Headroom Spreadsheet

Company Name	BRISTOL WATER		
Scenario Ref		**Version**	V1.0
Resource Zone Ref	BWZ	**Date**	

Component		Correlated With	Correlated By	Continuous /	Dependent Component	Overlapping Component	arameters		Headroom Component (Ml/d) 2007	2010	2015	2020	2025	2030	2035	2040
S1	**Vulnerable surfacewater licences**															
Sharpness: Impacts of additional demand restriction above current levels of 5% of total 210 Mld riskd are: worse droughts, more frequent droughts, need for longer periods of reduced abstraction from Severn Basd on (35 * 10Mld)/365 at 2010 increasing in future to (120*10Mld)/365 reduction Loss 1Mld in 2007 to 4 Mld in 2035							Type		Triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
							Param. A	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. B	Best	0.70	0.90	1.00	1.50	2.00	2.50	3.00	3.50
							Param. C	Max	1.00	1.00	1.50	2.00	2.50	3.00	3.50	4.00
S1/1	Increasing risk of longer period Severn Drought Order								1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S2	**Vulnerable groundwater licences**															
EA Confirm no RSA sites							Type		Triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
							Param. A	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. C	Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S2/1	Source B								1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S3	**Time Limited Licences**															
No Time limited licences in BW resource Zone except Sharpness contract with BWB renegotiated to 2050							Type		Custom	custom	custom	custom	custom	custom	custom	custom
							Param. A	#N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. B	#N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. C	#N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. D	#N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S3/1	Source C								0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S4	**Bulk transfers**															
Sharpness bulk transfer - financial security agreed but issues relating to security of 300 yr old canal. Operating agreement is for a minimum of 100 Mld, with best endevours return to full capacity Canal failed in 1990, Expect major failure with loss of supply of 110 Ml for 10 days and 60 Ml for 60 days = 2.7 +10 Mld at 1/25 years							Type		Triangular	custom	custom	custom	custom	custom	custom	custom
							Param. A	Min	2.70	3.00	3.00	3.00	3.00	3.00	3.00	3.00
							Param. B	Best	2.80	3.70	4.00	4.00	5.00	6.00	7.00	9.00
							Param. C	Max	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
S4/1	Severn to Sharpness transfer risk of failure								0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5	**Gradual pollution of sources causing a reduction in abstraction**															
TOTALS 2 3.3 5.6 8.9 12.2 11.5 11.5 11.5 Oldford derogation by Whatley quarry building up to a maximum of 6 Mld in 2025 then decreasing at end of permissions 1 1 2 4 6 4 3 3 Mld Egford sub main Nitrate issues outage periods increase to 120 days at for both sites 2035 with no deterioration thereafter 4.7 Mld - .4 of average outage = 4.3 120*4.3/365 = max of 1.5 Mld 0 .3 .6 .9 1.2 1.5 1.5 1.5									Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
									0.00	0.00	2.00	3.00	3.00	3.00	3.00	3.00
									1.00	2.00	4.00	6.00	8.00	7.00	6.00	5.00
									2.00	3.30	5.60	8.90	12.20	11.50	11.50	11.50
S5/1	Gradual Pollution/derogation Purton Oldford Egford								0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
S6	**Accuracy of supply side data**															
Hydrological model generally explains 85 to 90% of variation, and Long record uses a monthly sequence of data. Need to allow for possibility that current model may overestimate flow in dry years or years where there are large variations in climate. Assume +/- 7% distribution of error for extreme values, ie the loss of inflow in extreme drought may be much greater than the increase in inflow during normal events so using extreme value distribution 0.07* 80 = 5.6 Mld is applied as a baseline adjustment unchanged across the period. Climate Change taken account of in S8							Type		Gumbel	Gumbel	Gumbel	Gumbel	Gumbel	Gumbel	Gumbel	Gumbel
							Param. A	Mode	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. B	scale	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
							Param. C									
								#N/A								

