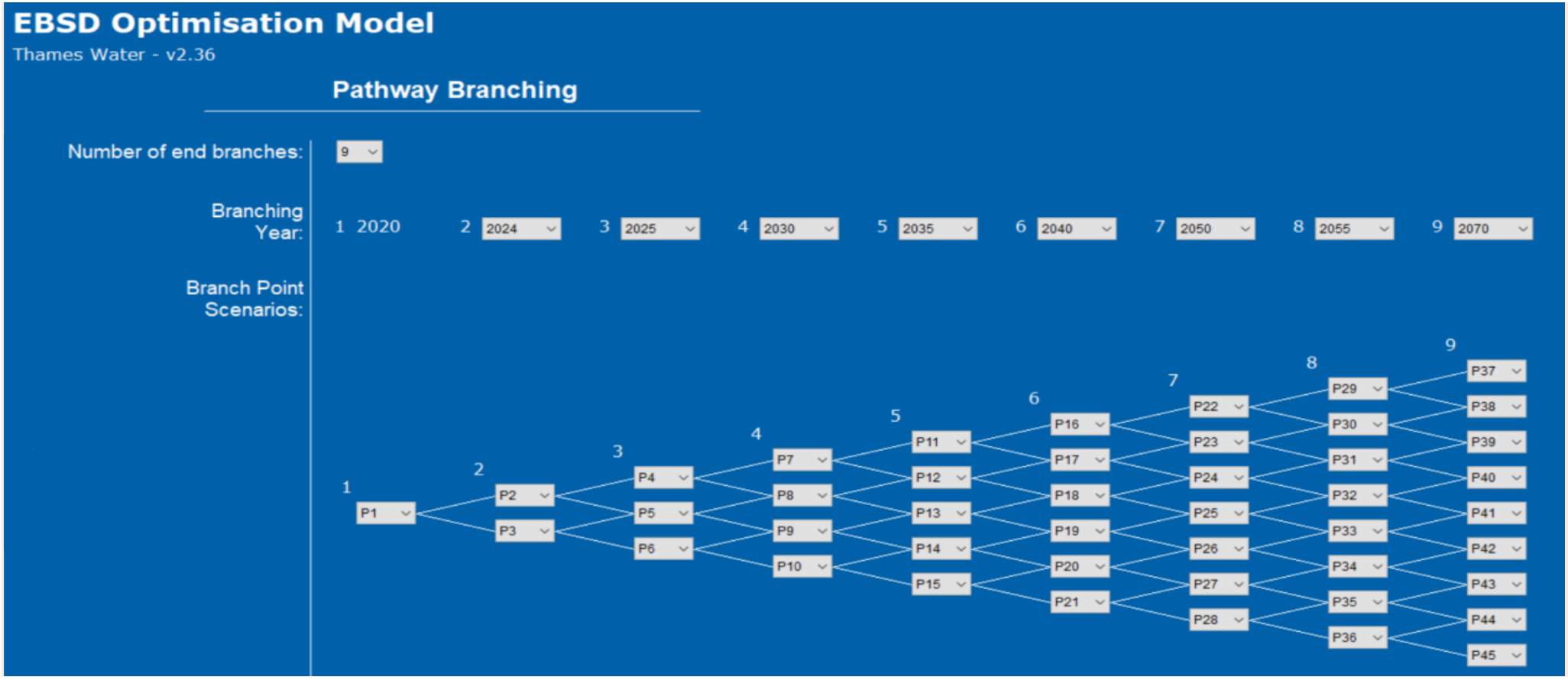
X.31 This section is structured as follows:

- Adaptability pathway distribution
- Outputs: Initial investment
- Outputs: Strategic options
- Outputs: Programme cost, risk of failure and standby costs
- Outputs: Pathway N180 for resilience to 1:500 drought
- Conclusions

Adaptability pathway distribution

X.32 The decision points and forecasts which form the adaptability pathways examined for rdWRMP19 are reproduced in Figure X-7 below. Analysis of the pathways formed from these decision points and forecasts is described in Appendix W.

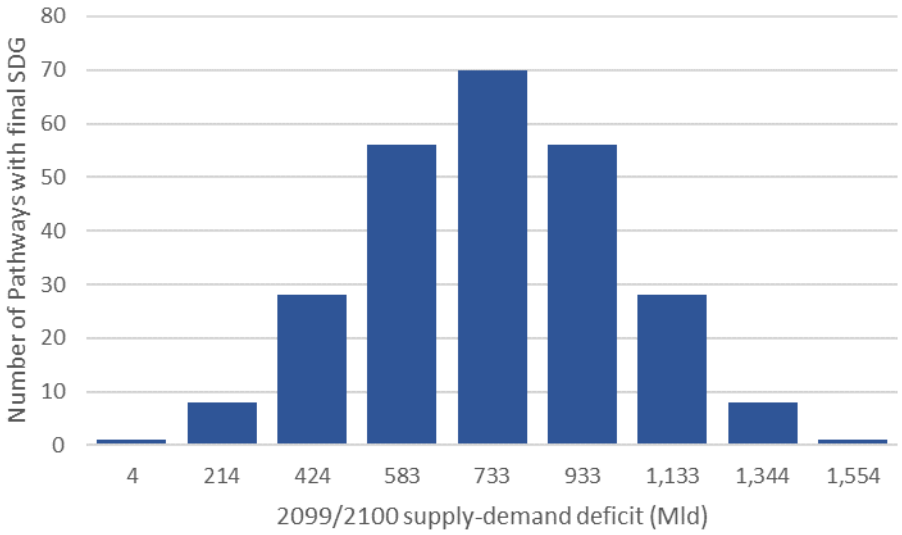
Figure X-7: Adaptability pathways schematic in EBSD+



X.33 There are 256 pathways[10] along which investment may evolve from the AMP7 starting-point (2020); the final decision point is in 2070/71 from which the pathways optimise for 9 different forecasts (P37 to P45) to 2099/2100.

X.34 The central estimate supply-demand gap for the baseline plus drought plus WRSE scenario forms the initial pathway. At each subsequent branch point, the pathway is limited to moving to one of the two options that exist at that point. This generates a range of routes to the final nine supply demand balances (SDBs) with a normal distribution about the central estimate (Figure X-8).

Figure X-8: Distribution of the supply demand deficit for 2099/2100 across the 256 adaptability pathways (London, SWOX and SWA WRZs in aggregate)



X.35 This shows that when analysing the distribution of costs, supply-demand failures and option selection across all pathways, the median has the same final SDB as the baseline forecast (733 Ml/d not including target headroom); the supply-demand deficit for the 25th percentile of the pathway distribution has been reduced by 150 Ml/d by the endpoint (some pathways will have greater deficit prior to their end), and the final deficit for the 75th percentile has increased by 200 Ml/d. Analysis of each of the significantly more or less severe deficits is less frequent, and the results will be expressed within the whiskers representing the 25th percentile to minimum and 75th percentile to maximum.

X.36 There will not always be direct correlation with the same pathway meeting the same point in the range across all outputs, but the percentiles of the range of outputs across all 256 pathways should broadly correspond to those of the original deficit distribution.

Outputs: Initial investment

X.37 Analysis of the shortlisted programmes shows that the variation between investment up to the first branch point gives the differences in initial resource options as shown in Table X-13. Completion and commissioning of these options is fixed within each subsequent adaptability

[10] Being $2^{(9-1)}$

analysis for all 256 pathways, as construction has already commenced when the first branch point is reached.

Table X-13: Resource development options commenced in AMP7 (by RAP)

RAP	Deephams Reuse	Oxford Canal	Severn Transfer	Reservoir	Beckton Desal	Beckton Reuse	Small options	Capacity of Initial Options
	Ml/d	Ml/d	Ml/d	Ml/d	Ml/d	Ml/d	Ml/d	Ml/d
NearO_RES		11	54		142		22	229
MultiObj_RES		11	60			190	32	293
Least Cost	45			253			3	301
MultiObj_FP	45	11		253			3	312
Min_IGEQ	45			294			9	348
NearO_TP				294	142		0	436

X.38 There is high similarity between the initial programmes for Least Cost and MultiObj_FP, with the 125Mm^3 reservoir supported by Deephams reuse plant, plus in MultiObj_FP, the Oxford Canal transfer. Min_IGEQ is also similar to Least Cost in choice of option type, although the larger reservoir is selected together with an additional 6 Ml/d of small option capacity.

X.39 NearO_RES and MultiObj_RES both have the Oxford Canal and Severn transfers supported by a reuse or desalination plant at Beckton, and a larger volume of small options. In contrast, NearO_TP has minimised the number of initial options, with only desalination supported by the largest reservoir, and no small options.

Outputs: Strategic options

X.40 Adaptability analysis looks for patterns of frequency and sequential selection of options and option types, weighed against the cost and resilience of option combinations to evaluate their value.

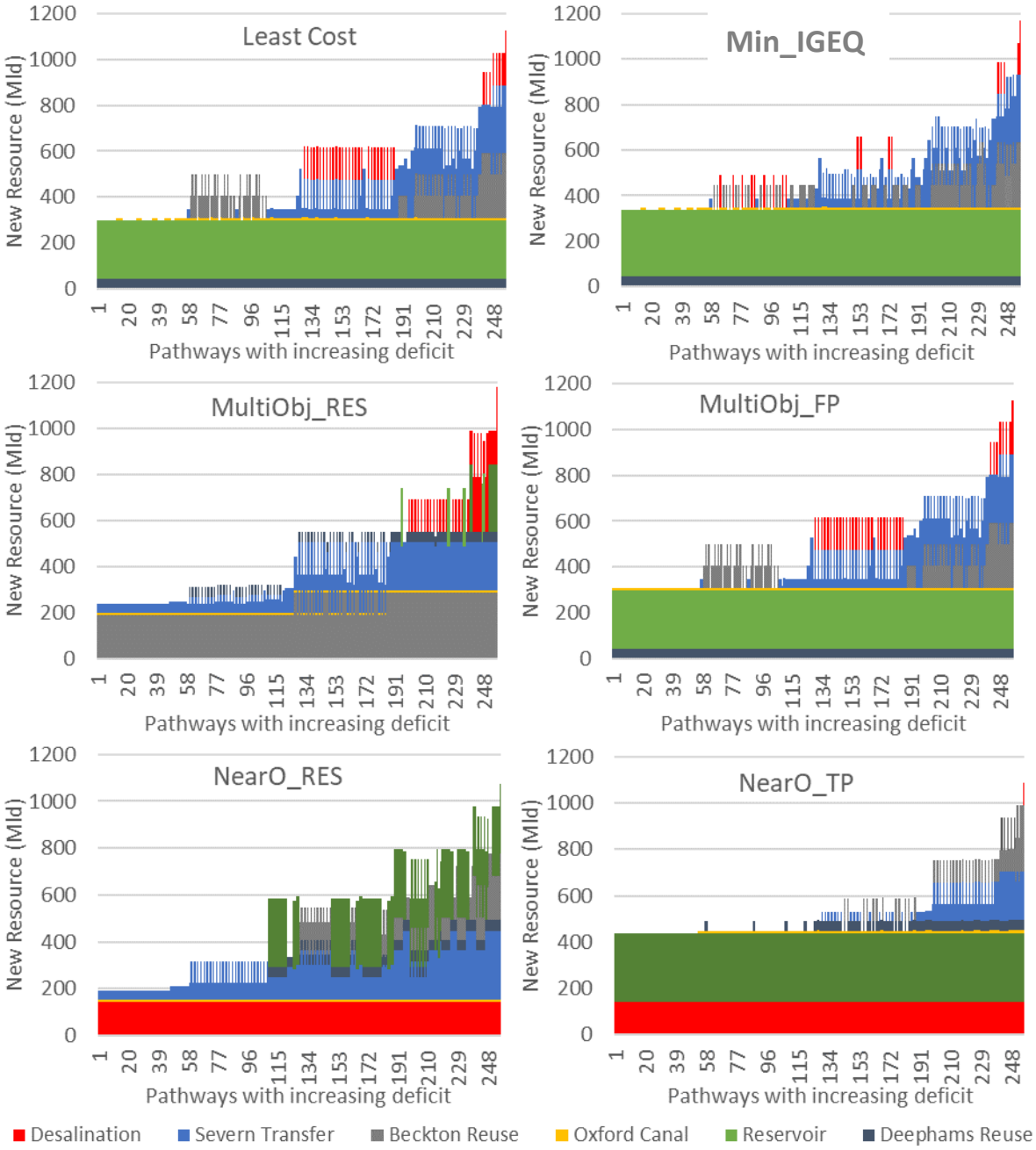
X.41 The combinations of the strategic options (Desalination, Beckton and Deephams re-use, Severn Thames Transfer, Oxford Canal transfer and reservoir) selected by the modelling for each RAP across all 256 pathways are shown in Figure X-9, below.

X.42 Smaller options which can be commissioned more swiftly were also available for selection, to a maximum capacity of 61 Ml/d (i.e. MultiObj_RES has already selected over half the available small options as part of the initial programme).

X.43 All RAPs include the same demand management programs for London, SWA and SWOX which are forecast to provide a combined 494 Ml/d demand reduction by 2054; demand management selection is not part of adaptability planning although the pathways have been developed to include the possibility that the forecast demand reduction may be delayed or may not be met.

X.44 Individual pathways have been ordered and numbered by increasing final supply-demand deficit; the complete matrix of links and decision points for each pathway is given in Appendix W, Annex 5.

Figure X-9: Strategic resource option selection across pathways with increasing final deficit



X.45 The data show that despite the slight difference in initial investment (MultiObj_FP includes the Oxford Canal), differences between the Least Cost and MultiObj_FP adaptability outputs are negligible and therefore further analysis of MultiObj_FP is not included in this Appendix. While Min_IGEQ is also very similar to Least Cost in initial investment, the choice of the larger

reservoir makes for a different profile of potential future investment. The additional 41Ml/d capacity of the larger reservoir could make a significant difference to the challenges that may face London and the larger Thames Valley zones, which the 11Ml/d Oxford Canal does not.

X.46 However, the data also indicate that the Oxford Canal is a valuable option that is almost always selected, if not as part of the initial investment, then as the first additional option once the initial investment is no longer sufficient.

X.47 Where the reservoir is not part of the initial investment, the frequency with which it is later selected depends to a degree upon the ability to increase the capacity of the initial investment options. In NearO_RES the Severn Transfer capacity can be expanded, but Beckton desalination cannot, and the reservoir is brought in to further increase capacity in 104 of the pathways as they become increasingly challenging (41%). In MultiObj_RES both the Severn transfer and the Beckton reuse plant can be expanded, and the reservoir is brought in for only 16 of the most challenging futures (6%).

X.48 The increase in reservoir size between Least Cost and Min_IGEQ affects the frequency with which the Severn transfer or London reuse/desalination are selected to increase capacity for more challenging futures.

Table X-14: Selection frequency for more challenging futures post-reservoir

	Large reuse/desal	Severn transfer
Least Cost (125Mm3 reservoir)	124	154
Min IGEQ (150Mm3 reservoir)	114	134

X.49 However, the Severn transfer is selected more frequently regardless of reservoir size, and as such can be seen as the logical next option after a reservoir, suitable for a wide range of futures (Table X-14).

X.50 Where initial investment in the Beckton desalination plant is supported by a large strategic resource option in the west, either the reservoir or the Severn Thames Transfer, analysis of the frequency of selection of further reuse/desalination or the alternative strategic resource option for more challenging futures shows that the alternative large strategic resource option is selected more frequently regardless of the initial strategic investment (Table X-15).

