Draft Regional Plan

for consultation

Appendix 3: Drought resilience and climate change

November 2022

WReN

Water Resources North

Appendix 3. Drought resilience and climate change

In our Revised Water Resources Position Statement (February 2021) we included an initial review of the availability of future water supply in the region. Since then, we have carried out more detailed modelling to better quantify what water supply will look like in the future. This modelling is specific to providing the data we require to complete forecasts of future public water supply (as opposed to non-PWS / other sectors).

For this round of planning, we have used long-periods of 'stochastic hydrological' data (plausible synthetic scenarios based on historical hydrological patterns) as inputs to our water company water resources models. This allows us to better understand the drought resilience of our systems as well as being able to assess our region against the 1 in 500-year average frequency for Level 4 restrictions (i.e., standpipes, rota cuts or in the case of some areas of the region, pressure reductions) required in the WRMP planning guidelines. It should also be noted that whilst Level 2 (Temporary Use Bans) and Level 3 (Non-Essential Use Bans) are a key part of our Deployable Output (DO) assessment approach, we do not consider these to be a key driver of investment or choices in their own right. The main constraint to DO is considered to be the 1:500 resilience level for Level 4 restrictions in the main strategic zones.

For the development of our regional plan, we have used the latest UK Climate Projections 2018 (UKCP18) projections to assess the potential impacts of climate change on water resources for public water supply. Originally, we used the Regional Climate Models (RCMs) data, which is spatially coherent and allows for consistent assessment across regional modelling. This initial modelling showed that the impact of climate change is more severe in both the Grid and Kielder WRZs than previous climate change assessments. This is partly because the RCM data is based on a high emissions scenario (RCP8.5, 4 degrees temperature increase) rather than medium. There may also be drier autumn conditions observed, which is of importance to winter reservoir refill, but with wetter springs and winters. As a result, we have used a published study by Atkins (Atkins - WRSE Climate Data Tools Scaling Report v0.4) to scale down the supply impacts to a probabilistic medium emissions scenario (RCP6, 2 degrees temperature increase), for use in our central estimates in the supply-demand balance. We understand similar approaches have been taken in some other regions. In terms of scaling the impact of climate change over time, climate change impacts have been scaled back to 1990, so some climate change influence is included on our forecasts even at the start of the planning period.

	Warming °C[3]	Prob.	GCM	Probabilistic				GCM
UKCP River Basin	RCP 8.5 bc (3.7°C)	RCP 2.6 (1.3°C)	RCP 2.6 (1.7°C)	RCP 4.5 (1.8°C)	RCP6.0 (1.9°C)	A1b (2°C)	RCP8.5 (2.3 °C)	RCP8.5 (2.7°C)
Anglian	3.9	34%	47%	47%	48%	52%	70%	89%
Dee	3.6	34%	46%	47%	49%	53%	71%	90%
Humber	3.7	34%	47%	47%	49%	52%	70%	89%
Northumbria	3.5	34%	46%	48%	49%	53%	71%	90%
NW England	3.6	34%	46%	47%	49%	53%	71%	90%
SE England	4.0	34%	47%	47%	48%	52%	70%	89%
Severn	3.8	34%	47%	47%	49%	52%	70%	89%
SW England	3.7	34%	47%	47%	49%	53%	70%	89%
Thames	4.0	34%	47%	47%	48%	52%	69%	89%
W Wales	3.5	34%	46%	48%	49%	53%	71%	90%
Median	**3.7**	**34%**	**46%**	**48%**	**49%**	**53%**	**71%**	**90%**

In addition, we are using a sample of probabilistic projections to further inform our understanding of climate change uncertainties within the Yorkshire Grid and Kielder WRZs.

	Grid WRZ	East WRZ	Kielder WRZ	Berwick WRZ	Hartlepool WRZ
Hydrological Inputs	Atkins stochastic data run through GR6J rainfall runoff models to create inflows	Atkins stochastic data run through GR6J rainfall runoff model to create inflows	Atkins stochastic data run through rainfall runoff models to create inflows	Atkins stochastic timeseries interrogated and a 1-500 hydrologic event selected.	GW yields adopted in AQUATOR XV
Resource Modelling	Sample (150 of the 400) of the stochastic inflows run through WRAPsim	All stochastic flows in WRAPsim	All stochastic inflows run through Aquator XV. 'Scottish' module ran to give return period of failures.	Selected rainfall timeseries run through ZOODRM to create groundwater recharge. MODFLOW then run with 1-500 hydrologic event.	Modelled in AQUATOR XV
LOS 4 Failure metric	Regional reservoir stocks below 20%, or 5% of demand not met	Demand not met	Strategic demand centre failure or stock level falling below the level 4 drought trigger.	40% of calculated saturated aquifer thickness.	
1-500 DO calculation	Return period analysis of minimum modelled reservoir stocks at failure threshold.	All stochastic flows-simple threshold analysis	Return periods of LOS4 failures from Aquator XV runs plotted and 1-500 DO calculated.	Borehole performance graph created using MODFLOW results and yield/DO calculated.	1-500 drought yields adopted in AQUATOR XV
Climate Change Inputs	Regional RCP 8.5 stochastic series from Atkins modelled with GR6J rainfall runoff models.	Regional RCP 8.5 stochastic series from Atkins modelled with GR6J rainfall runoff models	RCP 8.5 stochastic series along with probabilistic series from Atkins modelled with GR6J rainfall runoff models.	Three, of the 12, RCM runs selected. Monthly factors applied to 1-500.	
Climate Change Resource Modelling	Sample (56 of the 400) of the stochastic inflows run through WRAPsim	All stochastic climate change flows-simple threshold analysis	Sample (100 of the 400) of the stochastic inflows along with 20 (of 100) of the probabilistic inflows run through Aquator XV	The 3 perturbed rainfall timeseries run through ZOODRM to create groundwater recharge. MODFLOW then run.	
Climate Change Impacts	Impact in 2070s, under RCP8.5, scaled back to probabilistic RCP6.	Impact in 2070s, under RCP8.5, scaled back to probabilistic RCP6.	Impact in 2070s, under RCP8.5, scaled back to RCP6.	No reduction in DO due to climate change.	

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