S6/1	Climate constrained surface water resources							0.50	0.55	0.60	0.65	0.70	0.70	0.70	0.70
						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
						Param. A	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. C	Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S6/2	Meter uncertainty for licence critical sources							0.50	0.55	0.60	0.65	0.70	0.70	0.70	0.70
DO calculation for groundwater sources baed on old drought data from 75 90 and 95, yoilds may have changed and assessments no longer valid because of local changes. DO from old dat 55Mld may be in error by 10%, say between 0 to +5 Mld as maximum reduction. applied as a baseline correction futur changes rolled into climate change headroom uncertainty.						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
						Param. A	Min	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
						Param. B	Best	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
						Param. C	Max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
S6/3	Uncertainty for aquifer constrained groundwater sources							0.50	0.55	0.60	0.65	0.70	0.70	0.70	0.70
						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
						Param. A	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. C	Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S6/4	Uncertainty for surface water source							0.50	0.55	0.60	0.65	0.70	0.70	0.70	0.70
S8	**Uncertainty of impact of climate change on source yields**														
Uncertainty elements for DRY and WET scenario from UKCIP for 2020 factored to give time series DO Dry 10.5 20.9 23.0 25.3 27.6 29.9 DO Wet -9.5 -19.1 -21.0 -23.1 -25.2 -27.3 Triangular series with 0 as central tendency						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
						Param. A	Min	0.00	-0.10	-9.00	-19.00	-21.00	-23.00	-25.00	-27.00
						Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. C	Max	0.00	0.10	10.00	21.00	23.00	25.00	28.00	30.00
S8/1	Climate change uncertainty								0.23	0.40	1.00	1.00	1.00	1.00	1.00
S9	**Uncertainty over New Sources**														
Yield of Cheddar scheme assessed as 20 Mld, actually could be less by maximum of 5 Mld or more by end of period range 2 Mld increase to 5 Mld decrease						Type		Custom	Custom	Custom	Custom	Custom	Custom	Custom	Custom
						Param. A	x1	0.00	0.00	0.00	-3.00	-3.00	-3.00	-3.00	-3.00
						Param. B	x2	0.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00
						Param. C	p1	0.00	0.00	0.00	0.50	0.60	0.70	0.80	0.90
							p2	0.00	0.00	0.00	0.50	0.40	0.30	0.20	0.10
S9/1	Cheddar augmentation								0.50	0.50	0.50	0.50	0.50	0.50	0.50
D1	**Accuracy of sub-component data**														
Inherrent meter inaccuracy +/- 1.5 % on current average DI of 285 = +/-4.5Ml about mean						Type		Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
						Param. A	mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. B	SD	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
						Param. C									
D1/1	Uncertainty of distribution input arising from meter inaccuracy							0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
D2	**Demand forecast variation**														
HH ann non HH forecasts may be in error for following reasons uncertainty in household and popn from forecast Uncertainty in component use and values assigned pcc etc Uncertainty over economic prediction and growth pattern Uncertainty increases in future years 230 Mld delivered +/- 1% rising to +/- 5% by 2040						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
						Param. A	Min	-1.00	-3.00	-5.00	-6.00	-7.00	-8.00	-9.00	-11.00
						Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. C	Max	1.00	3.00	5.00	6.00	7.00	8.00	9.00	11.00
D2/1	Demand forecast variation.							1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
						Param. A	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						Param. C	Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