Table X-15: Selection frequency for more challenging futures post-desalination + initial strategic resource option

	Large reuse/ desal	Additional strategic resource option
NearO_RES (Severn transfer)	80	104
NearO_TP (150Mm3 reservoir)	50	86

X.51 This trend toward subsequent selection of the alternative large strategic resource option however does not hold true where the initial investment is Beckton reuse and the Severn transfer (MultiObj_RES). For this RAP, desalination is selected as additional capacity for 35 of the more challenging futures while the reservoir is selected for 16. This may in part be due to

the smaller remaining deficit challenge once the Beckton reuse plant and Severn Thames transfer are both expanded to full capacity.

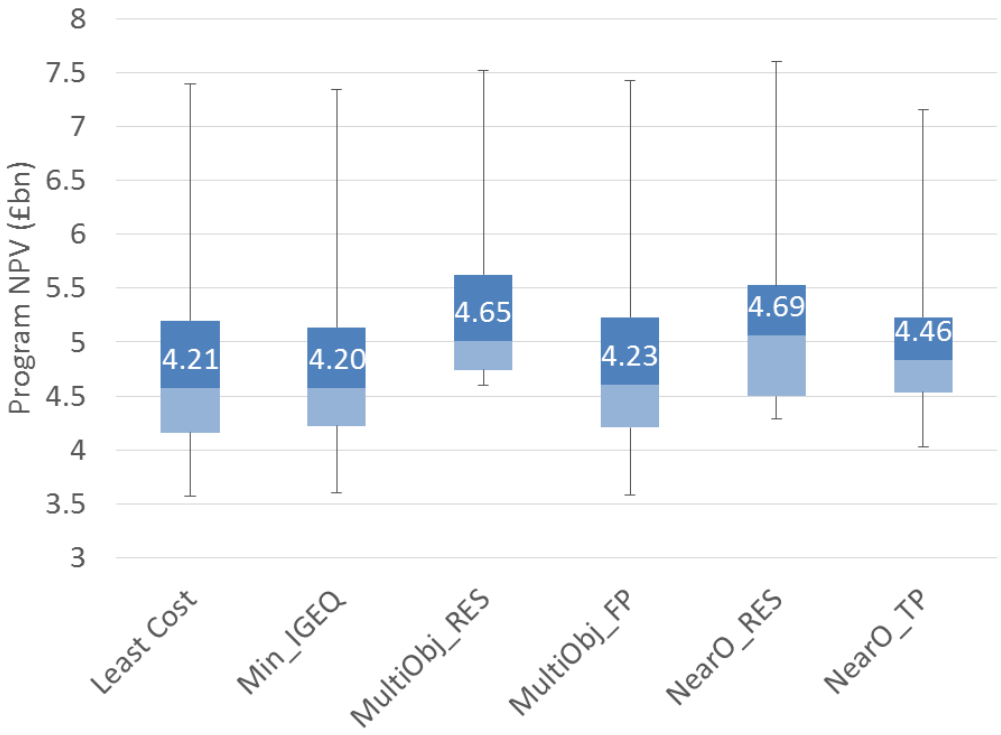
X.52 However, this trend towards increasing total reuse and desalination capacity in London would need to be assessed against a potential WFD challenge on the Thames Tideway (and risks to the Recommended Thames Estuary Marine Conservation Zone) from concurrent operation of multiple reuse and desalination capacity, a risk identified in the SEAs of the RAPs (Appendix B).

Outputs: Cost, risk of failure and standby cost

X.53 In addition to the patterns of options selected across different futures, adaptability analysis looks at the total costs, risk of failure of supply, and standby cost to maintain resources for risk resilience.

Cost

Figure X-10: Cost range across pathways for each programme



X.54 The central part of the box and whisker plot in Figure X-10 shows the 25th, 50th and 75th percentiles of the NPV of total cost for each of the programmes developed across the 256 pathways. The label is the 50th percentile. The whiskers show the maximum and minimum programme costs.

X.55 Least Cost, MultiObj_FP and Min_IGEQ have significantly lower minimum, 25th percentile and median costs than MultiObj_RES, NearO_RES and NearO_TP. The median NPV costs are more than £200 million below NearO_TP and more than £400 million below the two RES RAPs.

X.56 When comparing costs between Least Cost and Min_IGEQ pathways, Min_IGEQ has the lowest 50th and 75th percentile program NPV, although the increase to median Least Cost is negligible. Min_IGEQ has a narrower range, with higher costs for less challenging futures, and lower costs for more challenging futures. Since the main initial difference between the two RAPs is a larger reservoir in Min_IGEQ, the narrower cost range indicates that a larger reservoir size will be less cost effective should the future prove less challenging than the current baseline (median), and more cost effective should the future prove more challenging, although at the current baseline the larger reservoir is only marginally more cost effective.

X.57 The programmes optimised for resilience (RES) have a £450 million increase in median cost with respectively higher 25th and 75th percentiles, although the near optimal programme is closer to the Least Cost. This is mainly the cost of initial investment in a larger resource to meet 1:200 drought resilience by 2030.

X.58 NearO_TP sits between least cost and the resilience programmes in terms of costs.

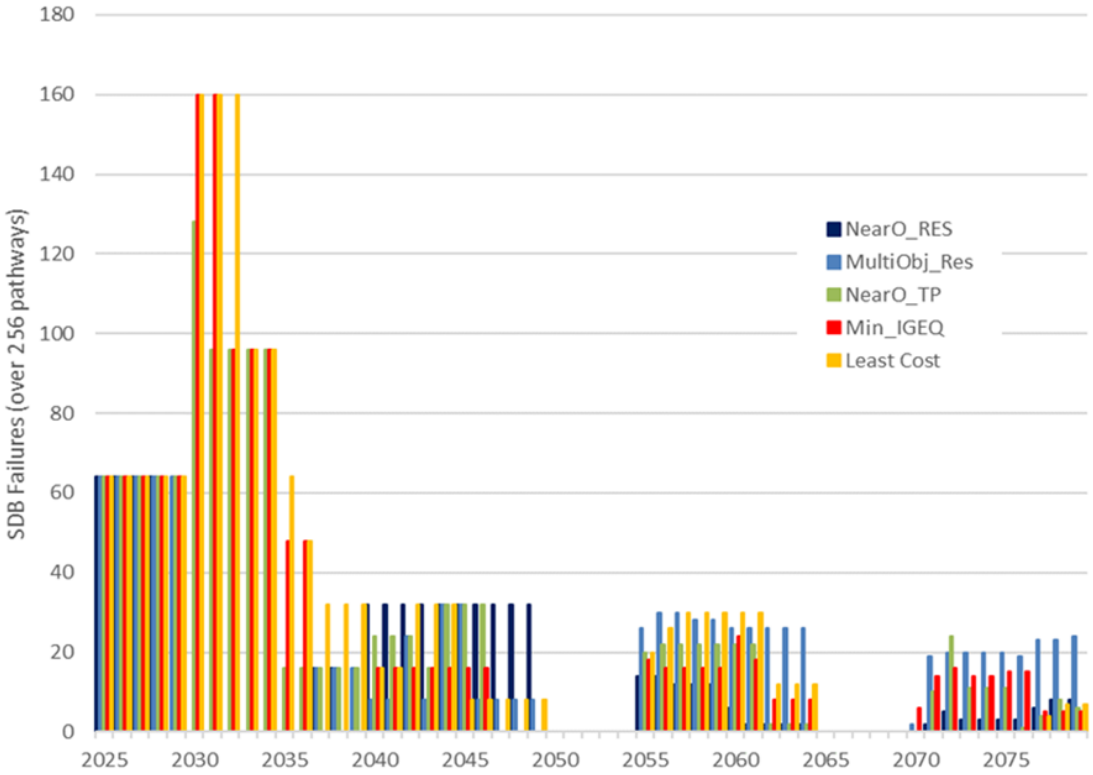
X.59 However, all costs can really only be evaluated in conjunction with the increased resilience that is provided by this investment.

Risk of failure

X.60 Programme resilience is assessed in terms of risk of failure. The pathways are designed to challenge investment capability within the lead times of the available large resources; decision points may increase or decrease demand between one year and the next by up to 210 Ml/d (combined for all three WRZs). With only 60 Ml/d of small option capacity available, failures are likely to occur in years immediately subsequent to a decision point; adaptability is assessing long-term strategic investment strategies rather than the ability to adapt to immediate unforeseen challenges to security of supply.

X.61 Looking at the outputs, across all RAPs there are four periods of failures – of increasing or less severity for the different RAPs, but coinciding across the planning horizon (Figure X-11).

Figure X-11: Failures across the planning horizon in London WRZ



X.62 Although Figure X-11 shows the failures for London WRZ only, there are no failures in SWA or SWOX for years where there are not also failures in London, in any of the RAP adaptability analyses.

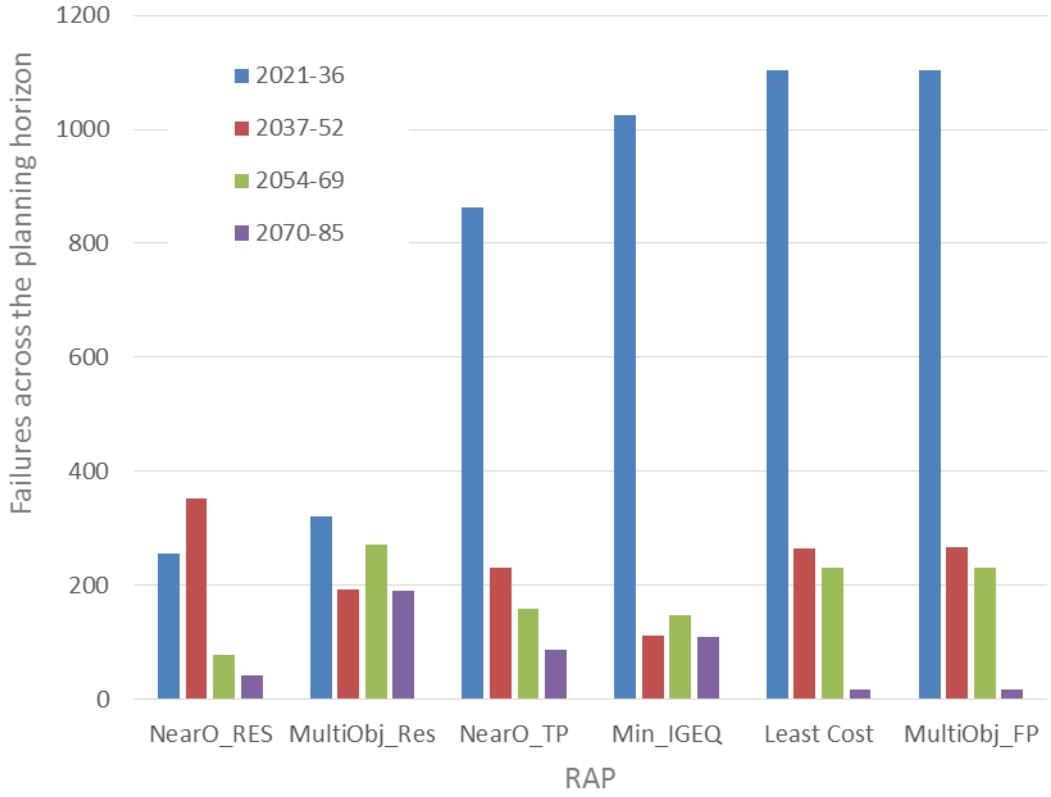
X.63 SWA failures are consistent across all RAPs, from 2030 to 2034. None of the RAPs selected options beyond demand management this early in the programme, so if there is a challenge, there is no method for the zone to deal with it.

X.64 SWOX has supply demand failure between 2030 and 2036 in 4 of the 6 RAPs; those which do not commission the Severn Thames transfer in 2030.

X.65 There are no failures in all WRZs before the first decision point (2025), or after 2079, and for two periods in the middle: 2051-54 and 2065-69.

X.66 Although some failures are contiguous in the London WRZ between 2036 and 2037 (max 32), there is a distinct change in profile, especially as there are no failures outside London post 2037. For comparative analysis, the horizon is divided into four 16-year periods (Figure X-12) which broadly speaking represent response to different challenges.

Figure X-12: Total number of London failures across each 16-year failure period for the 256 pathways analysed for each RAP



X.67 As stated in Section 10, there are three different drivers for strategic investment across the 80 year planning horizon: investment for increased drought resilience, investment in a shared strategic resource and investment to meet growth across the entire period.

X.68 Resilience to a 1:200 drought is planned from 2030. The failures for each RAP during the period 2021-2036 are broadly representative of the risk of failure to meet this drought resilience due to additional challenges. Unsurprisingly, the two RAPs optimised for resilience (NearO_RES and MultiObj_RES) are best able to meet these challenges, with the support of a large reuse/ desalination plant in London and the Severn Thames transfer from the West.

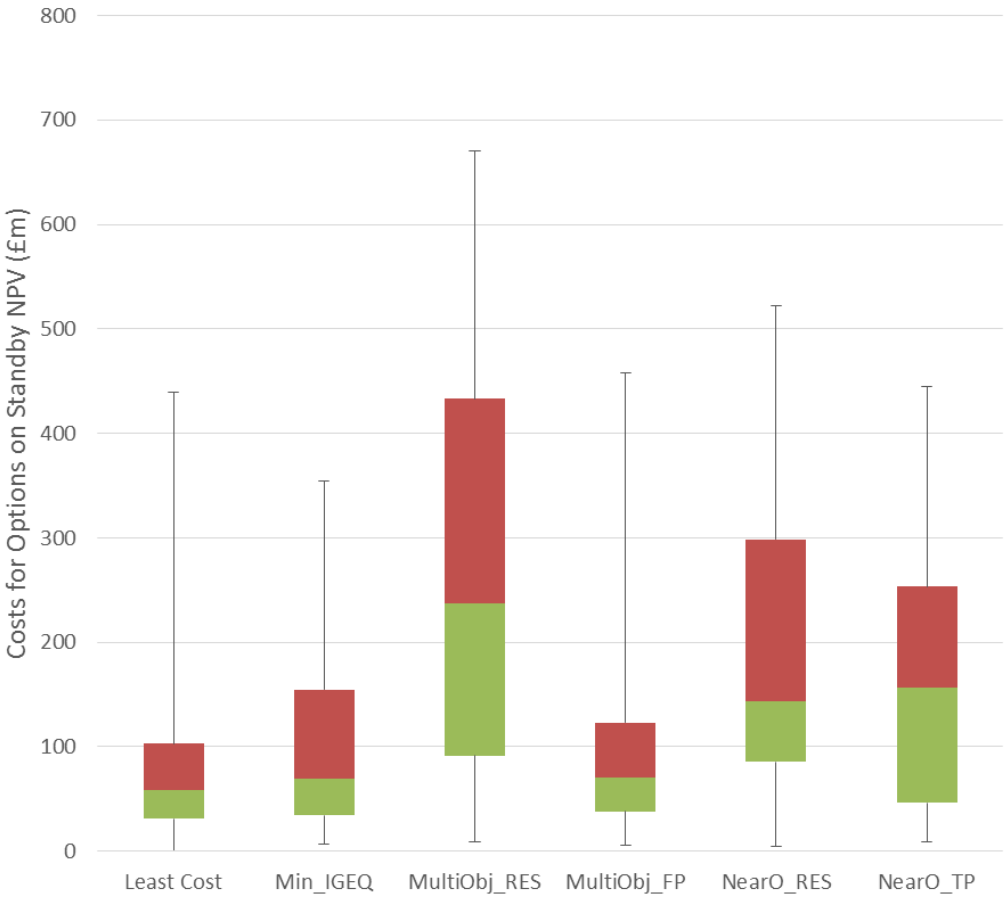
X.69 NearO_TP, which has a desalination plant in London, is the next best able to deal with these challenges, but without the Severn Thames transfer there are significantly more failures, while the remaining RAPs which have neither large London reuse/ desalination or the Severn Thames transfer experience failures in the upper quartile of most challenging pathways (75th percentile to maximum) over this period.

X.70 The strategic resource is commissioned in 2037, and all of the RAPs are resilient to over 90% of the pathways for the remaining three period of analysis. Overall, while Min_IGEQ has the fewest failures post 2037 and MultiObj_RES the most, there is little to drive choice in the variation in risk of failure (and hence resilience) for any of the RAPs after commissioning of the strategic asset.

Stand-by Cost

X.71 Building programmes that are more resilient to failure can be viewed in conjunction with overall cost, but the cost of maintaining assets on standby against resilience need is also of value in decision making. Adaptability separates out the standby cost from the totex value, calculated as the combined fixed operating costs and capital maintenance costs for any commissioned asset in any year that it is not utilised, again presented as net present value.

Figure X-13: Standby cost range across all 256 programs for each RAP

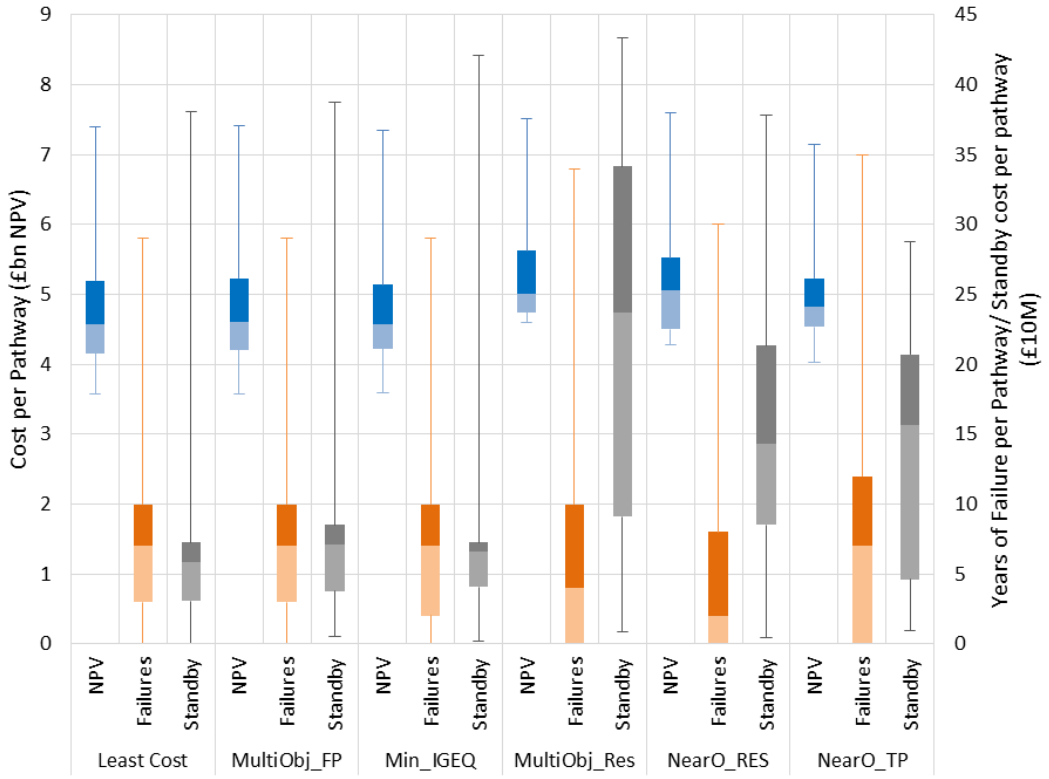


X.72 All of the RAPs which commission a reservoir in 2037 (Least Cost, Min_IGEQ, MultiObj_FP and NearO_TP) have lower standby costs in the 25th and 75th percentiles, and most have lower median standby costs. This is reflective of the lower cost of utilising and maintaining a reservoir which can sustain the supply across the majority of the central pathways.

Overall performance

X.73 Trade-offs between these three parameters are required to make the final selection, so they are presented together in Figure X-14 below, for ease of comparison.

Figure X-14: Totex NPV, total failures and standby NPV distribution trade-offs



X.74 NearO_RES has both lower risk of failure and lower standby costs than MultiObj_RES, indicating that in terms of resilience, building a 150 Ml/d desalination plant and the Severn Thames transfer, followed predominantly by a reservoir when further investment is needed, is more cost effective than building a 200 Ml/d reuse plant together with the Severn Thames transfer, and subsequent further reuse/ desalination for the majority of more challenging pathways. This is supported in Figure X-10, where NearO_RES has lower 25th and 75th percentiles of total cost, yet very similar median totex. As such, MultiObj_RES is no longer considered an option since NearO_RES is a more cost effective way of increasing resilience.

X.75 NearO_TP has significantly higher cost for all but the most challenging futures, but higher risk of failure in all but the least challenging futures at a higher standby cost. As such it is not a programme to be considered further either.

X.76 Min_IGEQ has generally higher standby costs than Least Cost, except at the 75th percentile. In contrast it has the lowest median totex and slightly fewer failures at the 25th percentile, due to the larger reservoir size and slightly higher number of small options available initially.

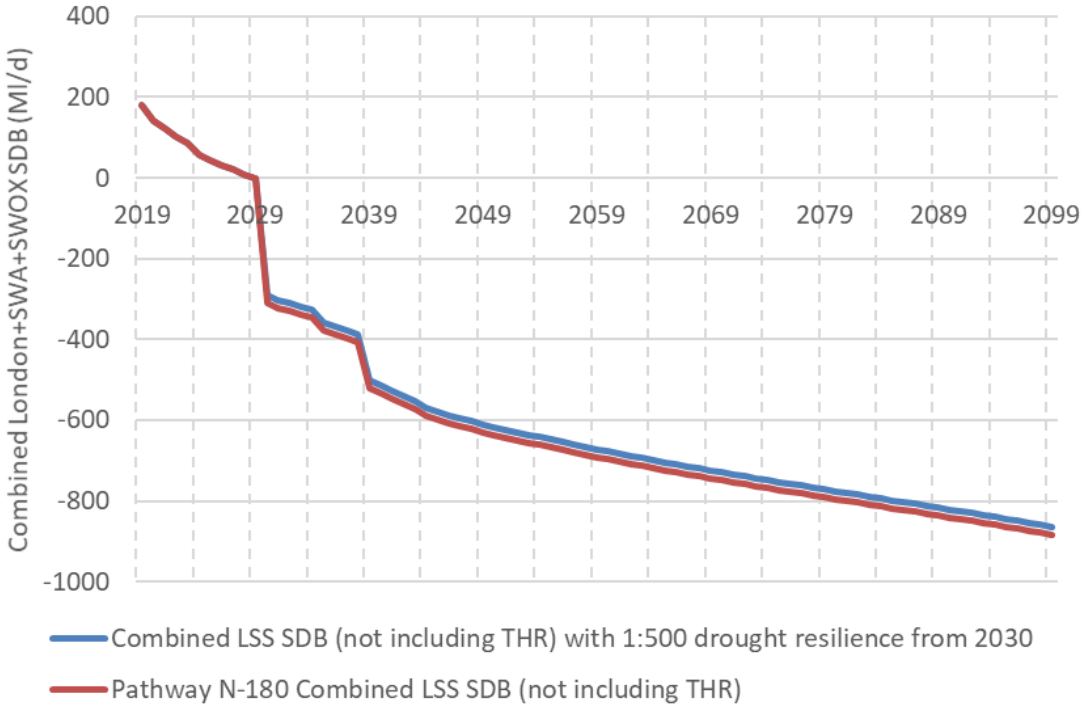
X.77 Programme selection in terms of adaptability is therefore between Least Cost, Min_IGEQ and NearO_RES RAPs, when appraising the trade-offs between totex, initial drought resilience and standby cost.

Outputs: Assessing specific pathways

X.78 It is also possible to pull out specific pathways from the Adaptability analysis that relate closely to one of several potential futures and assess how the different RAPs would adapt for

that future. For example, Path N-180 (see Appendix W, Annex 5) is within 20 Ml/d of the most likely volume required to be resilient to a 1:500 drought in London, SWA and SWOX combined (Figure X-15).

Figure X-15: Pathway_N180 in comparison with most likely 1:500 drought resilience



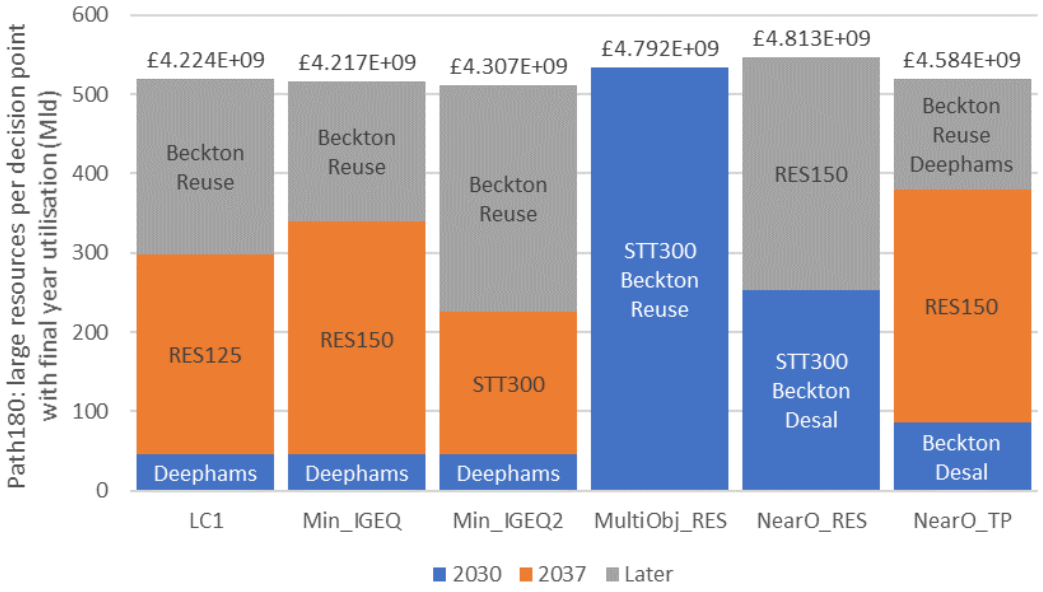
X.79 The key options selected for Pathway _N180 for each RAP are shown in Figure X-16 below. The difference between MultiObj_FP and Least Cost RAPs was insignificant, and therefore MultiObj_FP has not been included in Figure X-16, but replaced by Min_IGEQ2 which was not a selected RAP, but is included for comparison as if replaces the Abingdon reservoir with the Severn-Thames transfer as the 2037 strategic option.

X.80 The three colours delineate which large options are selected at each of the three key decision points described in Section 10, Figure 10-1, although the third decision point 'Later' has moved forward to between 2055/6 and 2060/1 in this pathway for all RAPs except NearO_TP, in order to maintain sufficient resilience equivalent to a 1:500 drought while providing for population growth. NearO_TP builds Beckton desalination plant in 2030 and Abingdon reservoir in 2037 so has sufficient resilience until 2080.

X.81 MultiObj_RES builds the Severn-Thames transfer and 200Mld of reuse at Beckton in 2030; the 'Later' option is a 100Mld expansion of the reuse plant in 2060 so is not designated as a new option.

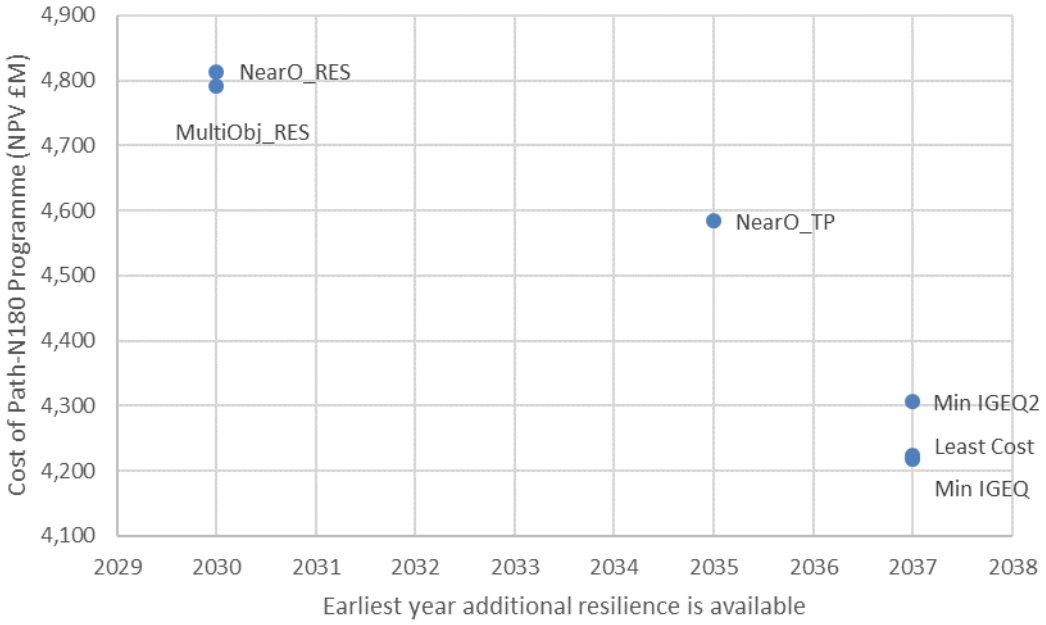
X.82 The total utilisation of new resources for all programmes at the end of Pathway_N180 is not identical because smaller option utilisation has not been included.

Figure X-16: Pathway_N180 large option selection per RAP at key decision points, utilisation by 2100 and 80-year NPV Totex



X.83 The RAP solutions for Pathway N-180 in Figure X-16 show that the Min_IGEQ RAP, which commissions Deephams reuse in 2030 and the 150Mm3 reservoir in 2037, is least costly in the long run if resilience to a 1:500 drought is required from 2037. The reservoir is supplemented by Beckton reuse in 2060 to maintain the level of resilience for the longer term. In contrast, Least Cost (LC1) and Min_IGEQ2 commission the 125Mm3 reservoir and the STT respectively in 2037, also supplemented by Beckton reuse in 2057 and 2058, at a higher total NPV for each.

Figure X-17: Pathway_N180 Trade-off between resilience enhancement date and cost



X.84 Building a larger plant in 2030 (Beckton reuse or desalination) provides resilience to 1:500 earlier, but at a higher cost. Figure X-17 above illustrates the trade-off between date of resilience enhancement and total programme cost.

X.85 Because Pathway N180 reflects the solutions if 1:500 drought resilience were required from 2030, changing the programme too rapidly to allow completion of additional large options not in the original RAP, all RAPs except those optimised for resilience (MultiObj_RES, NearO_RES) experience failures in the 2030s until either the SESRO or the Severn Thames Transfer is completed in 2037 as originally planned.

X.86 Analysing a specific pathway with reference to its representation of a future scenario can give insight as to how initial investment decisions could impact future option selection and cost should that future unfold. Pathway_N180 illustrates how should enhanced resilience beyond 1:200 drought be required in the future, the 150Mm3 Abingdon reservoir would be the most cost-effective solution to meet the enhanced resilience, if the enhancement is not required until the reservoir solution could be commissioned.

Adaptability conclusions

X.87 In summary, the adaptability analysis shows the trade-offs between future costs and risks dependent on the investment choices made now.