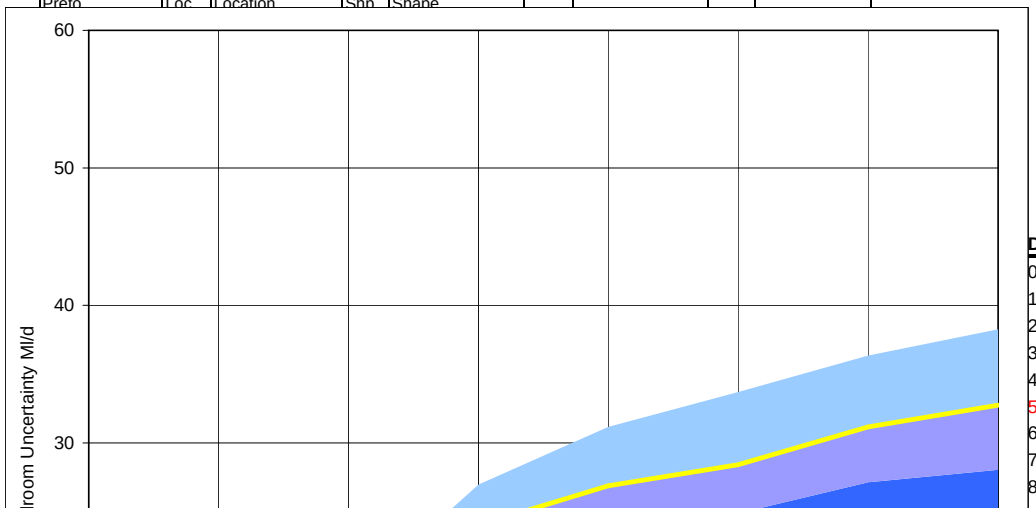
D2/2	Uncertainty associated with peak demand factors.									1.00	1.00	1.00	1.00	1.00	1.00	1.00
D3	**Uncertainty of impact of climate change on demand**																	
	Max and min uncertainty of demand variation for HH and NHH above and below the medium scenario for Wet and Dry fro SS CLIMATE CHANGE EA FACTORS using CCDEW work 2003 but interpolated as per EA guidelines impact begins 2015 DEM MAX 2.0 4.0 4.5 5.0 5.6 6.1 DEM MIN -0.1 -1.1 -1.3 -1.5 -1.7 -1.9						Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
							Param. A	Min	0.00	-0.01	-0.10	-1.10	-1.30	-1.50	-1.70	-1.90
							Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. C	Max	0.00	0.10	2.00	4.00	4.50	5.00	5.60	6.10
D3/1	Effect of climate change on demand									0.50	1.00	1.50	2.00	2.00	2.00	2.00
D4	**Uncertainty of impact of demand management**																	
							Type		triangular	triangular	triangular	triangular	triangular	triangular	triangular	triangular
							Param. A	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. B	Best	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
							Param. C	Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D4/1	Uncertainty of impact of demand management									0.50	1.00	1.50	2.00	2.00	2.00	2.00
Overlapping components																		
	Group 1	S2/1		s5/1					1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Group 2																	
	Group 3																	

Distribution Profile Parameters

Profile	A		B		C		D	
Fixed	Val	Value						
Triangular	Min	Min	Best	Best Estimate	Max	Max		
Normal	Avg	Mean	Max	Max Estimate	SD	St'd Deviation		
Lognormal	Avg	Mean	Max	Max Estimate	SD	St'd Deviation		
Beta	A	Alpha	B	Beta	Scl	Scale		
Exponential	Rate	Rate						
Custom	x1	Value 1	x2	Value 2	p1	Probability 1	p2	Probability 2
Uniform	Min	Min Estimate	Max	Max Estimate				
Weibull	Loc	Location	Scl	Scale	Shp	Shape		
Gama	Loc	Location	Scl	Scale	Shp	Shape		
Logistic	Avg	Mean	Scl	Scale				
Preto	Loc	Location	Shp	Shape				

Sum of Headroom components

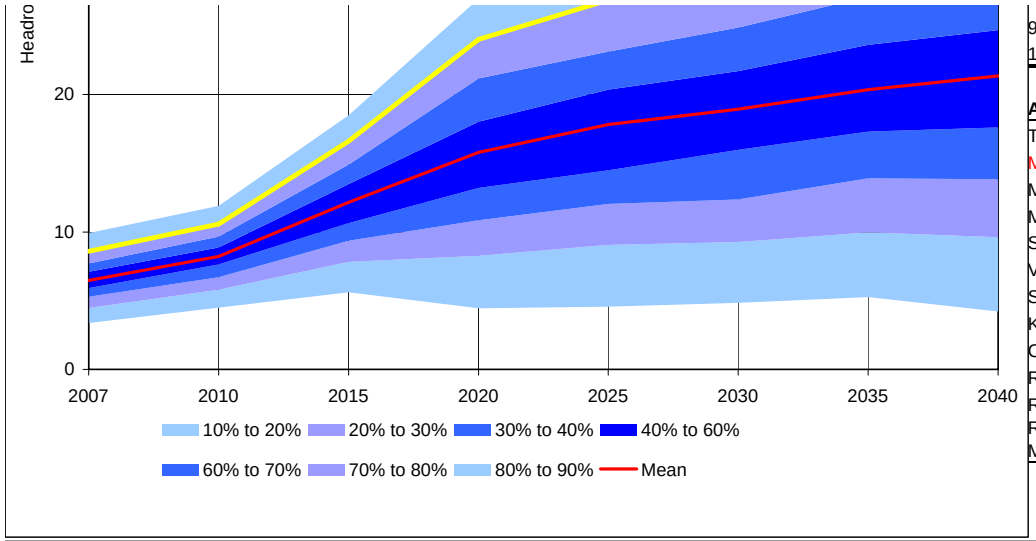
2007	2010	2015	2020	2025	2030	2035	2040
3.70	4.54	5.30	6.50	7.10	7.10	7.10	7.10