- Initial investment in a range of smaller options to meet the initial drought challenge, rather than one large resource, is more cost-effective across the widest range of futures. This is offset by a higher risk of failure in the early years.
- Investment in a reservoir as strategic resource reduces costs of meeting more challenging futures while requiring higher cost for less challenging futures. Increasing

the reservoir size narrows this range further. This is further demonstrated by analysis of a single pathway representing a potential requirement for 1:500 drought resilience.

- Where a further large resource is required, the Severn Thames Transfer is effective across a wider range of future challenges than desalination/reuse.
- Initial investment in a large desalination plant instead of reuse plant reduces the cost of standby for all but the least challenging futures, partly because the desalination plant is more frequently supported by a reservoir.

X.88 Balancing cost effectiveness against resilience, adaptability analysis supports investment in a range of smaller options to allow resilience to a 1:200 drought alongside a larger reservoir as a strategic resource which is capable of adapting to more challenging futures. Support in the longer-term is better provided by the Severn Thames Transfer.

E. Programme appraisal Step 4: 'What if?' testing

X.89 This section presents the outputs of the EBSD+ based 'what if?' testing carried out as part of programme appraisal for the combined London, SWOX and SWA (LSS) WRZs in aggregate.

X.90 Where the adaptability analysis was able to examine the impact of a combination of factors to generate a range of alternative futures, it is also informative to see the impact of a single change on the modelled outputs.

X.91 In the draft WRMP19 we carried out a basic set of 'what if' runs. We received several requests for alternatives during public consultation. For this, the rdWRMP19, we have carried out a much larger programme of 38 tests across more areas/topics.

Table X-16: Topics for 'what if' analysis

Topic	Alternative Future	Number of runs
Resilience	Timing of 1:200 drought resilience	2
Resilience	1:500 drought resilience in 2040	1
Resilience	Reservoir Outage/Replacement	2
Supply change	Remove outages >90 days from record	1
Supply change	Reduction in contribution from the West Berks Groundwater Scheme (WBGWS)	2
Economics	Shortened Planning Periods	3
Supply change/WRSE	Alternative use of existing Affinity transfer (Fortis Green)	1
WRSE	Alternative new Affinity transfer (Timing and phasing)	4
WRSE	Potential new WRSE transfers (Other companies)	3
Supply option change	No Reservoir options available for selection	1
Environmental	WINEP – WFD No Deterioration	4
Environmental	Reduction in abstraction from Chalk Streams	2
Demand forecast	Population forecast	3
Demand forecast	PCC forecast	6
Demand forecast	Leakage reduction 33% instead of 50% by 2050	1
Climate change	Climate change (2050s instead of 2080s)	1
	Total	**37**

X.92 All What if tests were run using:

- Step 2c (BL+DRO+WRSE) baseline
- Baseline target headroom
- Policy demand management
- Optimisation based on cost (i.e. Least Cost)

X.93 The remainder of this section is set out as follows:

- A programme to act as a comparator for the outputs of the what if tests
- The output of each individual test in turn
- Summary table of outputs for all tests

Comparator programme

X.94 The programme shown below can be used as a base case to compare with the outputs of the individual What if tests. It is the Step 2c Least Cost programme with Baseline Target Headroom.

X.95 It is also shown in the summary table in Section F, to enable quick comparison.

X.96 Metric interpretation is provided in Section 10, Table 10.14.

Table X-17: What If Comparator programme

What If Comparator programme		
Metrics		
Financial (£m NPV)		4,073
Environmental +		70
Environmental -		81
Deliverability		0.96
Resilience		0.83
IGEQ		11.35
Customer preference		4.41
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Merton (SLARS3)	5	2083
AR_Streatham (SLARS)	4	2087
ASR_Horton Kirkby	5	2080
ASR_South East London (Addington)	3	2084
ASR_Thames Valley/Thames Central	3	2086
DSL_Beckton 150	142	2088
GW_Addington	1	2086
GW_Datchet	5	2082
GW_Moulsford	4	2082
GW_Southfleet/Greenhithe	8	2031
IPR_Deephams 45	45	2030
IZT_R Thames to Medmenham	24	2095
NTC_Aston Keynes	2	2082
NTC_Britwell	1	2085
NTC_Epsom	2	2030
NTC_New River Head	3	2020
RES_Abingdon 125 Mm3	253	2039
RWP_Chingford (E&S)	20	2035
RWP_Oxford Canal to Cropredy	11	2030
RWP_Wessex Water to SWX	2.9	2085

What-if scenario: Timing of 1:200 drought resilience

X.97 This scenario tests the impact on option selection of becoming resilient to 1:200 year (0.5% p.a.) drought earlier (by 2027) or later (by 2035) than the current plan (by 2030).

Table X-18: Timing of 1:200 years drought resilience

1:200 drought resilience		2027	2035
Metrics			
Financial (£m NPV)		4,123	4,055
Environmental +		79	82
Environmental -		83	86
Deliverability		0.99	1.00
Resilience		0.84	0.90
IGEQ		12.58	12.42
Customer preference		4.41	4.42
Options	**Benefit (Ml/d)**	**Implementation date**	
DMP_LON_S4a	421	2020	2020
DMP_SWA_S4a	22	2025	2025
DMP_SWX_S4a	51	2020	2020
AR_Kidbrooke (SLARS1)	7		2098
AR_Merton (SLARS3)	5	2086	2095
AR_Streatham (SLARS)	4	2088	2097
ASR_Horton Kirkby	5	2027	2075
ASR_South East London (Addington)	3	2084	2096
ASR_Thames Valley/Thames Central	3	2087	
DSL_Beckton 150	142	2089	
GW_Addington	1	2027	2083
GW_Datchet	5	2082	2082
GW_London confined chalk	1	2027	2096
GW_Merton	2	2085	2094
GW_Moulsford	4	2083	2076
GW_Southfleet/Greenhithe	8	2027	2081
IPR_Deephams 45	45	2027	2084
IZT_R Thames to Medmenham	24	2095	2095
NTC_Aston Keynes	2	2082	2074
NTC_Britwell	1	2083	2083
NTC_Epsom	2	2027	2082
NTC_New River Head	3	2020	2020
RES_Abingdon 125 Mm3	253	2039	
RES_Abingdon 150 Mm3	294		2035
RWP_Chingford (E&S)	20	2035	2035
RWP_Oxford Canal to Cropredy	11	2027	2077
RWP_Oxford Canal to Dukes Cut	11.9		2077
RWP_Wessex Water to SWX	2.9	2085	2099

What-if scenario: Increase level of resilience to 1:500 from 2040

X.98 In this test we examine the impact on options selection if, having moved to a 1:200 resilience position in 2030, we increase resilience further to 1:500 in 2040.

Table X-19: Volume (Ml/d) required to increase level of resilience

LoR/ planning scenario / WRZ	1:200 (in 2030)		1:500 (in 2040)	
	DYAA	DYCP	DYAA	DYCP
London	140	140	250	250
SWOX	5.88	6.87	22.4	26.2
SWA	1.86	3.26	3.5	4.5

Table X-20: Increased level of drought resilience to 1:500 in 2040

Increased level of resilience		**1:500 in 2040**
Metrics		
Financial (£m NPV)		4,229
Environmental +		77
Environmental -		80
Deliverability		0.99
Resilience		0.87
IGEQ		11.24
Customer preference		4.42
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Merton (SLARS3)	5	2066
AR_Streatham (SLARS)	4	2099
ASR_Horton Kirkby	5	2062
ASR_South East London (Addington)	3	2065
ASR_Thames Valley/Thames Central	3	2064
DSL_Beckton 150	142	2067
GW_Addington	1	2064
GW_Datchet	5	2079
GW_Merton	2	2065
GW_Moulsford	4	2061
GW_Southfleet/Greenhithe	8	2031
IPR_Deephams	45	2030
IZT_R Thames to Medmenham	24	2092
NTC_Aston Keynes	2	2063
NTC_Britwell	1	2064
NTC_Epsom	2	2030
NTC_New River Head	3	2020
RES_Abingdon 150 Mm3	294	2039
RWP_Chingford (E&S)	20	2035
RWP_Oxford Canal to Cropredy	11	2030
RWP_Wessex Water to SWX	3	2063

What-if scenario: Reservoir maintenance

X.99 This scenario examines the impact of maintenance/outage of a reservoir in London, with an impact on water available for use of a 108 Ml/d reduction in two consecutive years.

X.100 Two timings, 2030-31 and 2040-41 have been run.

Table X-21: Reservoir maintenance

Reservoir replacement/ maintenance		2030 and 2031	2040 and 2041
Metrics			
Financial (£m NPV)		4,066	4,066
Environmental +		103	79
Environmental -		102	83
Deliverability		1.00	0.99
Resilience		0.74	0.84
IGEQ		11.79	12.54
Customer preference		4.39	4.41
Options	**Benefit (Ml/d)**	**Implementation date**	
DMP_LON_S4a	421	2020	2020
DMP_SWA_S4a	22	2025	2025
DMP_SWX_S4a	51	2020	2020
AR_Merton (SLARS3)	5	2065	2086
AR_Streatham (SLARS)	4		2088
ASR_Horton Kirkby	5	2030	2080
ASR_South East London (Addington)	3	2064	2084
ASR_Thames Valley/Thames Central	3	2066	2087
DSL_Beckton 150	142	2067	2089
GW_Addington	1	2059	2083
GW_Datchet	5.4	2082	2082
GW_London confined chalk	2	2054	2083
GW_Merton	2	2056	2085
GW_Moulsford	3.5	2040	2082
GW_Southfleet/Greenhithe	8	2031	2031
IPR_Deephams	45	2060	2030
IZT_R Thames to Medmenham	24	2095	2095
NTC_Aston Keynes	2	2043	2082
NTC_Britwell	1	2043	2083
NTC_Epsom	2	2043	2030
NTC_New River Head	3	2020	2020
RES_Abingdon 125 Mm3	253		2039
RWP_Chingford (E&S)	20	2035	2035
RWP_Oxford Canal to Cropredy	11	2030	2030
RWP_STT Minworth	70	2045	
RWP_STT Mythe	12	2044	
RWP_STT Netheridge	18	2039	
RWP_STT UU/ST Opt A	6	2030	
RWP_STT UU/ST Opt B	15	2030	
RWP_STT Vyrnwy 60	110	2030	
RWP_Wessex to SWX	2.9	2066	2085

What-if scenario: Removal of outages >90 days from record

X.101 This scenario demonstrates the impact of a change to our outage allowance.

X.102 Our outage database, that contains all reported outage events, includes instances of outage that are over 90 days in duration. We have been asked by the Environment Agency to test the impact of the removal of these events from the database.

X.103 Removing these events reduces our outage allowance and thus increases the water available for use. Associated impacts on DO or future risk are not included.

Table X-22: Improvement in WAFU (Ml/d) of removing outages >90 days from record

From 2020	Remove Outage >90days	
	DYAA	DYCP
London	19	-
SWOX	1.5	1.5
SWA	6.3	6.3

Table X-23: Remove outages >90 days from record

Remove outage >90 days from record		From 2020
Metrics		
Financial (£m NPV)		4,083
Environmental +		69
Environmental -		66
Deliverability		0.99
Resilience		0.87
IGEQ		12.42
Customer preference		4.41
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Kidbrooke (SLARS1)	7	2097
AR_Merton (SLARS3)	5	2095
AR_Streatham (SLARS)	4	2096
ASR_Horton Kirkby	5	2091
ASR_South East London (Addington)	3	2098
ASR_Thames Valley/Thames Central	3	2094
DSL_Beckton 150	142	2093
GW_Datchet	5.4	2098
GW_London confined chalk	2	2093
GW_Merton	2	2094
GW_Moulsford	3.5	2092
GW_Southfleet/Greenhithe	8	2031
IPR_Deephams 45	45	2030
NTC_Aston Keynes	2	2093
NTC_Epsom	2	2030
NTC_New River Head	3	2020

Remove outage >90 days from record		From 2020
RES_Abingdon 150 Mm3	294	2039
RWP_Chingford (E&S)	20	2035
RWP_Oxford Canal to Cropredy	11	2030
RWP_Wessex to SWX	2.9	2099

What-if scenario: Reduction in contribution from the West Berks Groundwater Scheme (WBGWS)

X.104 This scenario demonstrates the impact of a partial loss of deployable output associated with reduced use of the WBGWS, from 2031 or 2040.

Table X-24: Reduction in Deployable Output (Ml/d) from the WBGWS

Planning scenarios / WRZ	DYAA	ADPW
London	39	N/A
SWOX (for KV)	27	27

X.105 The WBGWS is an Environment Agency managed flow augmentation scheme that supports local river flows that in turn support our abstractions at Fobney (Kennet Valley) and in London.

X.106 The impact of a reduction in this scheme on Kennet Valley WRZ would be significant. There are currently insufficient options available in the Kennet Valley WRZ to make up for a loss of deployable output of this scale. Fobney would most likely have to be supported via a new intake on the River Thames near Reading. As such we have modelled the reduction in Kennet Valley WRZ as a reduction in SWOX WRZ as it is the potential donor zone.

X.107 The increased programme costs shown for the programmes below do not include for building the intake and distribution network to Fobney; only for the extra cost of the resource to be made available. As such it is an underestimation of the true total cost.

X.108 We will continue to work closely with the Environment Agency regarding the future of the WBGWS and update our WRMP as appropriate.

Table X-25: Reduction in contribution from the WBGWS

Reduction in contribution from the WBGW scheme		From 2031	From 2040
Metrics			
Financial (£m NPV)		4,380	4,148
Environmental +		70	79
Environmental -		71	83
Deliverability		0.99	0.99
Resilience		0.84	0.87
IGEQ		12.81	12.47
Customer preference		4.42	4.42
Options	**Benefit (Ml/d)**	**Implementation date**	
DMP_LON_S4a	421	2020	2020
DMP_SWA_S4a	22	2025	2025
DMP_SWX_S4a	51	2020	2020
AR_Merton (SLARS3)	5		2080
AR_Streatham (SLARS)	4		2082
ASR_Horton Kirkby	5	2076	2075
ASR_South East London (Addington)	3	2080	2081
ASR_Thames Valley/Thames Central	3		2078
DSL_Beckton 150	142		2083
GW_Addington	1	2079	2078
GW_Datchet	5.4	2082	2082
GW_London confined chalk	2	2079	2079
GW_Merton	2		2079
GW_Moulsford	3.5	2032	2076
GW_Southfleet/Greenhithe	8	2077	2031
IPR_Beckton 100	95	2030	
IPR_Beckton 100	95	2081	
IPR_Deephams	45		2030
IZT_R Thames to Medmenham	24	2095	2095
NTC_Aston Keynes	2	2031	2074
NTC_Britwell	1	2080	2077
NTC_Epsom	2	2075	2030
NTC_New River Head	3	2020	2020
RES_Abingdon 125 Mm3	253	2039	
RES_Abingdon 150 Mm3	294		2039
RWP_Chingford (E&S)	20	2035	2035
RWP_Oxford Canal to Cropredy	11	2031	2030
RWP_Wessex to SWX	2.9		2077

What-if scenario: Shortened planning periods

X.109 In this test we demonstrate the impact using an alternative planning period. We have tested 50, 55 and 60 years (compared to the 80 years adopted in our dWRMP19 and rdWRMP19 plans.

Table X-26: Shortened planning periods

Shortened planning periods		50-year	55-year	60-year
Metrics				
Financial (£m NPV)		3,872	4,026	4,047
Environmental +		89	48	60
Environmental -		93	51	69
Deliverability		0.99	0.99	0.99
Resilience		0.72	0.85	0.84
IGEQ		11.75	11.41	11.40
Customer preference		4.38	4.40	4.41
Options	**Benefit (Ml/d)**	**Implementation date**		
DMP_LON_S4a	421	2020	2020	2020
DMP_SWA_S4a	22	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020
AR_Kidbrooke (SLARS1)	7	2068		2078
AR_Merton (SLARS3)	5	2055	2073	2073
AR_Streatham (SLARS)	4	2067		2077
ASR_Horton Kirkby	5	2050	2071	2071
ASR_South East London (Addington)	3	2056		2074
ASR_Thames Valley/Thames Central	3	2066		2075
GW_Addington	1	2055	2074	2075
GW_Honor Oak	1	2067		2079
GW_London confined chalk	2	2066	2074	2076
GW_Merton	2	2069		
GW_Moulsford	3.5	2045	2072	2072
GW_Southfleet/Greenhithe	8	2031	2031	2031
IPR_Deephams	45	2030	2030	2030
NTC_Aston Keynes	2	2049	2070	2070
NTC_Britwell	1	2049	2072	2072
NTC_Epsom	2	2030	2030	2030
NTC_New River Head	3	2020	2020	2020
RES_Abingdon 100 Mm3	210		2037	2037
RWP_Chingford (E&S)	20	2035	2035	2035
RWP_Oxford Canal to Cropredy	11	2030	2030	2030
RWP_STT Minworth	70	2057		
RWP_STT Mythe	12	2037		
RWP_STT Netheridge	18	2037		
RWP_STT UU/ST Opt A	6	2037		
RWP_STT UU/ST Opt B	15	2051		
RWP_STT Vyrnwy 60	110	2037		
RWP_Wessex to SWX	2.9	2056		2076

What-if scenario: Alternative existing transfer (Affinity, Fortis Green)

X.110 We have an existing bulk supply agreement that provides up to ~27Ml/d of treated water to Affinity Water. We currently include in our baseline supply demand balance a transfer of between 13 and 15 Ml/d (blue line below).

X.111 In this scenario we examine the impact of an alternative profile.

Figure X-18: Affinity Water bulk supply Fortis Green (comparing current and "alternative")

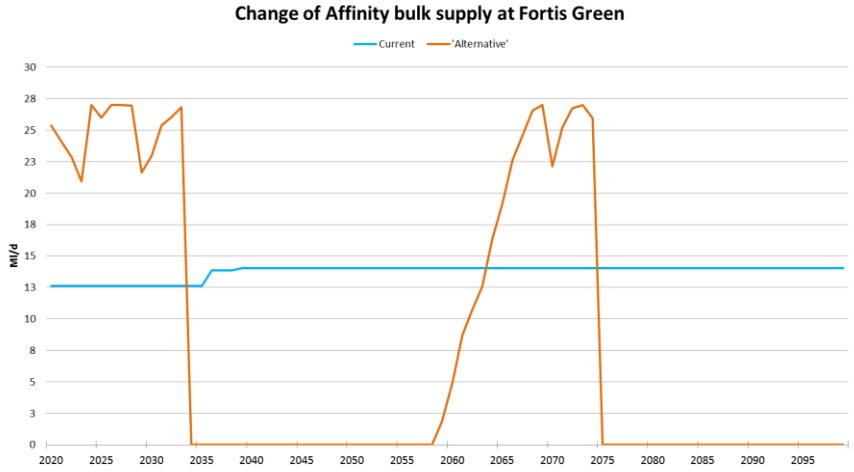


Table X-27: Alternative Affinity Water Bulk Supply (Fortis Green)

Fortis Green alternative profile		
Metrics		
Financial (£m NPV)		4,138
Environmental +		70
Environmental -		68
Deliverability		0.99
Resilience		0.87
IGEQ		12.44
Customer preference		4.36
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Merton (SLARS3)	5	2099
ASR_Horton Kirkby	5	2031
ASR_South East London (Addington)	3	2031
ASR_Thames Valley/Thames Central	3	2031
GW_Addington	1	2030
GW_Datchet	5.4	2082
GW_London confined chalk	2	2031
GW_Merton	2	2098

Fortis Green alternative profile		
GW_Moulsford	3.5	2097
GW_Southfleet/Greenhithe	8	2030
IPR_Deephams	45	2030
IZT_R Thames to Medmenham	24	2095
NTC_Aston Keynes	2	2097
NTC_Britwell	1	2030
NTC_Epsom	2	2020
NTC_New River Head	3	2039
RWP_Chingford (E&S)	20	2035
RWP_Oxford Canal to Cropredy	11	2030
RWP_Wessex to SWX	2.9	2098

What-if scenario: Alternative timing of Affinity Water 100Ml/d transfer

X.112 Our preferred programme includes a new transfer of raw water to Affinity Water in 2037/38.

X.113 The three tests below explore the impact on the options selected if the transfer were to come online in alternative years, or if its delivery were to be phased.

Table X-28: Alternative new WRSE transfer (timing and volume for Affinity Water 100Ml/d)

Starting year / Run no.	2027 (Ml/d)	2035 (Ml/d)	2039 (Ml/d)	2055 (Ml/d)
1	100			
2		100		
3			50	50

Table X-29: Outputs: Alternative timing and volume for Affinity Water 100Ml/d transfer

Alternative WRSE transfer to Affinity		100Ml/d from 2027	100Ml/d from 2035	Phased (50M/d in 2039 and 2055)
Metrics				
Financial (£m NPV)		4,140	4,020	3,910
Environmental +		109	103	103
Environmental -		107	102	102
Deliverability		1.00	0.99	1.00
Resilience		0.68	0.67	0.66
IGEQ		11.79	11.79	11.80
Customer preference		4.22	4.39	4.39
Options	**Benefit (Ml/d)**	**Implementation date**		
DMP_LON_S4a	421	2020	2020	2020
DMP_SWA_S4a	22	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020
AR_Merton (SLARS3)	5		2066	2066
ASR_Horton Kirkby	5	2030	2050	2053
ASR_South East London (Addington)	3	2066	2065	2060
ASR_Thames Valley/Thames Central	3	2031	2055	2065
DSL_Beckton 150	142	2067	2067	2067
GW_Addington	1	2047	2064	2054
GW_Datchet	5.4	2082	2082	2082
GW_London confined chalk	2	2030	2099	2099
GW_Merton	2	2099	2065	2065
GW_Moulsford	3.5	2027	2045	2045
GW_Southfleet/Greenhithe	8	2030	2031	2031
IPR_Deephams	45	2048	2030	2030
IZT_R Thames to Medmenham	24	2095	2095	2095
NTC_Aston Keynes	2	2027	2049	2051

Alternative WRSE transfer to Affinity		100Ml/d from 2027	100Ml/d from 2035	Phased (50M/d in 2039 and 2055)
NTC_Britwell	1	2027	2049	2051
NTC_Epsom	2	2030	2030	2030
NTC_New River Head	3	2020	2020	2020
RWP_Chingford (E&S)	20	2035	2035	2035
RWP_Oxford Canal to Cropredy	11	2027	2030	2030
RWP_Oxford Canal to Dukes Cut	11.9	2027		
RWP_STT Minworth	70	2057	2056	2055
RWP_STT Mythe	12	2030	2035	2058
RWP_STT Netheridge	18	2030	2035	2060
RWP_STT UU/ST Opt A	6	2030	2035	2052
RWP_STT UU/ST Opt B	15	2030	2051	2061
RWP_STT Vyrnwy 60	110	2030	2035	2039
RWP_Wessex to SWX	2.9	2031	2055	2064

What-if scenario: Potential new WRSE transfers (other companies)

X.114 Although only Affinity Water has a confirmed need for a transfer of water from us, in building the WRMP we have had discussions with all our neighbours about potential future needs.

X.115 In the following tests we have allowed for additional transfers, beyond that being supplied to Affinity Water, to neighbouring companies, ranging from 50 to 185 Ml/d.

X.116 The costs shown only represent the resource costs to have available water for transfer. It doesn't include any downstream costs.

Table X-30: Potential new WRSE transfers (other companies)

To	From	Starting year	Run 1 (Ml/d)	Run 2 (Ml/d)	Run 3 (Ml/d)	Run 4 (Ml/d)
SWS	SWOX	2035	50	125		125
SES	London	2045			30	30
SEW	SWOX	2060			30	30
		Total	50	125	60	185

Table X-31: Outputs: Potential new WRSE transfers (other companies)

Potential regional transfer to other companies		Run 1	Run 2	Run 3	Run 4
Metrics					
Financial (£m NPV)		4,301	4,143	4,387	4,468
Environmental +		81	77	75	86
Environmental -		86	80	77	94
Deliverability		1.00	0.99	0.99	0.99
Resilience		0.90	0.87	0.90	0.90
IGEQ		11.19	12.46	12.64	12.71
Customer preference		4.42	4.42	4.42	4.43
Options	**Benefit (Ml/d)**	**Implementation date**			
DMP_LON_S4a	421	2020	2020	2020	2020
DMP_SWA_S4	22	2025	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020	2020
AR_Kidbrooke (SLARS1)	7				2098
AR_Merton (SLARS3)	5	2082	2081	2066	2096
AR_Streatham (SLARS)	4	2084	2083		2097
ASR_Horton Kirkby	5	2080	2077	2063	2070
ASR_South East London (Addington)	3	2083	2082	2065	2072
ASR_Thames Valley/Thames Central	3	2086	2079		
DSL_Beckton 150	142	2087	2084	2067	
GW_Addington	1	2081	2080	2064	2071
GW_Datchet	5.4	2082	2082	2082	2082
GW_Honor Oak	1	2086			
GW_London confined chalk	2	2085		2064	2072
GW_Merton	2	2081	2080	2065	2095
GW_Moulsford	3.5	2079	2076	2062	2069
GW_Southfleet/Greenhithe	8	2031	2031	2031	2031
IPR_Beckton 100	95				2060

Potential regional transfer to other companies		Run 1	Run 2	Run 3	Run 4
IPR_Beckton 100	95				2073
IPR_Deephams	45	2030	2030	2030	2030
IZT_R Thames to Medmenham	24	2095	2095	2095	2095
NTC_Aston Keynes	2	2078	2078	2064	2071
NTC_Britwell	1	2078	2080	2064	2071
NTC_Epsom	2	2030	2030	2030	2030
NTC_New River Head	3	2020	2020	2020	2020
RES_Abingdon 125 Mm3	253				
RES_Abingdon 150 Mm3	294	2035	2039	2035	2035
RWP_Chingford (E&S)	20	2035	2035	2035	2035
RWP_Oxford Canal to Cropredy	11	2030	2030	2030	2030
RWP_STT Minworth	70				
RWP_STT Mythe	12				
RWP_STT Netheridge	18				
RWP_STT UU/ST Opt A	6				
RWP_STT UU/ST Opt B	15				
RWP_STT Vyrnwy 60	110				
RWP_Wessex to SWX	2.9	2085	2078	2099	2099

What-if scenario: No reservoir

X.117 In this scenario we removed all reservoirs from the option list.

Table X-32: No reservoir options available for selection

No Reservoir		
Metrics		
Financial (£m NPV)		4,089
Environmental +		103
Environmental -		102
Deliverability		0.99
Resilience		0.67
IGEQ		11.79
Customer preference		4.39
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Merton (SLARS3)	5	2055
ASR_Horton Kirkby	5	2050
ASR_South East London (Addington)	3	2056
ASR_Thames Valley/Thames Central	3	2066
DSL_Beckton 150	142	2067
GW_Addington	1	2055
GW_Datchet	5.4	2082
GW_London confined chalk	2	2066
GW_Merton	2	2099
GW_Moulsford	3.5	2045
GW_Southfleet/Greenhithe	8	2031
IPR_Deephams	45	2030
IZT_R Thames to Medmenham	24	2095
NTC_Aston Keynes	2	2049
NTC_Britwell	1	2049
NTC_Epsom	2	2030
NTC_New River Head	3	2020
RWP_Chingford (E&S)	20	2035
RWP_Oxford Canal to Cropredy	11	2030
RWP_STT Minworth	70	2057
RWP_STT Mythe	12	2039
RWP_STT Netheridge	18	2039
RWP_STT UU/ST Opt A	6	2039
RWP_STT UU/ST Opt B	15	2051
RWP_STT Vyrnwy 60	110	2039
RWP_Wessex to SWX	2.9	2056

What-if scenario: Water Industry National Environment Programme (WINEP) – WFD No deterioration

X.118 As explained in Section 4 of the main report, we received details of the WINEP from the Environment Agency in March 2018.

X.119 'Certain' and 'indicative' sustainability reductions are included within the baseline supply demand balance as an adjustment to Deployable Output (DO). Unconfirmed sustainability reductions can only be assessed in the WRMP through the running of scenarios, to determine what impact on the WRMP they would have were they to become certain.

X.120 Below we test 4 scenarios related to potential, unconfirmed WFD concerns and the need to cause no deterioration to water bodies. These apply DO reductions for two WFD no deterioration scenarios (potential, and most likely) for two start dates (2027 and 2035), per the data given in Table X-33.

Table X-33: WINEP WFD No deterioration scenarios, expressed as reductions in DO

	Potential				Most likely			
	DYAA Ml/d	ADPW Ml/d	Starting Year (a)	Starting year (b)	DYAA Ml/d	ADPW Ml/d	Starting year (a)	Starting year (b)
London	75.86	0	2027	2035	20	0	2027	2035
SWOX	17.08	0	2027	2035	5	0	2027	2035
SWA	0.00	0	2027	2035	0	0	2027	2035

X.121 The reductions apply to average DO only and are based on an internal desk based assessment of actual vs licensed abstraction and judgement regarding source sensitivity.

X.122 For the most likely scenario we have only considered sources identified in WINEP3. For the 'potential' scenario we have also additionally included sources in known sensitive catchments such as the Darent and Cray and sources in the Goring gap.

X.123 2027 is chosen as the WFD compliance date. 2035 is a reasonable pragmatic alternative allowing sufficient strategic options to be made available to meet the need.

X.124 The scenarios are created for information only, without prejudice. Any reductions would ultimately be justified and confirmed through established processes.

Table X-34: WINEP – WFD No deterioration

WINEP - no deterioration	Most likely 2027	Most likely 2035	Potential 2027	Potential 2035
Metrics				
Financial (£m NPV)	4,174	4,125	4,409	4,327
Environmental +	79	79	71	79
Environmental -	83	83	72	79
Deliverability	0.99	0.99	1.00	0.99
Resilience	0.85	0.85	0.83	0.90
IGEQ	11.31	12.52	12.85	11.19
Customer preference	4.41	4.41	4.41	4.42

WINEP - no deterioration		Most likely 2027	Most likely 2035	Potential 2027	Potential 2035
Options	**Benefit (Ml/d)**	**Implementation date**			
DMP_LON_S4a	421	2020	2020	2020	2020
DMP_SWA_S4a	22	2025	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020	2020
AR_Kidbrooke (SLARS1)	7				2080
AR_Merton (SLARS3)	5	2031	2081		2076
AR_Streatham (SLARS)	4	2083	2083		2079
ASR_Horton Kirkby	5	2030	2035	2080	2073
ASR_South East London (Addington)	3	2031	2035	2089	2075
ASR_Thames Valley/Thames Central	3	2030	2035		2077
DSL_Beckton 150	142	2084	2084	2029	2082
GW_Addington	1	2030	2034	2088	2074
GW_Datchet	5.4	2082	2082	2082	2082
GW_Honor Oak	1			2099	
GW_London confined chalk	2	2031	2035	2088	2078
GW_Merton	2	2030	2080		2075
GW_Moulsford	3.5	2081	2079	2084	2072
GW_Southfleet/Greenhithe	8	2030	2031	2086	2031
IPR_Deephams	45	2030	2030	2090	2030
IZT_R Thames to Medmenham	24	2095	2095	2095	2095
NTC_Aston Keynes	2	2081	2080	2087	2074
NTC_Britwell	1	2082	2082	2089	
NTC_Epsom	2	2030	2030	2085	2030
NTC_New River Head	3	2020	2020	2020	2020
RES_Abingdon 125 Mm3	253	2039	2039	2039	
RES_Abingdon 150 Mm3	294				2035
RWP_Chingford (E&S)	20	2035	2035	2035	2035
RWP_Oxford Canal to Cropredy	11	2030	2030	2027	2030
RWP_Wessex to SWX	2.9	2082	2082		2078

What-if scenario: Reduction in abstraction from chalk streams

X.125 In addition to complying with the Environment Agency's requirements on WINEP licensing scenarios, we have developed scenarios to assess the potential impact of sustainability reductions in abstractions from chalk streams that may be required to protect vulnerable chalk stream ecosystems.