Graph Plots	2007	2010	2015	2020	2025	2030	2035	2040
0% to 10%	3.84	4.94	7.84	13.76	12.70	15.80	22.99	17.51
10% to 20%	1.09	1.30	2.21	3.83	4.49	4.41	4.70	5.40
20% to 30%	0.82	0.91	1.53	2.57	2.98	3.11	3.94	4.23
30% to 40%	0.61	0.93	1.29	2.35	2.44	3.59	3.39	3.77
40% to 60%	1.20	1.23	2.85	4.83	5.86	5.74	6.32	7.07
60% to 70%	0.61	0.80	1.42	3.13	2.78	3.17	3.52	3.35
70% to 80%	0.88	0.92	1.69	2.85	3.74	3.53	4.02	4.71
80% to 90%	1.33	1.31	1.90	2.96	4.29	5.30	5.20	5.53
90% to 100%	5.35	7.51	7.46	15.93	16.76	16.92	16.31	15.61
0%	-0.46	-0.44	-2.22	-9.32	-8.13	-10.95	-17.73	-13.31
Mean	6.46	8.22	12.14	15.79	17.81	18.92	20.35	21.36
BW Risk	8.59	10.58	16.59	24.00	26.86	28.40	31.15	32.73

Deciles

0%	-0.46	-0.44	-2.22	-9.32	-8.13	-10.95	-17.73	-13.31
10%	3.38	4.50	5.62	4.44	4.57	4.85	5.26	4.21
20%	4.47	5.79	7.82	8.27	9.06	9.26	9.96	9.61
30%	5.29	6.70	9.36	10.84	12.04	12.37	13.90	13.84
40%	5.90	7.63	10.64	13.19	14.48	15.96	17.29	17.61
50%	6.46	8.22	12.14	15.79	17.81	18.92	20.35	21.36
60%	7.10	8.86	13.49	18.02	20.34	21.70	23.61	24.68
70%	7.70	9.66	14.91	21.15	23.12	24.87	27.12	28.03
80%	8.59	10.58	16.59	24.00	26.86	28.40	31.15	32.73



90%	9.92	11.89	18.50	26.96	31.15	33.70	36.35	38.26
100%	15.27	19.40	25.95	42.89	47.91	50.62	52.66	53.87

Analysis Statistics

Trials	1000	1000	1000	1000	1000	1000	1000	1000
Mean	6.55	8.23	12.08	15.82	17.78	18.98	20.59	21.20
Median	6.46	8.22	12.14	15.79	17.81	18.92	20.35	21.36
Mode	---	---	---	---	---	---	---	---
St'd Deviation	2.48	2.83	4.97	8.96	10.03	10.81	12.20	12.90
Variance	6.16	8.04	24.67	80.26	100.63	116.90	148.73	166.34
Skewness	0.16	0.11	-0.10	-0.05	0.11	0.09	0.04	0.06
Kurtosis	3.07	3.03	2.63	2.72	2.51	2.46	2.70	2.46
Coeff. of Variability	0.38	0.34	0.41	0.57	0.56	0.57	0.59	0.61
Range Minimum	-0.46	-0.44	-2.22	-9.32	-8.13	-10.95	-17.73	-13.31
Range Maximum	15.27	19.40	25.95	42.89	47.91	50.62	52.66	53.87
Range Width	15.73	19.84	28.17	52.21	56.04	61.57	70.39	67.18
Mean Std. Error	0.08	0.09	0.16	0.28	0.32	0.34	0.39	0.41