X.126 We have developed two scenarios, one which allows for a 34Ml/d reduction in ADPW DO from 2030 and a second scenario which increases the ADPW reduction to 77 Ml/d from 2040, as per the data shown in Table X-35. We selected 2030 and 2040 as reasonable delivery dates based on when strategic schemes would be available to replace the abstraction reductions made.

Table X-35: DO Reduction from reduced abstraction from Chalk Streams

	From 2030		Increase by 'X' in 2040	
WRZ	DYAA (Ml/d)	ADPW (Ml/d)	DYAA (Ml/d)	ADPW (Ml/d)
London	15.97	23.87	28.46	38.3
SWOX	0	0	3.72	4.73
SWA	9.8	9.8	0	0

X.127 To 2030 this includes changing abstraction licences at North Orpington (R. Cray); Waddon (R.Wandle) and Pann Mill (R.Wye), to emergency use only.

X.128 To 2040 it additionally includes sources on the Darent (Eynsford, Horton Kirby and Lullingstone), Epsom (R.Hogsmill) and Marlborough and Clatford on the Kennet.

X.129 These sites were identified based on perceived sensitive catchments and previous investigations.

X.130 For clarity, these scenarios informed the performance testing of our reasonable alternative programmes in programme appraisal. It is not identical in either timing or volume to the 'chalk stream' reduction that has been subsequently included in preferred programme.

Table X-36: Reduction in abstraction from Chalk Streams

Reduction in chalk stream abstraction		34 Ml/d 2030	77 Ml/d 2040
Metrics			
Financial (£m NPV)		4,450	4,513
Environmental +		79	77
Environmental -		83	80
Deliverability		0.99	0.99
Resilience		0.85	0.87
IGEQ		11.29	11.20
Customer preference		4.41	4.41
Options	**Benefit (Ml/d)**	**Implementation date**	
DMP_LON_S4a	421	2020	2020
DMP_SWA_S4a	22	2025	2025
DMP_SWX_S4a	51	2020	2020
AR_Merton (SLARS3)	5	2031	2031
AR_Streatham (SLARS)	4	2030	2030
ASR_Horton Kirkby	5	2030	2030
ASR_South East London (Addington)	3	2031	2031
ASR_Thames Valley/Thames Central	3	2030	2030
DSL_Beckton 150	142	2082	2081
GW_Addington	1	2030	2030
GW_Datchet	5.4	2042	2042
GW_London confined chalk	2	2031	2031
GW_Merton	2	2030	2030
GW_Moulsford	3.5	2080	2080
GW_Southfleet/Greenhithe	8	2030	2030
IPR_Deephams	45	2030	2030
IZT_R Thames to Medmenham	24	2069	2069
NTC_Aston Keynes	2	2080	2079
NTC_Britwell	1	2081	2080
NTC_Epsom	2	2030	2030
NTC_New River Head	3	2020	2020
RES_Abingdon 125 Mm3	253	2039	
RES_Abingdon 150 Mm3	294		2039
RWP_Chingford (E&S)	20	2035	2035
RWP_Oxford Canal to Cropredy	11	2030	2030
RWP_Wessex to SWX	2.9	2081	

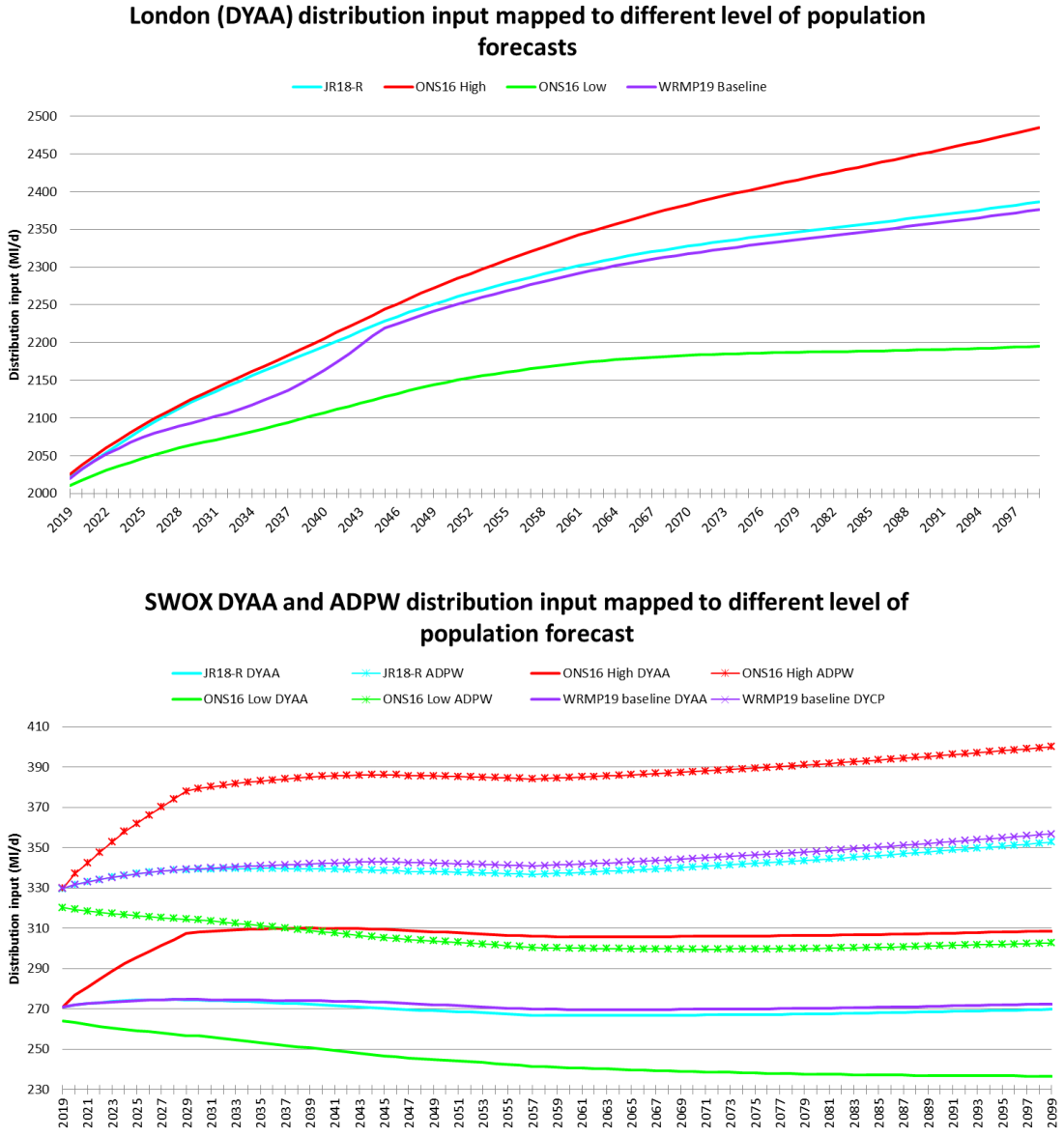
What-if scenario: Population uncertainty

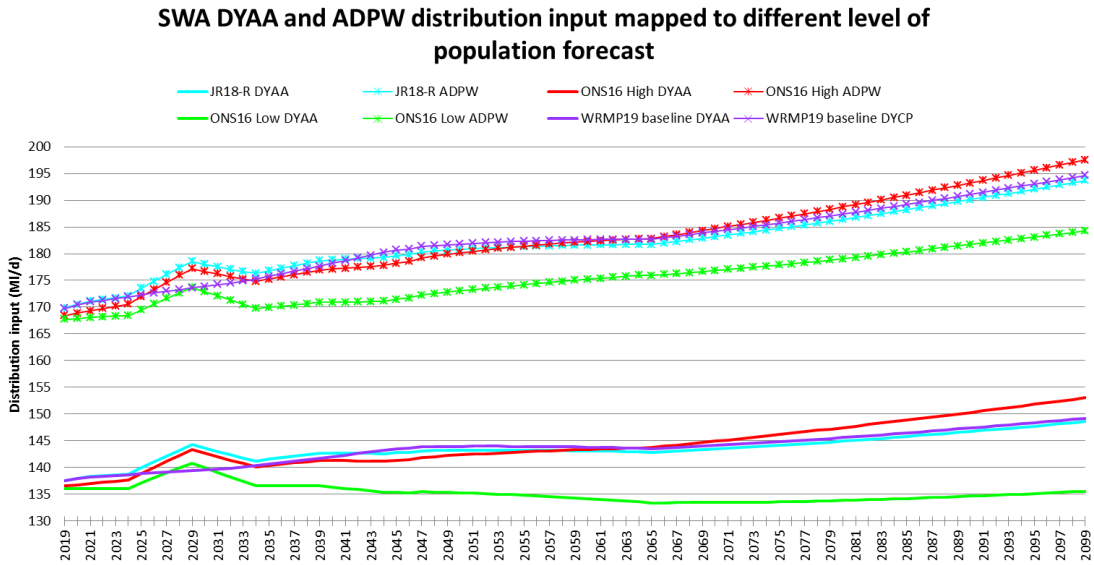
X.131 We set out our population projections in Section 3 of the main report. They were developed in line with the WRPG and are plan-based to 2045 and trend based in the longer term.

X.132 We have developed three variant scenarios of distribution input (DI) based on the following population forecasts:

- JR18-R – Which uses the latest draft London Plan projections
- ONS16 High – Using an ONS High trend-based projection throughout
- ONS16 Low – Using an ONS Low trend-based projection throughout

Figure X-19: Distribution Input forecasts for different population forecasts for London, SWOX and SWA (DYAA and DYCP data, as appropriate)




SWA DYAA and ADPW distribution input mapped to different level of population forecast
JR18-R DYAA
JR18-R ADPW
ONS16 High DYAA
ONS16 High ADPW
ONS16 Low DYAA
ONS16 Low ADPW
WRMP19 baseline DYAA
WRMP19 baseline DYCP
Distribution input (Ml/d)
200
195
190
185
180
175
170
165
160
155
150
145
140
135
130
2019
2021
2023
2025
2027
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2093
2095
2097
2099

Table X-37: Impact of population uncertainty for London, SWOX and SWA

Population forecast uncertainty		JR-18	ONS 16 High	ONS 16 Low
Metrics				
Financial (£m NPV)		4,227	4,242	3,501
Environmental +		100	113	72
Environmental -		107	115	56
Deliverability		1.00	1.00	1.00
Resilience		0.90	0.75	0.48
IGEQ		11.67	13.41	12.05
Customer preference		4.39	4.41	4.38
Options	**Benefit (Ml/d)**	**Implementation date**		
DMP_LON_S4a	421	2020	2020	2020
DMP_SWA_S4a	22	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020
AR_Merton (SLARS3)	5	2080		
AR_Streatham (SLARS)	4	2081		
ASR_Horton Kirkby	5	2046	2031	2030
ASR_South East London (Addington)	3	2068	2040	2031
ASR_Thames Valley/Thames Central	3		2040	2031
GW_Addington	1	2067	2032	2030
GW_Datchet	5.4		2075	
GW_London confined chalk	2	2058	2035	2031
GW_Merton	2	2079	2099	
GW_Moulsford	3.5	2040	2039	2039
GW_Southfleet/Greenhithe	8	2047	2031	2030
IPR_Beckton 100	95		2060	
IPR_Beckton 100	95		2071	
IPR_Beckton 100	95		2086	
IPR_Deephams	45	2069	2055	
IZT_R Thames to Medmenham	24	2025	2085	
NTC_Aston Keynes	2		2039	2039
NTC_Britwell	1	2040	2039	
NTC_Epsom	2	2054	2030	2030
NTC_New River Head	3	2020	2020	2020
RWP_Chingford (E&S)	20	2035	2035	2035
RWP_Oxford Canal to Cropredy	11	2039	2030	2030
RWP_STT Minworth	70	2059	2045	
RWP_STT Mythe	12	2055	2039	2075
RWP_STT Netheridge	18	2050	2030	2091
RWP_STT UU/ST Opt A	6		2030	2071
RWP_STT UU/ST Opt B	15		2030	2082
RWP_STT Vyrnwy 180	147	2030		
RWP_STT Vyrnwy 60	110		2030	2039
RWP_Wessex to SWX	2.9		2040	

What-if scenario: Per capita consumption (PCC) uncertainty

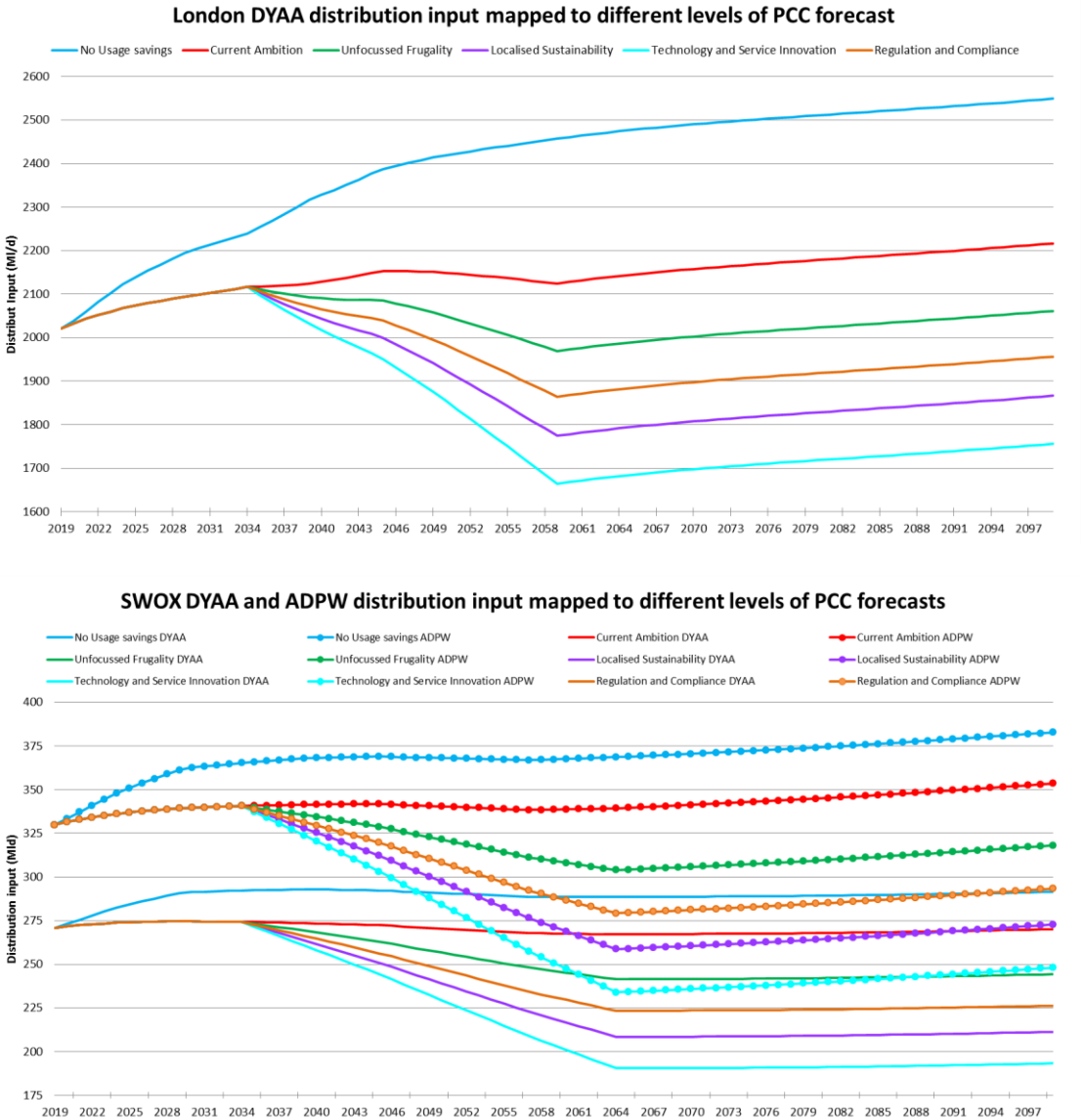
X.133 We have tested the impact of alternative PCC profiles on DI, and thence on the options selected.

X.134 There are six variants, five of which correspond to the aspirational scenarios set out in the Ofwat/Artesia report on the potential for long-term PCC reductions by 2065. The sixth has been derived by removing the usage savings associated with the metering and water efficiency activity within our rdWRMP preferred demand management programme.

X.135 These scenarios are applied from 2035-2065.

X.136 No costs have been added to allow for the additional cross-sector activity that would be required to realise the aspirational PCC targets.

Figure X-20: Distribution Input forecasts for different PCC forecasts



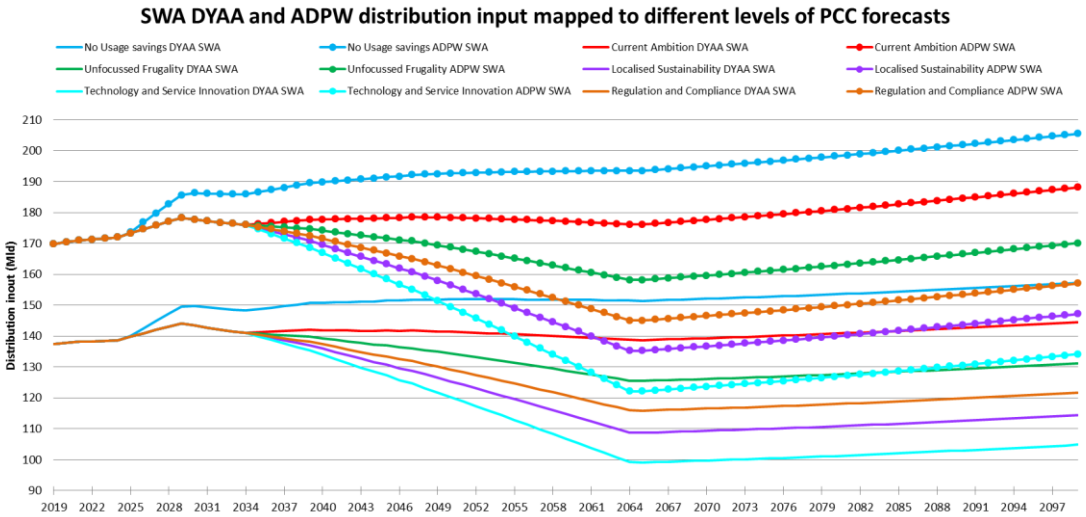

SWA DYAA and ADPW distribution input mapped to different levels of PCC forecasts
No Usage savings DYAA SWA
No Usage savings ADPW SWA
Current Ambition DYAA SWA
Current Ambition ADPW SWA
Unfocussed Frugality DYAA SWA
Unfocussed Frugality ADPW SWA
Localised Sustainability DYAA SWA
Localised Sustainability ADPW SWA
Technology and Service Innovation DYAA SWA
Technology and Service Innovation ADPW SWA
Regulation and Compliance DYAA SWA
Regulation and Compliance ADPW SWA
Distribution inout (Mld)
210
200
190
180
170
160
150
140
130
120
110
100
90
2019 2022 2025 2028 2031 2034 2037 2040 2043 2046 2049 2052 2055 2058 2061 2064 2067 2070 2073 2076 2079 2082 2085 2088 2091 2094 2097

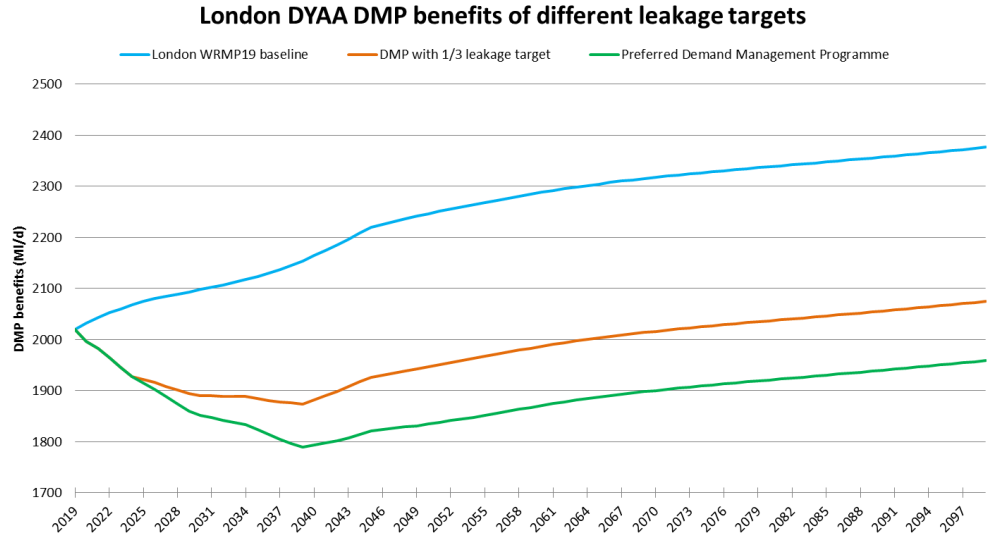
Table X-38: PCC uncertainty for London, SWOX and SWA

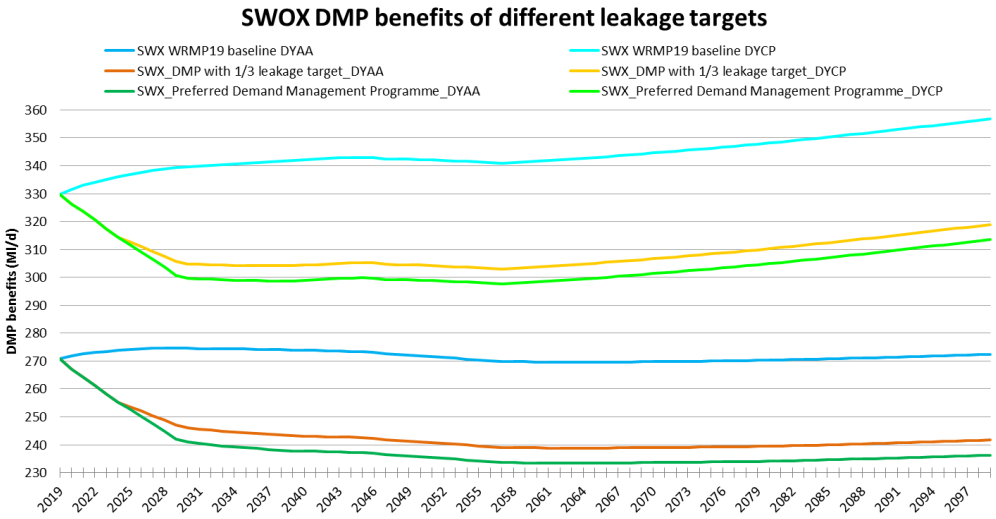
PCC forecast uncertainty		No Saving	PCC0 (105)	PCC1 (86)	PCC4 (73)	PCC2 (62)	PCC3 (45)
Metrics							
Financial (£m NPV)		4,759	3,713	3,632	3,623	3,611	3,603
Environmental +		66	59	40	36	40	36
Environmental -		93	68	42	37	49	39
Deliverability		0.968	0.996	0.996	0.996	0.996	0.996
Resilience		0.87	0.64	0.79	0.85	0.86	0.87
IGEQ		N/A	N/A	N/A	N/A	N/A	N/A
Customer preference		4.24	4.39	4.38	4.38	4.38	4.39
Options	**Benefit (Ml/d)**	**Implementation date**					
DMP_LON_S4a	421	2020	2020	2020	2020	2020	2020
DMP_SWA_S4a	22	2025	2025	2025	2025	2025	2025
DMP_SWX_S4a	51	2020	2020	2020	2020	2020	2020
AR_Merton (SLARS3)	5	2031					
AR_Streatham (SLARS)	4	2035					
ASR_Horton Kirkby	5	2022	2083				
ASR_South East London (Addington)	3	2035					
ASR_Thames Valley/Thames Central	3	2035					
DSL_Beckton 150	142	2029					
GW_Addington	1	2023	2084				
GW_Datchet	5.4	2030	2098				
GW_Honor Oak	1	2021					
GW_London confined chalk	2	2032					
GW_Merton	2	2022					
GW_Moulsford	3.5	2072	2039	2039		2039	
GW_Southfleet/Greenhithe	8	2024	2031	2031	2031	2031	2031
IPR_Beckton 100	95	2084					
IPR_Deephams	45	2073	2030	2030	2030	2030	2030
IZT_R Thames to Medmenham	24	2066					
NTC_Aston Keynes	2	2032	2039	2039		2039	2039
NTC_Britwell	1	2083	2039			2039	
NTC_Epsom	2	2024	2030	2030	2030	2030	2030
NTC_New River Head	3	2020	2020	2020	2020	2020	2020
RES_Abingdon 150 Mm3	294	2039					
RWP_Chingford (E&S)	20	2035	2035				
RWP_Oxford Canal to Cropredy	11	2030	2030	2030	2030	2030	2030
RWP_STT Minworth	70		2085				
RWP_STT Mythe	12		2039			2039	2039
RWP_STT Netheridge	18		2039	2039	2039		
RWP_STT UU/ST Opt A	6		2071	2039	2039	2039	2039
RWP_STT UU/ST Opt B	15		2079				
RWP_STT Vyrnwy 60	110		2039	2039	2039	2039	2039
RWP_Wessex Water to SWX	3	2083					

What-if scenario: Leakage uncertainty

X.137 This scenario is to investigate the impact on plan composition and costs of reducing leakage by a third instead of a half by 2050.

Figure X-21: Leakage uncertainty for London, SWOX and SWA





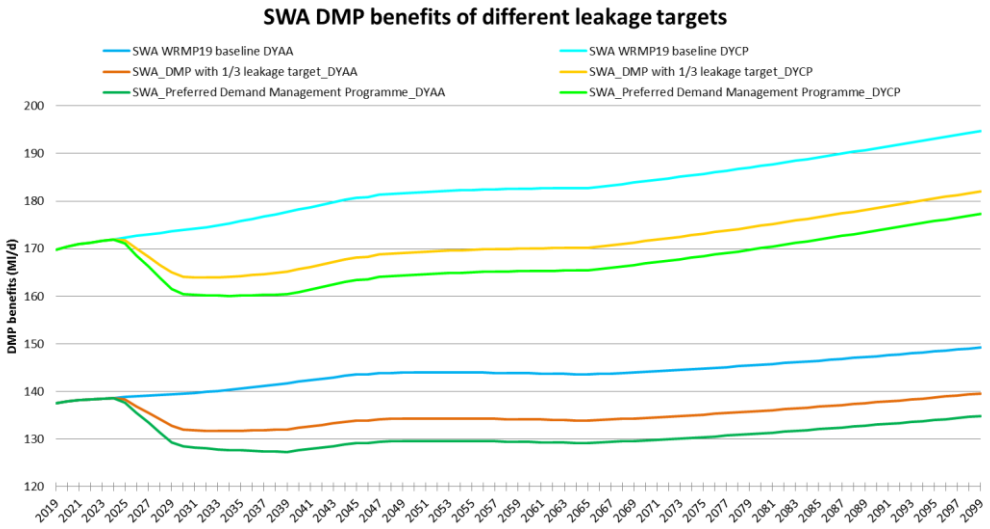


Table X-39: Leakage uncertainty

Reduced leakage reduction target		33% Leakage reduction by 2050 (instead of 50%)
Metrics		
Financial (£m NPV)		4,450
Environmental +		75
Environmental -		77
Deliverability		1.00
Resilience		0.87
IGEQ		11.63
Customer preference		4.41
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Merton (SLARS3)	5	2089
AR_Streatham (SLARS)	4	
ASR_Horton Kirkby	5	2080
ASR_South East London (Addington)	3	2087
ASR_Thames Valley/Thames Central	3	
DSL_Beckton 150	142	2029
GW_Addington	1	2086
GW_Datchet	5.4	2068
GW_London confined chalk	2	2088
GW_Merton	2	2088
GW_Moulsford	3.5	2081
GW_Southfleet/Greenhithe	8	2082
IPR_Deephams	45	2090
IZT_R Thames to Medmenham	24	2084
NTC_Aston Keynes	2	2079
NTC_Britwell	1	2087
NTC_Epsom	2	2086

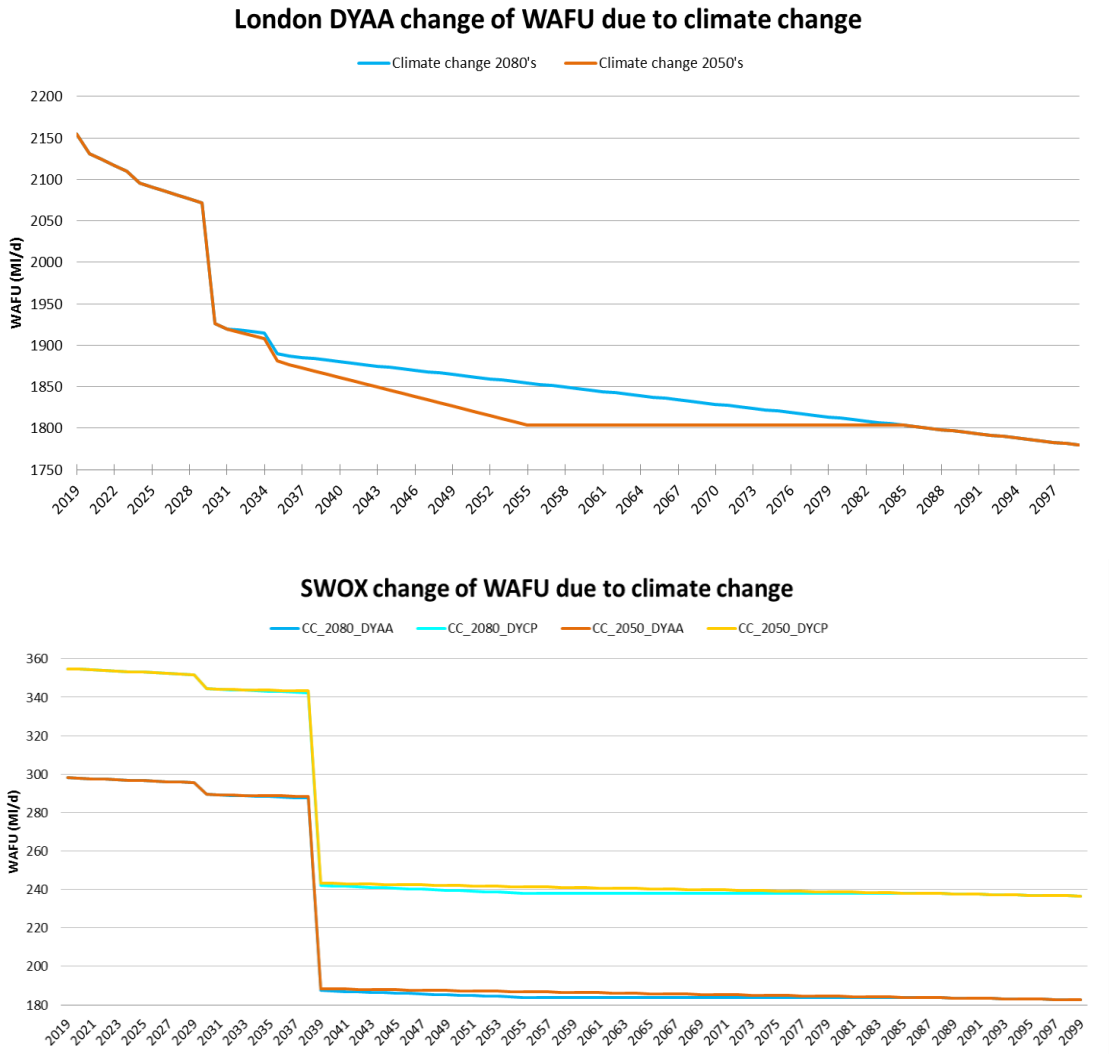
Reduced leakage reduction target		33% Leakage reduction by 2050 (instead of 50%)
NTC_New River Head	3	2020
RES_Abingdon 125 Mm3	253	
RES_Abingdon 150 Mm3	294	2039
RWP_Chingford (E&S)	20	2035
RWP_Didcot	18	
RWP_Oxford Canal to Cropredy	11	2084
RWP_Wessex to SWX	2.9	2099

What-if scenario: Climate change in the 2050s

X.138 This scenario tests the impact of 2080s-modelled climate change occurring in the 2050s on WAFU, and thence on programme composition and costs.

X.139 We have developed this scenario based on analysis undertaken for us by HR Wallingford that indicated that the expected impacts of climate change in 2080 might be felt earlier in the planning period.

Figure X-22: Climate change in the 2050s



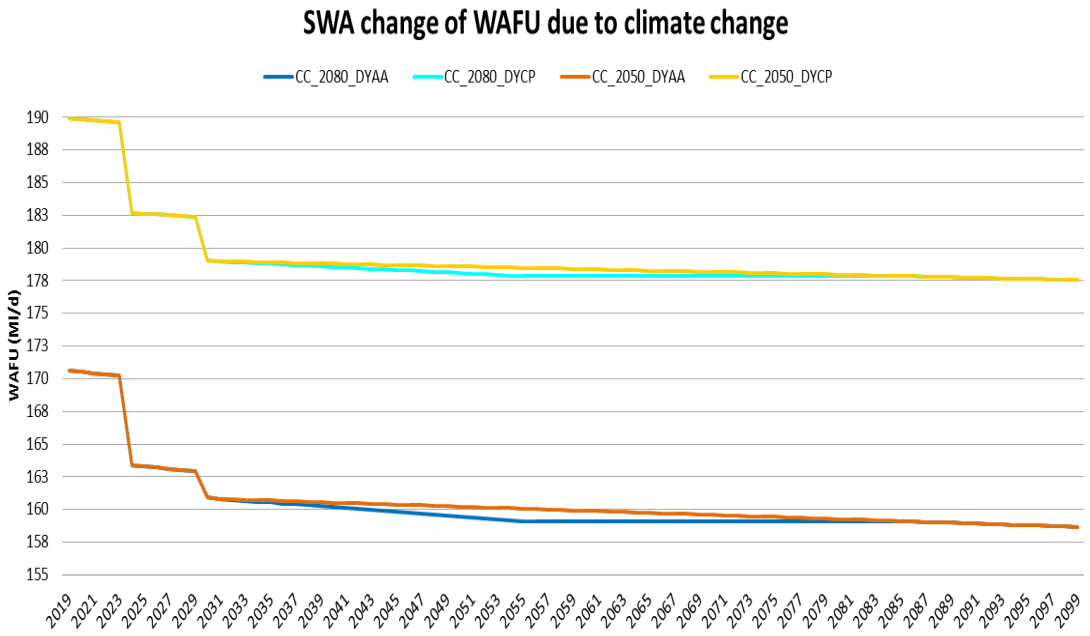


Table X-40: 2080s climate change advanced to the 2050s

2080s climate change brought forward to 2050s		
Metrics		
Financial (£m NPV)		4,066
Environmental +		79
Environmental -		83
Deliverability		0.99
Resilience		0.84
IGEQ		12.49
Customer preference		4.41
Options	**Benefit (Ml/d)**	**Implementation date**
DMP_LON_S4a	421	2020
DMP_SWA_S4a	22	2025
DMP_SWX_S4a	51	2020
AR_Merton (SLARS3)	7	2084
AR_Streatham (SLARS)	5	2088
ASR_Horton Kirkby	4	2081
ASR_South East London (Addington)	3	2086
ASR_Thames Valley/Thames Central	3	2087
DSL_Beckton 150	142	2089
GW_Addington	1	2083
GW_Datchet	5	2082
GW_London confined chalk	1	2086
GW_Merton	2	2083
GW_Moulsford	4	2082
GW_Southfleet/Greenhithe	8	2031
IPR_Deephams	45	2030
IZT_R Thames to Medmenham	24	2095
NTC_Aston Keynes	2	2080

2080s climate change brought forward to 2050s		
NTC_Britwell	1	2083
NTC_Epsom	2	2030
NTC_New River Head	2	2020
RES_Abingdon 125 Mm3	253	2039
RWP_Chingford (E&S)	20	2035
RWP_Oxford Canal to Cropredy	11	2030
RWP_Wessex to SWX	3	2085

F. Summary Table

X.140 A summary table of all what-if situation results analysed is shown below.

What If Test	BASE COMPARATOR	Resilience					Supply change					WRSE regional transfer							Economics (planning period)			Environmental							Demand forecast								
		1:200 DRO Timing		1:500 DRO	Reservoir Maintenance /Outage		Removal of outage >90 days	WBGWS		Bulk supply (Fortis Green)	No Res Options	Affinity 100Ml/d Timing		Phased 50/50	Potential new WRSE transfer				Planning period			WINEP - No deterioration				Reduction in abstraction chalk streams		Climate change	Population			PCC						Leakage
		2027	2035	2040	2030-31	2040-41	2020	2031	2040			2027	2035	2039/2055	Run 1 SWS 50Ml/d	Run 2 SWS 125Ml/d	Run 3 SES/SEW 60Ml/d	Run 4 Max 185Ml/d	50-yr	55-yr	60-yr	Most likely 2027	Most likely 2035	Pot. 2027	Pot 2035	34Ml/d by 2030	77Ml/d by 2040	Starts 2050s	JR-18R	ONS16 High	ONS16 Low	No Usage savings	PCC0 (105)	PCC1 (86)	PCC4 (73)	PCC2 (62)	PCC3 (45)	33% reduction instead of 50%
Metrics																																					
Financial (£m NPV)	4,073	4,123	4,055	4,229	4,066	4,066	4,083	4,380	4,148	4,138	4,089	4,140	4,020	3,910	4,301	4,387	4,143	4,468	3,872	4,026	4,047	4,174	4,125	4,409	4,327	4,450	4,513	4,066	4,227	4,242	3,501	4,759	3,713	3,632	3,623	3,611	3,603	4,450
Environmental +	70	79	82	77	103	79	69	70	79	70	103	109	103	103	81	75	77	86	89	48	60	79	79	71	79	79	77	79	100	113	72	66	59	40	36	40	36	75
Environmental -	81	83	86	80	102	83	66	71	83	68	102	107	102	102	86	77	80	94	93	51	69	83	83	72	79	83	80	83	107	115	56	93	68	42	37	49	39	77
Deliverability	0.96	0.99	1.00	0.99	1.00	0.99	0.99	0.99	0.99	0.99	0.99	1.00	0.99	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.00	0.99	0.99	0.99	0.99	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00
Resilience	0.83	0.84	0.90	0.87	0.74	0.84	0.87	0.84	0.87	0.87	0.67	0.68	0.67	0.66	0.90	0.90	0.87	0.90	0.72	0.85	0.84	0.85	0.85	0.83	0.90	0.85	0.87	0.84	0.90	0.75	0.48	0.87	0.64	0.79	0.85	0.86	0.87	0.87
IGEQ	11.35	12.58	12.42	11.24	11.79	12.54	12.42	12.81	12.47	12.44	11.79	11.79	11.79	11.80	11.19	12.64	12.46	12.71	11.75	11.41	11.40	11.31	12.52	12.85	11.19	11.29	11.20	12.49	11.67	13.41	12.05							11.63
Customer preference	4.41	4.41	4.42	4.42	4.39	4.41	4.41	4.42	4.42	4.36	4.39	4.22	4.39	4.39	4.42	4.42	4.42	4.43	4.38	4.40	4.41	4.41	4.41	4.41	4.42	4.41	4.41	4.41	4.39	4.41	4.38	4.24	4.39	4.38	4.38	4.38	4.39	4.41
Options																																						
AR_Kidbrooke (SLARS1)			2098				2097		2080				2066	2066				2098	2068		2078				2080													
AR_Merton (SLARS3)	2083	2086	2095	2066	2065	2086	2095		2080	2099	2055		2066	2066	2082	2066	2081	2096	2055	2073	2073	2031	2081		2076	2031	2031	2084	2080			2031						2089
AR_Streatham (SLARS)	2087	2088	2097	2099		2088	2096		2082						2084		2083	2097	2067		2077	2083	2083		2079	2030	2030	2088	2081			2035						
ASR_Horton Kirkby	2080	2027	2075	2062	2030	2080	2091	2076	2075	2031	2050	2030	2050	2053	2080	2063	2077	2070	2050	2071	2071	2030	2035	2080	2073	2030	2030	2081	2046	2031	2030	2022	2083					2080
ASR_South East London (Addington)	2084	2084	2096	2065	2064	2084	2098	2080	2081	2031	2056	2066	2065	2060	2083	2065	2082	2072	2056		2074	2031	2035	2089	2075	2031	2031	2086	2068	2040	2031	2035						2087
ASR_Thames Valley/Thames Central	2086	2087		2064	2066	2087	2094		2078	2031	2066	2031	2055	2065	2086		2079		2066		2075	2030	2035		2077	2030	2030	2087		2040	2031	2035						
DMP_LON_Sprint4a	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DMP_SWA_S4a2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025	2025
DMP_SWX_Sprint4a	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
DSL_Beckton 150	2088	2089		2067	2067	2089	2093		2083		2067	2067	2067	2067	2087	2067	2084					2084	2084	2029	2082	2082	2081	2089				2029						2029
DSL_Crossness 100																																						
GW_Addington	2086	2027	2083	2064	2059	2083		2079	2078	2030	2055	2047	2064	2054	2081	2064	2080	2071	2055	2074	2075	2030	2034	2088	2074	2030	2030	2083	2067	2032	2030	2023	2084					2086
GW_Datchet	2082	2082	2082	2079	2082	2082	2098	2082	2082	2082	2082	2082	2082	2082	2082	2082	2082	2082				2082	2082	2082	2082	2042	2042	2082		2075		2030	2098					2068
GW_Honor Oak															2086				2067		2079			2099								2021						
GW_London confined chalk		2027	2096		2054	2083	2093	2079	2079	2031	2066	2030	2099	2099	2085	2064		2072	2066	2074	2076	2031	2035	2088	2078	2031	2031	2086	2058	2035	2031	2032						2088
GW_Merton		2085	2094	2065	2056	2085	2094		2075	2098	2099	2099	2065	2065	2081	2065	2080	2095	2069			2030	2080		2075	2030	2030	2083	2079	2099		2022						2088
GW_Moulsford	2082	2083	2076	2061	2040	2082	2092	2032	2076	2097	2045	2027	2045	2045	2079	2062	2076	2069	2045	2072	2072	2081	2079	2084	2072	2080	2080	2082	2040	2039	2039	2072	2039	2039		2039		2081
GW_Southfleet/Greenhithe	2031	2027	2081	2031	2031	2031	2031	2077	2031	2030	2031	2030	2031	2031	2031	2031	2031	2031	2031	2031	2031	2030	2031	2086	2031	2030	2030	2031	2047	2031	2030	2024	2031	2031	2031	2031	2031	2082
IPR_Beckton 100								2030										2060												2060		2084						
IPR_Beckton 100								2081										2073												2071								
IPR_Beckton 100																														2086								
IPR_Beckton 150																																						
IPR_Deephams 45	2030	2027	2084	2030	2060	2030	2030		2030	2030	2030	2048	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2090	2030	2030	2030	2030	2069	2055		2073	2030	2030	2030	2030	2030	2090
IZT_North SWX to SWA 72																																						
IZT_R Thames to Medmenham	2095	2095	2095	2092	2095	2095		2095	2095	2095	2095	2095	2095	2095	2095	2095	2095	2095				2095	2095	2095	2095	2069	2069	2095	2025	2085		2066						2084
NTC_Aston Keynes	2082	2082	2074	2063	2043	2082	2093	2031	2074	2097	2049	2027	2049	2051	2078	2064	2078	2071	2049	2070	2070	2081	2080	2087	2074	2080	2079	2080		2039	2039	2032	2039	2039		2039	2039	2079
NTC_Britwell	2085	2083	2083	2064	2043	2083		2080	2077		2049	2027	2049	2051	2078	2064	2080	2071	2049	2072	2072	2082	2082	2089		2081	2080	2083	2040	2039		2083	2039			2039		2087
NTC_Epsom	2030	2027	2082	2030	2043	2030	2030	2075	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2085	2030	2030	2030	2030	2054	2030	2030	2024	2030	2030	2030	2030	2030	2086
NTC_New River Head	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
RES_Abingdon 100 Mm3																				2037	2037																	
RES_Abingdon 125 Mm3	2039	2039				2039		2039		2039												2039	2039	2039		2039		2039										
RES_Abingdon 150 Mm3			2035	2039			2039		2039						2035	2035	2039	2035							2035		2039					2039						2039
RWP_Chingford (E&S)	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035	2035					2035
RWP_Didcot																																						
RWP_Oxford Canal to Cropredy	2030	2027	2077	2030	2030	2030	2030	2031	2030	2030	2030	2027	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2027	2030	2030	2030	2030	2039	2030	2030	2030	2030	2030	2030	2030	2030	2084
RWP_Oxford Canal to Dukes			2077									2027																										
RWP_STT Minworth					2045						2057	2057	2056	2055					2057										2059	2045			2085						
RWP_STT Mythe					2044						2039	2030	2035	2058					2037										2055	2039	2075		2039			2039	2039		
RWP_STT Netheridge					2039						2039	2030	2035	2060					2037										2050	2030	2091		2039	2039	2039				
RWP_STT UU/ST Opt A					2030						2039	2030	2035	2052					2037											2030	2071		2071	2039	2039	2039	2039		
RWP_STT UU/ST Opt B					2030						2051	2030	2051	2061					2051											2030	2082		2079						
RWP_STT Vyrnwy 180																													2030									
RWP_STT Vyrnwy 60					2030						2039	2030	2035	2039					2037											2030	2039		2039	2039	2039	2039	2039		
RWP_STT Welsh 60																																						
RWP_Wessex to SWOX	2085	2085	2099	2063	2066	2085	2099		2077	2098	2056	2031	2055	2064	2085	2099	2078	2099	2056		2076	2082	2082		2078	2081		2085		2040		2083						2099